AMENDMENT 7

TO THE NORTHERN ANCHOVY FISHERY MANAGEMENT PLAN

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LIST OF ACRONYMS AND ABBREVIATIONS

ABC	acceptable biological catch
CCS	California current system
CalCOFI	California Cooperative Oceanic Fisheries Investigations
CDFG	California Department of Fish and Game
Council	Pacific Fishery Management Council
CPS	coastal pelagic species, including northern anchovy, Pacific sardine, Pacific mackerel, jack mackerel and other species
CPFV	commercial passenger fishing vessel
CUTOFF	threshold parameter used in harvest formulas
DAH	domestic annual harvest
EEZ	exclusive economic zone
EFP	exploratory or experimental fishing permit
EPM	egg production method estimate of spawning biomass
ESA	Endangered Species Act
FMP	fishery management plan
FRACTION	fraction of biomass above the CUTOFF used in optimum yield formulas
IRFA	Initial Regulatory Flexibility Analysis
MAXCAT	largest allowable harvest from a harvest formula
MFCMA	Magnuson Fishery Conservation and Management Act
MMPA	Marine Mammal Protection Act
mt	metric ton
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OY	optimum yield
RIR	Regulatory Impact Review
SAFE Report	stock assessment and fishery evaluation report
Secretary	Secretary of Commerce
SEIS	Supplementary Environmental Impact Statement
SSC	Scientific and Statistical Committee
TALFF	total allowable level of foreign fishing
Team	Coastal Pelagic Species Management Team

EXECUTIVE SUMMARY

The fishery management plan (FMP) for Coastal Pelagic Species (CPS) is Amendment 7 to the FMP for Northern anchovy which was implemented in 1978. With Amendment 7, the name of the plan is changed because the scope of the FMP shifts from northern anchovy to the entire CPS fishery.

CPS are northern anchovy, Pacific sardine, Pacific mackerel, and jack mackerel as well as market squid and other species taken in the CPS fishery. Only northern anchovy, Pacific sardine, Pacific mackerel, and jack mackerel would be actively managed at the outset of Amendment 7. If required, other species can be added later without amending the FMP.

Northern anchovy, Pacific sardine and mackerels contributed about 21 percent of total landings in California and were among the nine species with highest catches during 1994. Including squid, the CPS fishery contributes about 55 percent of total landings in California. The size and value of the CPS fishery are expected to increase in the near future because of increased Pacific sardine biomass and higher California sardine quotas (55,000 mt in 1994 worth about $5.5 million).

The CPS fishery in the U.S. operates in state and federal waters mainly off southern and central California but occasionally as far north as Washington. There is a large fishery in Mexican waters and CPS are sometimes taken commercially off British Columbia. Purse seines and other roundhaul nets are the primary gear but many other gear types are also used. Current participants include U.S. commercial vessels, Mexican commercial vessels, party and charter boats that carry anglers, and other anglers who target coastal pelagic species or use them as bait. Potential participants include factory trawlers, offshore motherships, and foreign and domestic vessels engaged in joint ventures. CPS are among the most important source of food for gamefish stocks, commercial fish stocks, sea birds and marine mammals including a number of species that are either endangered, threatened or depleted species under the Endangered Species Act and the Marine Mammal Protection Act.

Consolidation of responsibilities for CPS under a single FMP makes management of directed fisheries and bycatch more efficient and cost effective. Management under one FMP makes best use of limited state and federal resources. It promotes data collection, fishery monitoring and stock assessment at the state and federal levels.

Most important, the FMP creates a license limitation (limited entry) program that is strongly supported by industry. Limited entry is particularly important at this time because increased sardine biomass and landings are expected to generate overcapitalization with loss of economic efficiency and attendant management problems.

The FMP and appendices (see table of contents) include: goals objectives (Section 1); a framework process to accommodate changes in management measures, and provisions for exploratory and scientific fishing (Section 2); a license limitation program to manage fishing effort (Section 3); optimum yield and overfishing definitions, formulas for calculating harvest levels in U.S. fisheries, a description of annual management activities, and fishing seasons (Section 4) and; approaches for managing bycatch and allocation (Section 5).

Stocks, their fisheries, ecological relationships, and current management are described in Appendix A. Appendix B describes the need and justification for the FMP and contains detailed analyses of all management measures adopted and considered. Appendix C contains cost estimates.

1.0 INTRODUCTION

Amendment 7 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. At the same time, it changes the name of the FMP from the "Northern Anchovy Fishery Management Plan" to the "Fishery Management Plan for Coastal Pelagic Species".

The four CPS species actively managed at the outset of Amendment 7 are northern anchovy, Pacific sardine, Pacific mackerel, and jack mackerel, although market squid and other species are also taken in the CPS fishery and could be managed in the future (Table 1.0-1). Stocks, fisheries, and current management are described in Appendix A. The need for the FMP along with management options and analyses for Amendment 7 are described in Appendix B. Cost estimates are given in Appendix C.

1.1 Goals and Objectives

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

1. Promote full utilization
2. Promote efficiency and profitability in the fishery
3. Provide year-round fishing opportunities
4. Maintain existing CPS fishery segments
5. Protect U.S. fishery investment
6. Avoid discard
7. Acquire biological information and develop long term research program
8. Foster effective monitoring and enforcement
9. Provide adequate forage for dependent species
10. Manage CPS stocks throughout their range
11. Achieve optimum yield (OY)
12. Encourage cooperative international management of CPS
13. Prevent overfishing
14. Manage fishing effort, industry capacity and capitalization to achieve other goals
15. Use resources spent on management of CPS efficiently

TABLE 1.0-1. Species taken in the CPS fishery that could be managed under this FMP.

Common Name	Scientific Name
Pacific saury	*Cololabis saira*
Northern anchovy	*Engraulis mordax*
Market squid	*Loligo opalescens*
Pacific bonito	*Sarda chiliensis*
Pacific herring	*Clupea harengus*
Pacific sardine	*Sardinops sagax*
Pacific (chub or blue) mackerel	*Scomber japonicus*
Jack (Spanish) mackerel	*Trachurus symmetricus*

2.0 FRAMEWORK MANAGEMENT

The framework approach to management of Coastal Pelagic Species (CPS) fisheries allows necessary changes and modifications to be made in a timely and efficient manner without the need to amend the Fishery Management Plan (FMP). The FMP establishes two framework procedures through which the Council is able to recommend the establishment and adjustment of management measures. The "points of concern" framework allows the Council to develop management measures in response to resource conservation issues. The "socioeconomic" framework allows the Council to develop management measures in response to social, economic, and ecological issues.

Management measures are normally imposed, adjusted, or removed at the beginning of the fishing year but may, if the Council determines it is necessary, 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 the criteria, procedures, goals, and objectives set forth in the FMP.

Because the potential actions which may be taken cover a wide range, analyses of biological, social, and economic impacts will be considered at the time a particular change is proposed. As a result, the time required to take action will vary depending on the nature of the action, its impacts on the fishing industry, resource, and environment, and review of these impacts by interested parties. Satisfaction of the legal requirements of other applicable law (e.g., the Administrative Procedure Act, Regulatory Flexibility Act, Executive Order 12866, etc.) for actions taken under this framework requires analysis and public comment before measures may be implemented by the Secretary of Commerce (Secretary).

2.1 Procedures for Establishing and Adjusting Management Measures

There are four different categories of management actions, each of which requires a slightly different process. Management measures may be established, adjusted, or removed using any of the four procedures. The four basic categories of management actions are:

1. Automatic Actions. Automatic management actions may be initiated by the Regional Director 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 fishery, season, or gear type closures when a quota is attained. The Secretary will publish a single notice in the Federal Register making the action effective.

2. "Notice" Actions Requiring at Least One Council Meeting and One Federal Register Notice. These include all management actions other than automatic actions that are either non-discretionary or have probable impacts that have been previously analyzed.

   These actions are intended to have temporary effect and the expectation is that they will need frequent adjustment. They may be recommended at a single Council meeting, 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 trip landing and frequency limits for all gear types and recreational bag limits. Previous analysis must have been specific as to species and gear type before a management measure can be defined as routine and acted upon at a single Council meeting. If the recommendations are approved, the Secretary will waive for good cause the requirement for prior notice and comment in the Federal Register and will publish a single notice in the Federal Register making the action effective. This category of actions presumes the Secretary will find that the 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 Requiring at Least Two Council Meetings and One Federal Register Rule. These include all management actions (1) being classified as routine, or (2) intended to have permanent effect and be discretionary in nature with impacts which have not been previously

analyzed. Examples include changes to gear regulations or landing limits for the first time on any species or species group or gear type. The Council will develop and analyze the proposed management actions over the span of at least two Council meetings and provide the public advance notice and opportunity to comment on both the proposals and the analysis prior to and at the second Council meeting. If the Regional Director approves the Council's recommendation, the Secretary will waive for good cause the requirement for prior notice and comment in the Federal Register and publish a final rule 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 is not prevented from exercising the right not to 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. The 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 Requiring at Least Two Council Meetings and Two Federal Register Rules (Regulatory Amendment). These include any proposed management measure that is highly controversial or any measure which directly allocates the resource. The Council normally will follow the two meeting procedure 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.

   Management measures recommended to address a resource conservation issue must be based upon the establishment of a point of concern and must be consistent with the specific procedures and criteria listed in Section 2.1.2.

   Management measures recommended to address social or economic issues must be consistent with the specific procedures and criteria described in Section 2.1.3.

2.1.1 Routine Management Measures

Routine management measures are those that the Council determines are likely to be adjusted on an annual or more frequent basis. Measures are classified as routine by the Council through either the full or abbreviated rulemaking process. In order for a measure to be classified as routine, the Council will determine that the measure is of the type normally used to address the issue at hand and may require further adjustment to achieve its purpose with accuracy.

As in the case of all proposed management measures, prior to initial implementation as routine measures, the Council will analyze the need for the measures, their impacts, and the rationale for their use. Once a management measure has been classified as routine through one of the two rulemaking procedures, it may be modified thereafter through the single meeting notice procedure if (1) the modification is proposed for the same purpose as the original measure; and (2) the impacts of the modification are within the scope of the impacts analyzed when the measure was originally classified as routine. The analysis of impacts need not be repeated when the measure is subsequently modified if the Council determines that they do not differ substantially from those contained in the original analysis. The Council may recommend removing 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.

The Council will conduct a continuing review of landings of those species for which harvest guidelines, quotas or specific routine management measures have been implemented, and will make projections of the landings at various times throughout the year. If it becomes apparent that the rate of landings is substantially different than anticipated and that the current routine management measures will not achieve the annual management objectives, then the Council may recommend inseason adjustments to those measures. Such adjustments may be implemented through the single meeting notice procedure.

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

1. Bycatch allowances (all species and fishery segments, Section 5.1)
2. Inseason release of reserves for low volume uses (all species and fishery segments, Section 5.2.1)
3. Inseason release of northern allocations (all species and fishery segments, Section 5.3)

2.1.2 Resource Conservation Issues and The Points of Concern Framework

The points of concern process is the Council's second major tool (along with setting harvest levels) for exercising its resource stewardship responsibilities. The process is intended to foster a continuous and vigilant review of the Pacific coast CPS stocks and fisheries that will prevent overfishing or other resource damage. To facilitate this process, a Council-appointed management team (the Coastal Pelagic Species Management Team) will monitor the fishery throughout the year, taking into account any new information on the status of each species or species group, to determine whether a resource conservation issue exists that requires a management response. The points of concern criteria are intended to assist Council in determining when a focused review on a particular species is warranted that might result in the need to recommend implementation of specific management measures.

This framework provides the authority to act based solely on the points of concern. Thus, the Council may act quickly and directly to address a resource conservation issue. In conducting this review, the Coastal Pelagic Species Management Team 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 any one or more of the following is found or expected:

1. Catch is projected to exceed the current harvest guideline or 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 exists or is imminent
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, and
6. An error in data or a stock assessment is detected that significantly changes estimates of impacts due to current management

Once a point of concern is identified, the Coastal Pelagic Species Management Team 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 Coastal Pelagic Species Management Team determines a resource conservation issue exists, it will provide its recommendation, rationale, and analysis for the appropriate management measures that will address the issue.

In developing its recommendation for management action, the Coastal Pelagic Species Management Team will recommend options from one or more of the following categories which include the types of management measures most commonly used to address resource conservation issues.

- Harvest guidelines (including area closures)
- Quotas (including area closures)
- 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, codend specifications, marking requirements, and other gear specifications as necessary
- Observer coverage
- Reporting requirements
- Permits
- Enforcement measures
- Other necessary measures

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

After receiving the Coastal Pelagic Species Management Team's report, the Council will take public testimony and, if appropriate, will recommend management measures to the National Marine Fisheries Service (NMFS) Regional Director accompanied by supporting rationale and analysis of impacts. The Council's analysis will include a description of (a) how the action will address the resource conservation issue consistent with the objectives of the FMP; (b) likely impacts on other management measures and other fisheries; and (c) socioeconomic impacts, particularly the cost to the commercial and recreational segments of the fishing industry.

The NMFS Regional Director will review the Council's recommendation and supporting information and will follow the appropriate implementation process described in Section 2.1 depending on the amount of public notice and comment provided by the Council and the intended permanence of the management action. If the Council contemplates the need for 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 Director does not concur with the Council's recommendation, the Council will be notified in writing of the reasons for the rejection. Nothing prevents the Secretary from exercising the authority to take emergency action under Section 305(e) of the Magnuson Fishery Conservation and Management Act (MFCMA). Nothing precludes or limits Council's access to the points of concern framework.

2.1.3 Non-Biological Issues and the Socioeconomic Framework

From time to time, non-biological issues may arise which require the Council to recommend management actions to address certain social or economic conditions in the fishery. Resource allocation, seasons, or landing limits based on market quality and timing, safety measures, and prevention of gear conflicts are

only a few examples of possible management issues with a social or economic basis. In general, there may be any number of situations where the Council determines that management measures are necessary to achieve the stated social or economic objectives of the FMP.

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 of the categories of actions authorized under the points of concern framework with the addition of direct resource allocation and access limitation measures.

If the Council concludes that a management action is necessary to address a social or economic issue, it or the Coastal Pelagic Species Management Team will prepare a report containing the rationale in support of its conclusion. The report will include the proposed management measure, a description of other viable alternatives considered, and an analysis that addresses the following criteria: (a) how the action is expected to promote achievement of the goals and objectives of the FMP; (b) likely impacts on other management measures and other fisheries; sociobiological impacts; (d) economic impacts, particularly the cost to the fishing industry; and (e) how the action is expected to accomplish at least one of the following:

1. enable a quota, harvest guideline, or allocation to be achieved
2. avoid exceeding a quota, harvest guideline, or allocation
3. increase sustainable landings
4. reduce discards
5. develop fisheries for underutilized species with minimal impacts on existing domestic fisheries
6. reduce gear conflicts, or conflicts between competing user groups;
7. extend domestic fishing and marketing opportunities as long as practicable during the fishing ear;
8. maintain or improve product volume and flow to the consumer
9. increase economic yield
10. maintain or improve the safety of fishing operations
11. increase fishing efficiency
12. maintain or improve product quality
13. maintain or improve the recreational fishery
14. maintain or improve data collection, including means for verification
15. maintain or improve monitoring and enforcement
16. any other measurable benefit to the fishery

The Council, following review of the report, supporting data, public comment and other relevant information, may recommend management measures to the NMFS Regional Director 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 Director 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.

The procedures specified in this FMP do not affect the authority of the Secretary to take emergency regulatory action under Section 305(e) of the MFCMA. Nor do they affect the Secretary's ability to take action under Section 305(g) of the MFCMA.

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.

Harvest guidelines and quotas, including allocations, implemented through this framework will be set annually and may be modified inseason only to reflect technical corrections. In contrast, harvest guidelines and quotas may be imposed at any time of year for resource conservation reasons under the points of concern mechanism. Nothing is intended to preclude or limit Council's access to the Socioeconomic Framework.

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. the economics of the fishery
4. any agreement or negotiated settlement between the affected participants in the fishery
5. potential biological impacts on any species affected by the allocation
6. consistency with the MFCMA national standards
7. consistency with the goals and objectives of this FMP

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

2.1.4 Harvest Formulas and Procedures for Setting Harvest Guidelines and Quotas

As data become available, improve, or are updated, the harvest formulas or procedures for setting harvest guidelines and quotas for CPS 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.

2.1.5 Management Agreements with Other Nations

In the event that a management agreement between the U.S. and a foreign nation concerning coastal pelagic species occurs, the FMP authorizes changes or modifications to any management measure described herein.

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), or other applicable laws, while minimizing disruption of the CPS fishery. Any of these measures described in this FMP may be employed to control fishing impacts on non-coastal pelagic 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 2.1.1), which will allow adjustment at a single meeting based on relevant information available at the time if (1) the modification is proposed for the same purpose as the original measure, and (2) the 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, Coastal Pelagic Species Management Team, or other appropriate technical advisory group for evaluation. If the Council determines that management measures may be necessary to address requirements of the ESA, Marine Mammal Protection Act, international agreement, 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 those vessels which harvest in the Washington, Oregon, and California area and land in another area, may be required to accommodate NMFS-certified observers on board for the purposes of collecting 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 Regional Director, 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 be willing to 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 Habitat Protection

Beginning in January 1989, the Marine Plastic Pollution Research and Control Act of 1987 (PL 100-220, MARPOL) restricted the dumping of gear or other material from domestic vessels. The Secretary, upon the recommendation of the Council, may propose additional management measures restricting disposal of fishing gear by domestic and foreign vessels.

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 the development of additional effort limitation programs. Changes that may be made include, but are not limited to, requirements for obtaining, maintaining, and renewing permits in any effort limitation system.

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.

2.2.2.1 Permits

All U.S. commercial fishing vessels are required by state laws to be in possession of a current fishing or landing permit from the appropriate state agency in order to land CPS in the Washington, Oregon, and California areas. Federal permits authorizing the harvest or processing of CPS by U.S. vessels may be required under this FMP if necessary to obtain data that is not otherwise available and necessary for management. In particular, federal permits may be required for domestic at-sea processors that do not land within the management area, or do not land often enough to provide landing reports in a timely manner for inseason management of the fishery. In the event that a federal fishing or access permit is required, failure to obtain and possess such a federal permit will be in violation of this FMP. Applications for such permits may include vessel name, length, type, documentation number or state registration number, radio call sign, home port, and capacity, owner or operator's name, mailing address, telephone number, and relationship of the applicant to the owner, type of fishing gear to be used, signature of the applicant, and any other information found necessary for identification and registration of the vessel.

Federal permits for domestic CPS vessels will be required for any license limitation program adopted by the Council. In addition, federal permits will be required for any adopted exploratory offshore fishing program for jack mackerel.

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.

2.2.2.2.1 Prohibited Species

This FMP does not authrize 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.

2.2.2.3 Gear Restrictions

This FMP authorizes the use of net gear, hook-and-line, pots (traps), and longlines as legal gear for the commercial harvest of CPS.

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 area 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, codend size (length, diameter, or volume), chafing gear, gear marking, escape panels and ports, and the length of time gear may be left unattended, or other gear restrictions are authorized by this FMP. Gear restrictions may be established, modified, or removed under the points 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.

2.2.2.4 Reporting Requirements

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

2.2.2.4.1 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.

2.2.2.4.2 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 the data collection and reporting systems operated by state agencies fail to provide the Secretary with statistical information for adequate management.

Two major instances where state reporting requirements may be insufficient have been identified. The first is where a vessel harvests fish within the Washington, Oregon, and California management area but lands outside the management area. The second case occurs when a vessel (usually a processor) remains at sea for a long period of time before unloading its catch shoreside. In the first case, reporting of the harvest may never occur, which could affect stock assessments dependent on accurate catch information. In the second case, reporting frequently is delayed several weeks or even months. Delayed reporting could seriously hamper inseason management of quota and harvest guideline species.

To address these inadequacies, the FMP authorizes implementation of federal reporting requirements in addition to those of the various states. Such requirements will be announced in the Federal Register. The owner or operator of any vessel that retains fish harvested in the area managed by this FMP whose port of landing is outside the management area may be required to report those catches in a timely manner. They also may be required to submit a completed fish landing ticket from either Washington, Oregon, or California, or an equivalent document containing all of the information required by the state on that fish ticket.

In addition, these vessels, or vessels that remain at sea for long periods of time (in particular, those that process their catch or the catch of another vessel at sea) may be required to report within a specified time period:

1. Vessel name
2. Radio call sign
3. Documentation number or federal permit number
4. Company representative and telephone, fax, and/or telex number
5. Vessel location including daily positions
6. Check-in and check-out reports giving the time, date, location of the beginning or ending of any fishing activity
7. Gear type
8. Reporting area and period
9. Duration of operation
10. Estimated catch by species and area, species disposition (including discards, product type, and weights)
11. Product recovery ratios, products sold (in weight and value by species and product type, and if applicable, size or grade)
12. Any other information deemed necessary for management of the fishery

Vessels also may be required to maintain and submit logbooks, and accurately record the following information at specified intervals: (1) daily and cumulative catch by species, effort, processing, and transfer information; 2) crew size; (3) time, position, duration, sea depth, and catch by species of each haul or set; (4) gear information; (5) identification of catcher vessels; (6) information on parties receiving fish or fish products; and (6) any other information deemed necessary.

Vessels may be required to inform a NMFS enforcement or U.S. Coast Guard office prior to landing or unloading any seafood product. Vessels may also be required to report prior to departing the Washington, Oregon, and California management area with fish or fish products on board.

The Council intends that any special reporting requirement be imposed only if it is expected to enhance the NMFS' ability to monitor the catch accurately.

2.2.2.5 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 license or permit is required, failure to obtain and possess such federal permit will be in violation of this FMP.

2.2.3.2 Catch Restrictions

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

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.

2.2.4 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 shore side. 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 a joint venture processing or to foreign vessels that operate in a fishery directed at a species for which there is a total allowable level of foreign fishing (TALFF). The FMP provides the authority to establish, modify or remove future regulations including, but not limited to, harvest guidelines, quotas, seasons, area closures, bycatch 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 MFCMA.

2.2.5.2 Target Species

A foreign nation may conduct joint venture operations only for species for which there is a joint venture processing (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 bycatch 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.

Incidental allowances for bycatch in joint venture 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 Regional Director may establish or modify incidental species allowances to reflect changes in the condition of the resource and performance of the U.S. industry. The Regional Director will consult with the Council, consider public testimony received, 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. Changes will be made following the same procedures as for annual or inseason changes.

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 quota. 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 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 2.1.2 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 to be at specified intervals. The Regional Director may require daily reports when a specified fraction of the JVP, TALFF, or incidental allowance is reached. In addition, each country may be required to report the arrival, departure, and positions of each of its vessels, as specified under the regulations and permit conditions, as needed for monitoring deployment of the fleet.
Logbooks may be required to fulfill the fishery conservation, management, and enforcement purposes of the MFCMA. These logs may include, but not be limited to, a communications log, transfer log, and daily joint venture log 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 quota or harvest guideline for the allocated species is reached; (4) the applicable open season is ended; or (5) as necessary for resource conservation reasons under the points 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 MFCMA. 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 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 points 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 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 MFCMA.

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 Experimental and Exploratory Fishing

"Experimental fishing" and "exploratory fishing" are used synonymously in this FMP and are defined to be fishing practices that are new to the fishery or not allowed under the FMP. Under this FMP, the Regional Director may authorize the targeted or incidental harvest of CPS for experimental or exploratory fishing that would otherwise be prohibited.

Experimental and exploratory fisheries are expected to be of limited size and duration and will require EFPs issued under Section 303(b)(1) of the MFCMA. The duration of EFPs will ordinarily be one year. Permits will not be renewed automatically. An application must be submitted to the Regional Director 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 data reporting and on-board observers with experimental fishing permits. Installation of vessel monitoring units aboard vessels with experimental 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 Regional Director 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. The date of the application
    B. The applicant's name, mailing address, and telephone number

C. A 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. A 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. A description of the species (target and incidental) to be harvested under the EFP and the amount(s) of such harvest necessary to conduct the experiment
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, and
H. The signature of the applicant

The Regional Director may request from an applicant additional information necessary to make the determinations required.

2. The Regional Director 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 Regional Director finds any application does not warrant further consideration, he shall notify both the applicant and the Council in writing of the reasons for his/her decision. If the Regional Director determines any application warrants further consideration, he 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 Regional Director also will forward copies of the application to the Council, the U.S. Coast Guard, and the fishery management agencies of Oregon, Washington, California, and Idaho, accompanied by the following information:

   A. The current utilization of DAH and processing capacity (including existing experimental harvesting, if any) of the target and incidental species
   B. A statement of why the target species is considered underutilized or why the issue and opportunity are important (if applicable)
   C. A citation of the regulation or regulations which, absent the EFP, would prohibit the proposed activity, and
   D. Biological information relevant to the proposal

3. At a Council meeting following receipt of a complete application, the Regional Director 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 Regional Director 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, or
   F. The activity proposed under the EFP could create a significant enforcement or safety problem

5. If the permit is granted, the Regional Director will publish a notice in the Federal Register describing the experimental fishing to be conducted under the EFP. The Regional Director 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 bycatch restrictions (trip allowance and/or total incidental reserve or harvest guideline) 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, and
   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. Part 904, Subpart D.

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

2.2.8.1 Policies for Issuing Experimental Fishing Permits

Priorities for issuing EFP's 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.

2.2.9 Other Fees and Permits

Nothing in this FMP is intended to exclude the 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 and is conducted under adequate scientific supervision using a scientific research vessel or a commercial vessel contracted to carry out scientific research.

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, and
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

2.3.1 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 MFCMA and its implementing regulations. The Secretary should transmit copies of letters of acknowledgment to the Council and to state and 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; and,
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 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 exclusive economic zone (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.

2.5.1 Review Procedure

Any state may propose that 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 inconsistent with the objectives of the FMP, the MFCMA, and other applicable law
2. The likely effect on or interaction with any other regulations in force for the fisheries in the area concerned
3. The expected impacts on the species or species group taken in the fishery sector being affected by the regulation
4. The 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, and
5. Any impacts in terms of achievement of quotas or harvest guidelines, 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 Director for review and approval. The NMFS Regional Director 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 Director disapproves the proposed regulations, he or she will inform the Council in writing of the reasons for his disapproval.

3.0 LIMITED ENTRY IN THE COASTAL PELAGIC SPECIES FISHERY

This Fishery Management Plan (FMP) creates a two-tiered license limitation system with large and small boat permits for managing fishing effort in the Coastal Pelagic Species (CPS) fishery. The license limitation system includes a window period for initially allocating permits, policies for underutilized species, requirements for renewing permits and an appeals process.

3.0.1 Nature of the Interest Created

CPS license limitation permits would confer a right to participate in the CPS fishery in accordance with the license limitation system established under the CPS FMP or any future amendment that may modify or even abolish the license limitation system. Permits and other endorsements would be subject to sanctions, including revocation, as provided by the Magnuson Fishery Conservation and Management Act (MFCMA) 16 USC at 1858(g) and 15 CFR Part 904, Subpart D.

3.1 Window Period

In November of 1991, Council established a window period (January 1, 1986 to November 13, 1991, inclusive) for defining present participants in the CPS fishery and for use in establishing a limited entry management system.

3.2 Types of Landings

Incidental landings are defined as 1 mt of CPS or less per trip. Small boat landings are defined as more than 1 mt but no more than 10 mt of CPS per trip. Large boat landings are defined as landings larger than 10 mt of CPS per trip. For these definitions, CPS are understood to be coastal pelagic species actively managed under this FMP (i.e. northern anchovy, Pacific sardine, Pacific mackerel and, jack mackerel). The significance of these definitions lies in their relationship to total landings during the window period of CPS and CPS plus squid. Boats that landed less than 20 mt of CPS and squid or CPS only during the window period typically landed less than 1 mt of CPS per trip on average. Boats that landed at least 20 mt but less than 400 mt of CPS and squid, or of CPS only, typically landed more than 1 mt of CPS per trip but less than 10 mt per trip on average. Boats that landed 400-800 mt or more of CPS plus squid or CPS alone typically landed more than 10 mt of CPS per trip on average.

3.3 License Limitation Program

The following conditions hold in the license limitation system for CPS:

1. Permits are permanent subject to legal, performance or other renewal requirements.
2. Permits are assigned for use on one vessel at a time.
3. 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.
4. Only entities (persons, corporations, etc.) qualified to own a U.S. fishing vessel may hold (by ownership, lease or otherwise) a permit.
5. 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.
6. CPS may be landed (other than as incidental catch or other category explicitly excluded from license limitation requirements) within the boundaries of the limited entry system (south of 39° N latitude) only by a boat with a license limitation permit.
7. CPS may be purchased (other than as incidental catch or other category explicitly excluded from license limitation requirements) from any boat with a license limitation permit.
8. Application, renewal and other fees may be charged by NMFS to cover administrative costs.
9. Permits will be issued initially to owners of boats that apply and qualify for permits based on landings during the window period and other criteria described below. In the event that a boat was sold after the window period but before permits were issued, the permit will be issued to the new owner.

10. Fees, procedures for obtaining and renewal of permits, and other details will be spelled out in implementing regulations.
11. A license limitation permit is unnecessary when landing less than 1 mt of CPS (incidental landings of CPS are excluded from license limitation requirements).
12. A license limitation permit is not necessary for the capture and sale of CPS as live bait used in recreational fisheries (live bait landings of CPS are excluded from license limitation requirements).
13. Recreational harvest of CPS is excluded from limited entry requirements although recreational harvest could still be restricted by quotas, area closures or any other type of management measure.
14. Fishing north of 39° N latitude (approximately Pt. Arena) is not effected by license limitation requirements. Fishing south of 39° N latitude requires license limitation permits.
15. Small boat permits will be issued to boats with window period landings of more than 20 mt of CPS or squid but less than 800 mt of CPS or squid. Large boat permits will be issued to boats with at least 800 mt of CPS or squid during the window period.
16. The amount of CPS products CPS carried, landed, transported, or delivered by any fishing boat is limited to 100 mt (round weight equivalent) or less. This option applies to large boat permit holders only because small boat permit holders will already be limited to 10 mt per trip. A trip is defined to mean any activity (e.g., catching, landing, transporting or delivering) by a boat that fishes for CPS with or without a license limitation permit. The trip limit is defined in round weight equivalent units so that, for example, a boat could not carry CPS products weighing less than 100 mt if they were derived from more than 100 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.
17. A person who qualifies for a large boat permit at the outset of the license limitation program for CPS can elect (within a period of one year and subject to other regulations) to receive a small boat permit instead. The choice would be permanent; small boat permits obtained in this fashion could not be reconverted to large boat permits. This allows persons qualifying for large boat permits to benefit from low volume reserves (Section 5.2) in exchange for converting to a small boat permit.
18. Boat owners with California Marine Resource Protection Act (MRPA also known as Proposition 132) permits for 1993 will be issued nontransferable conditional permits good for two years (January 1, 1995 to December 31, 1996), subject to application and other requirements. Permanent permits will be issued to conditional permit holders who apply and land at least 10 mt of CPS in both years and make at least 10 landings of CPS in both years during the proving-up period. Conditional permits will be valid until terminated or converted to permanent CPS permits by NMFS. No more than one conditional CPS permit will be issued per vessel; vessels used by two or more MRPA permittees would receive a single conditional CPS permit that could be issued in the name of two or more owners. Restrictions on eligibility or transferability of permits may be waived due to hardship under the appeals process described in Section 3.6.

3.4 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, boats 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.

3.5 Permit Renewal Process

Following the initial issue of license limitation permits, owners must renew permits every two years. The renewal date for license limitation permits will be January 1 at two year intervals beginning in the year after implementation. For example, if the FMP is implemented on June 5, 1996, then the first due date for renewing permits will be January 1, 1999. Subsequent renewal dates will be January 1 in the years 2001, 2003, etc. The same renewal dates will apply to all permit holders. For example, a person who purchased a permit on December 1, 1998 would still be required to renew it by January 1, 1999. A fee sufficient to cover administrative costs may be charged for permit renewals.

Permits not renewed by the renewal date become inactive and may not be used to land CPS in the license

limitation program. Inactive permits may not be transferred. A permit may be reactivated by NMFS at any time during the year upon receipt of a completed renewal application and renewal fee. If a permit remains inactive for one year, NMFS will notify the permit owner that the permit will be retired in 60 days unless it receives a renewal application and renewal fee. If NMFS does not receive the renewal application within 60 days, the inactive permit will be permanently retired.

The owner of an inactive permit may appeal to the Regional Director as described in Section 3.6. Requirements for renewing permits may be modified or added as described in Section 2. Landings are not a requirement for permit renewal but could be in the future.

3.6 Appeals Process

An owner or person wishing to obtain a license limitation permit may appeal to the Regional Director about how the permit may be issued, denied, conditioned, suspended, or transferred in the CPS fishery. 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 Regional Director 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 Regional Director will decide the appeal in accordance with the criteria, goals and objectives set out in the CPS FMP and any other available information, including a summary record of the hearing and hearing officer's recommendation. The Regional Director will decide the appeal and notify affected parties with a written justification in a timely fashion (normally within 30 days of the receipt of sufficient information or hearing). The Regional Director's decision on any appeal is intended to be a final action on the appeal.

3.7 Policy for Issuing Limited Entry Permits for Underutilized Species

Boats already involved in developing a fishery for an underutilized species (i.e. boats with a catch history or previous experimental fishing permit) should receive highest priority if a limited entry scheme is implemented for a previously underutilized species.

4.0 OPTIMUM YIELD, HARVEST FORMULAS AND OVERFISHING DEFINITIONS FOR THE CPS FISHERY

This fishery management plan (FMP) defines optimum yield (OY), defines overfishing and establishes harvest level formulas in the coastal pelagic species (CPS) fishery. In addition, factors considered in choosing harvest guidelines or quotas, annual management cycles and fishing seasons for CPS are described.

4.1 Optimum Yield

OY for the CPS fishery is defined as all of the fish that can be taken under the regulations, specifications and management measures authorized by the FMP and promulgated by the Secretary of Commerce (Secretary).

4.2 Harvest Formula Approach

The general formula for setting total target harvest levels in the CPS fishery is:

$$H_{t+1} = (BIOMASS_t - CUTOFF) \times FRACTION$$

where H_{t+1} is the total harvest target level (for the entire stock throughout its range), CUTOFF is the lowest level of estimated biomass at which harvest is allowed and FRACTION is the fraction of the biomass above CUTOFF that can be taken by the fishery. For all CPS, $BIOMASS_t$ is the estimated total biomass of fish age 1+ at the beginning of season t. Other definitions of $BIOMASS_t$ may, however, be used if required or desirable. The formula uses the estimated biomass for the whole stock in one season ($BIOMASS_t$) to set harvest for the whole fishery in the following season (H_{t+1}). In addition to CUTOFF and FRACTION parameters, a maximum harvest level parameter (MAXCAT) can be used optionally to ensure that total harvest never exceeds MAXCAT.

4.3 General Approach to Defining Overfishing

Overfishing is defined as any fishing (except as allowed by bycatch restrictions) that occurs when biomass falls below a prespecified level equal to or less than CUTOFF. When estimated biomass falls below the definition of overfishing, no harvest (except as allowed by bycatch restrictions) is allowed.

4.4 Harvest Levels for U.S. Fisheries

In the absence of a cooperative management agreement, harvest levels for U.S. fisheries are obtained by prorating the total target harvest level according to the portion of the stock resident in U.S. waters. 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. Best available estimates of the portion of CPS stocks in U.S. waters should be used in calculating harvest levels for U.S. fisheries.

4.5 Harvest Formulas and Definition of Overfishing for Each Species

Harvest formula parameters and the definition of overfishing for Pacific sardine, northern anchovy, Pacific mackerel, and jack mackerel are summarized below.

	Pacific Sardine	Northern Anchovy	Pacific Mackerel	Jack Mackerel
FRACTION	20 percent	25 percent	30 percent	25 percent
CUTOFF[a/]	50,000	300,000	18,200	35 percent virgin[b/]
MAXCAT[a/]	400,000	200,000	none	none
Definition of Overfishing[1]	50,000	75,000	18,200	35 percent virgin[b/]

a/ Metric tons.
b/ 578,000 mt according to current best estimates of virgin biomass

4.5.1 Sardine

For sardine, the total target harvest is 20 percent of the estimated biomass above 50,000 mt up to a maximum of 400,000 mt. Overfishing is any harvest (except as allowed under bycatch restrictions) when the estimated biomass drops below 50,000 mt. For example, if the estimated biomass were 400,000 mt and portion in U.S. waters was 59 percent, then the total target harvest would be (400,000 – 50,000) x 0.2 = 70,000 mt and the U.S. harvest level would be 70,000 x 0.59 = 41,300 mt. Harvest levels for a range of Pacific sardine biomass levels (assuming 59 percent portion in U.S. waters) are given below.

Estimated Sardine Biomass (mt)	Total Target Harvest Level (mt)	Total U.S. Harvest (mt)
10,000	0	0
20,000	0	0
40,000	0	0
50,000	0	0
60,000	2,000	1,180
80,000	6,000	3,540
100,000	10,000	5,900
200,000	30,000	17,700
400,000	70,000	41,300
600,000	110,000	64,900
800,000	150,000	88,500
1,000,000	190,000	112,100
2,000,000	390,000	230,100
3,000,000	400,000	236,000
4,000,000	400,000	236,000

4.5.2 Northern Anchovy

For northern anchovy, the total target harvest is 25 percent of the estimated biomass above 300,000 mt up to a maximum of 200,000 mt. Overfishing is any harvest (except as allowed under bycatch restrictions) when the biomass drops below 75,000 mt.

The live bait fishery for northern anchovy (about 5,000 mt per year) operates under a non-numeric OY (is unrestricted) at biomass levels above the definition of overfishing. In addition, a 3,000 quota for low volume uses is allowed at biomass levels above the definition of overfishing and below the CUTOFF (Section 5.2). For example, if the estimated anchovy biomass were 400,000 mt and portion in U.S. waters was 82 percent, then the total target harvest would be (400,000 - 300,000) x 0.25 = 25,000 mt. The U.S. harvest level would be 25,000 x 0.82 = 20,500 mt plus live bait (about 5,000 mt per year) for a total of about 25,500 mt. If the estimated biomass were 200,000 mt (below CUTOFF), then the U.S. harvest would be 3,000 mt (for low volume uses) plus live bait (about 5,000 mt) for a total of about 8,000 mt. Harvest levels for a range of northern anchovy biomass levels (assuming 82 percent portion in U.S. waters) are given on the following table.

Estimated Anchovy Biomass (mt)	Total Target Harvest Level (mt)	Total U.S. Harvest (mt)
50,000	0	0
75,000	0	0
100,000	0	0[a/b/]
125,000	0	0[a/b/]
150,000	0	0[a/b/]
175,000	0	0[a/b/]
200,000	0	0[a/b/]
225,000	0	0[a/b/]
275,000	0	0[a/b/]
300,000	0	0[a/b/]
400,000	25,000	20,500[a/]
500,000	50,000	41,000[a/]
1,000,000	175,000	143,500[a/]
1,500,000	200,000	164,000[a/]

a/ Plus live bait (non-numeric OY, about 5,000 mt per season).
b/ Plus 3,000 mt for low volume uses.

4.5.3 Pacific Mackerel

For Pacific mackerel, the total target harvest level is 30 percent of the estimated biomass above 18,200 mt. No maximum harvest level (MAXCAT) is defined. Overfishing is any fishing that occurs when the biomass falls below 18,200 mt except as allowed under bycatch restrictions. For example, if the estimated biomass were 400,000 mt and portion in U.S. waters was 70 percent, then the total target harvest would be (400,000 - 18,200) x 0.3 = 114,540 mt and the U.S. harvest level would be 114,540 x 0.7 = 80,178 mt. Harvest levels for a range of Pacific mackerel biomass levels (assuming 70 percent portion in U.S. waters) are given on the following page.

Estimated Pacific Mackerel Biomass (mt)	Total Target Harvest Level (mt)	Total U.S. Harvest (mt)
10,000	0	0
20,000	540	378
30,000	3,540	2,478
40,000	6,540	4,578
50,000	9,540	6,678
60,000	12,540	8,778
70,000	15,540	10,878
80,000	18,540	12,978
90,000	21,540	15,078
100,000	24,540	17,178
200,000	54,540	38,178
400,000	114,540	101,178
600,000	174,540	122,178

4.5.4 Jack Mackerel

For jack mackerel, the total target harvest level is 25 percent of the estimated biomass above a CUTOFF equal to 35 percent of virgin biomass. No maximum harvest level (MAXCAT) is defined. Overfishing is any fishing that occurs when the biomass falls below 35 percent of the virgin level except as allowed under bycatch restrictions. A prespecified biomass level is not used for the CUTOFF or definition of overfishing because too little information is available. Instead, harvest formula parameters are based on common "rules of thumb" and estimates of virgin biomass. It is not currently possible to update biomass estimates for jack mackerel on an annual basis. The best estimate of average biomass for jack mackerel is about 1,650,000 mt. Jack mackerel are underutilized and the stock is essentially unfished so average biomass is equivalent to virgin biomass.

In practice, the harvest formula for jack mackerel will likely result in a constant U.S. target harvest level of 174,200 mt (see below) unless current estimates of virgin or average biomass are refined or approaches to estimating current biomass are developed.

Harvest formula parameters, definition of overfishing and other data for jack mackerel.

Virgin Biomass	1,650,000 mt
CUTOFF and Definition of Overfishing (35 percent of Virgin Biomass)	578,000 mt
FRACTION	25 percent
MAXCAT	none
Total Harvest	268,000 mt
Annual Exploitation Rate	16 percent
Percent in U.S. Waters	65 percent
U.S. Harvest	174,200

4.6 Annual Specifications and Announcement of Harvest Levels (optimum yield, domestic annual processing, domestic annual harvest, joint venture processing, and and total allowable level of foreign fishing)

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) domestic annual harvest (DAH), (3) domestic annual processing (DAP), (4) joint venture processing (JVP), and (5) the total allowable level of foreign fishing (TALFF) for all coastal pelagic species actively managed by the Council. The total U.S. harvest will be allocated to the various fisheries as harvest guidelines or as quotas according to the requirements in the FMP.

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

When a harvest guideline is reached, a bycatch allowance (Section 5.1) will normally be allowed. Bycatch allowances may be adjusted through the "routine" management procedures to keep the harvest from exceeding the target harvest level. If the estimated bycatch portion is too high, resulting in the probability of not attaining the target harvest level by the end of the fishing season, the remaining bycatch portion will be allocated to the directed fishery through the "routine" procedures. Although adjustments may be made, fine-scale, inseason adjustments to bycatch allowances and other measures are not anticipated unless substantial errors are discovered in calculations or considerable harvest beyond or below the target for U.S. fisheries is likely to occur. Reallocation of unused bycatch portions will normally occur nine months into the fishing season.

This FMP allocates portions of harvest guidelines for different components of the CPS fishery as reserves. Reserves are used to ensure access to a portion of a harvest guideline or quota to a particular fishery component. Reserves are not, however, considered as separate harvest guidelines or quotas. Unused reserves will be available to all harvesters nine months into the fishing season, that is, they will be released by the "automatic" management procedure described in the FMP.

4.6.1 General Procedure

The intent of the management approach under the FMP is to reassess the status of each species every year (although this may not be necessary or possible in some cases). The general procedure for making the annual specifications for CPS is as follows:

1. The Coastal Pelagic Species Management Team will produce a Stock Assessment and Fishery Evaluation (SAFE) Section 4.6.2.1 report, or reports, that document the current estimates of biomass for each coastal pelagic species assessed and status of the fishery. In the report, the Coastal Pelagic Species Management Team will recommend either harvest guidelines or quotas, will recommend an initial bycatch allowance to be used when harvest guidelines are reached together with an estimate of total bycatch, and will make all calculations of the specifications as required by the FMP.

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

3. A public meeting will be held with the Coastal Pelagic Species Advisory Subpanel to discuss the annual specifications and to obtain public comments.

4. Following the meeting of the Coastal Pelagic Species Advisory Subpanel, the Regional Director will consider all comments obtained during the review and make a determination of the final specifications. This determination will be published in the Federal Register with a request for additional public comment. For CPS on a February to January management cycle (Pacific mackerel and jack mackerel), annual specifications will be announced on or about February 1 of each year. For CPS on an August to July management cycle (northern anchovy and Pacific sardine), annual specifications will be announced on or about August 1 of each year.

5. At its first opportunity, the Council will review all information compiled for the annual specifications, consult with its Scientific and Statistical Committee, Coastal Pelagic Species Management Team, Coastal Pelagic Species Advisory Subpanel, and hear public comments. The Council also will review any important social and economic information at that time, then make a recommendation to the Regional Director on the final specifications for the fishing season.

   The goal in having the Regional Director make harvest guidelines or quota specifications quickly (without discussion at a Council meeting) is to allow fishing to begin without delay while allowing review of all background documents contributing to the determination of the biomass estimates and resulting target harvest level, harvest guidelines and quotas. Assembling the data and producing a report requires enough time that permitting a complete public review before the beginning of the fishing season could reduce the season, especially if special problems arose. For this reason, final specifications will be announced after a partial public review so that the fisheries can begin. Following a complete public review and consideration by Council, changes in the harvest guidelines or quotas will be announced if necessary.

6. Following the meeting of the Council, the Regional Director 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.

7. NMFS will monitor the fishery throughout the year, tracking bycatch and harvest guidelines. 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 a harvest guideline is reached, then directed fishing is prohibited and the prespecified bycatch allowance is invoked by an automatic procedure. Based on the results of that review, the Council will recommend that continued harvest either be allowed with no restrictions beyond the initial bycatch allowance, be allowed with additional restrictions to further reduce harvest, or be discontinued and the fishery closed.

4.6.2 Factors Considered

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

1. The current estimated biomass
2. The harvest formula described in the FMP, which is specific for each resource
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 coastal pelagic resources

All data used to make annual specifications will be available for public inspection during normal business hours at the Southwest Regional Office, National Marine Fisheries Service, 501 W. Ocean Boulevard, Long Beach, California 90802-4213.

4.6.2.1 Stock Assessment and Fishery Evaluation Report

The SAFE report or reports should normally be published on an annual basis and provide the following information:

1. Current status of CPS resources
2. A list of harvest formula parameters and definition of overfishing for all species
3. The total and U.S. target levels, if calculated, along with all available information about bycatch, DAH, DAP, JVP, and TALFF used to specify harvest guidelines or quotas
4. Recent and historical catch statistics (landing and value)
5. Recommendations for use of harvest guidelines 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
9. Other relevant biological, social, economic and ecological information that may be useful to the Council

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

4.6.3 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 which will normally be used. 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 catch would occur after a quota was reached and further landings prohibited, resulting in curtailing the harvest of other resources or discard
3. Fishing in excess of a harvest guideline is not expected to significantly affect future yields

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 the quota. 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; and
3. fishing in excess of a harvest guideline would significantly affect future yields.

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.

4.6.4 Annual Assessment and Management Cycles

This FMP specifies annual schedules for managing CPS. Annual schedules may be modified at a later date if need arises. The annual cycle used to manage each species must accommodate 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 Coastal Pelagic Species Management Team and Coastal Pelagic Species Advisory Subpanel.

Pacific mackerel and jack mackerel (Table 4.6.4-1) will be managed using a February to January fishing season with biomass estimates conducted in November to December and review by industry and technical experts during January. Quotas and harvest guidelines will be set by NMFS on or before February 1 (when the season begins) and reviewed by Council at the annual meeting held currently in March. February to January, rather than January to December, annual cycles are proposed in order to accommodate holidays and problems with scheduling meetings during December and early January.

TABLE 4.6.4-1. Assessment schedule for Pacific mackerel and jack 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					Dec												Dec		
4. CalCOFI survey								Mar	- - -	May	Jun	- -	Aug						
5. CalCOFI data			Oct												Oct				
6. Aerial spotter index				Nov												Nov			
7. EPM spawn. biomass									Apr	- - -	- - -	Jul							
8. EPM results available		Sep												Sep					
9. Biomass estimation				Nov	Dec											Nov	Dec		
10. Preliminary review						Jan												Jan	
11. Fishing season starts							Feb												Feb

Northern anchovy and Pacific sardine will be managed using the August to July annual cycle already used for northern anchovy (Table 4.6.4-2). Anchovy biomass and Pacific sardine will be assessed in late May to early June and reviewed during June and July. Quotas and harvest guidelines would be set by NMFS on or before August 1 (when the season begins). Council will review the biomass estimates and preliminary regulations for anchovy and jack mackerel at the first opportunity (currently the August meeting).

TABLE 4.6.4-2. Assessment schedule for northern anchovy and 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. EPM							Feb-Mar												
8. EPM results available											Jun								
9. Biomass estimation											Jun								
10. Preliminary review												Jul							
11. Season starts	Aug												Aug						

5.0 BYCATCH AND ALLOCATION FOR COASTAL PELAGIC SPECIES

This fishery management plan (FMP) establishes bycatch allowances for coastal pelagic species (CPS), allocation for low volume uses, and allocation to northern fishery segments.

5.1 Bycatch Allowances

Bycatch refers to catch or mortality of one species from fishing directed at another species. Bycatch allowances are the primary tool for managing bycatch when quotas and harvest guidelines are exhausted in the CPS fishery. Bycatch allowances are percentages of total weight of a catch, landing or delivery. Bycatch allowances come into force for overfished stocks or once a directed quota or harvest guideline is filled. Loads of fish that exceed bycatch allowances for overfished species or species with no harvest guideline or quota can not be delivered or sold. The Regional Director will set bycatch allowances according to guidelines described in this FMP.

Bycatch would normally be measured when a load is landed for enforcement of bycatch allowances. Depending on the fishery, however, bycatch could be measured when a load is brought on deck, delivered, sold, or at any point that is appropriate and practical.

Bycatch allowances will normally be set by the Regional Director at the same time as harvest guidelines or quotas (Section 2 and 4). Estimates of bycatch and bycatch rates will be considered in setting harvest guidelines and quotas (Section 4). Bycatch allowances (like harvest guidelines and quotas) can be changed inseason but will generally remain constant through the fishing season unless a resource conservation issue or substantial error in harvest level or other calculations is discovered.

Other management approaches, such as fishing seasons or area restrictions, might also be required to reduce bycatch. Bycatch allowances 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 Bycatch Allowances When Stocks are Overfished

When a stock is overfished according to the definition of overfishing in this FMP, bycatch allowances for commercial fishing shall be set to 0–15 percent of landed weight, as determined by the Southwest Regional Director.

5.1.2 Bycatch Allowances When Stocks are Not Overfished

When a stock is not overfished according to the definition of overfishing in the FMP, bycatch allowances for commercial fishing shall be set to 0–45 percent of landed weight, as determined by the Southwest Regional Director.

5.1.3 Pacific Mackerel Landed Incidentally

Landings of Pacific mackerel smaller than a minimum size (1 mt per trip or lower limit determined by the Regional Director according to guidelines described in Section 5.1.6) are excluded from bycatch restrictions for Pacific mackerel when the directed quota for Pacific mackerel is exhausted and the resource is not overfished.

5.1.4 Bycatch Allowances for Live Bait When Stocks are Overfished

When a stock is overfished according to the definition of overfishing in the FMP, bycatch allowances for live bait fishing shall be set to 0–15 percent of landed weight, as determined by the Southwest Regional Director.

5.1.5 Bycatch 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 Bycatch Allowances

In setting bycatch allowances, the Regional Director 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 by the Regional Director about bycatch allowances will be made in consultation with the Council Chair, Director of the California Department of Fish and Game, Coastal Pelagic Species Management Team, other representatives appointed by the Council, and other interested parties.

5.1.6.1 Overfished Stocks

In order of priority, bycatch allowances for overfished stocks should be set to (1) minimize fishing mortality on overfished stocks, and (2) minimize discard of overfished stocks. Bycatch allowances for overfished stocks should approximate rates of bycatch when fishing is conducted in a manner that minimizes catch of the overfished stock.

The Regional Director must set bycatch allowances for all overfished stocks. Once set, bycatch allowances for overfished stocks remain in force until they are changed by the Regional Director. Bycatch allowances for overfished stocks can be revised inseason if conditions warrant or new information becomes available.

5.1.6.2 Stocks Not Overfished

Bycatch allowances for stocks that are not overfished come into force once a quota or harvest guideline has been filled and the directed fishery has been closed. Under these conditions, bycatch allowances should be set 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 bycatch (based on past or current bycatch rates, bycatch allowances, harvest guidelines and other conditions in the fishery) are normally considered when harvest guidelines or quotas or set. Thus, bycatch allowances should be set at the same time and in concert with quotas or harvest guidelines.

Bycatch allowances are meant to accommodate bycatch that is difficult to avoid during normal fishing directed at other species. Therefore, bycatch allowances should be set at levels that approximate bycatch rates during normal fishing activities.

5.2 Allocation for Low Volume Resource Uses

Low volume/high value markets for CPS are served primarily by vessels with small boat license limitation permits. On this basis, allocations for low-volume uses are based on possession of a small boat limited entry permit and small boat reserves. A small boat permit allows a vessel to land a maximum of 20 mt of CPS per trip (Section 3) A small boat reserve is a fixed harvest level or proportion of a harvest guideline/quota reserved for use by persons with small boat license limitation permits.

Low volume reserves, when they exist, are available at the beginning of the fishing season. Low volume reserves are not further allocated to northern and southern fishery segments (Section 5.3).

5.2.1 Release of Low Volume Reserves

Any portion of a small boat reserve for CPS that is unused nine months into the season will normally be made available to all segments of the directed fishery at that time.

Utilization of the reserve would be monitored inseason and any portion of the reserve which was unused nine months into the season would be made available to all segments of the directed fishery at that time.

5.2.2 Use of Unallocated Harvest Guidelines or Quotas by Boats with Small Boat License Limitation Permits

Vessels with small boat license limitation permits will be allowed to compete with other segments of the fishery for whatever remains of the unallocated harvest guideline or quota once the low volume reserve is exhausted.

5.2.3 Low Volume Reserves for Pacific Sardine and Pacific Mackerel

Low volume reserves for sardine and Pacific mackerel are a fraction of the harvest guideline or quota, with a cap on the maximum size of the reserve.

Species	Fraction	Cap (mt)
Pacific Sardine	10 percent	3,200
Pacific Mackerel	10 percent	2,000

For example, if the harvest guideline for sardine in U.S. fisheries was 100,000 mt, then the low volume reserve would be 3,000 mt. If the harvest guideline for sardine in U.S. fisheries was 20,000 mt, then the low volume reserve would be 2,000 mt.

5.2.4 Low Volume Reserves for Northern Anchovy

The low volume reserve for northern anchovy is a fixed 3,000 mt reserve offset against the U.S. harvest guideline or quota when it is exist. The approach for anchovy differs from the approach for sardine and Pacific mackerel because the definition of overfishing (75,000 mt) for anchovy is smaller than the CUTOFF (lowest level of estimated biomass at which harvest is allowed) parameter (300,000 mt) in the harvest formula. The low volume reserve for anchovy allows some fishing for low volume/high value uses when anchovy biomass is above the definition of overfishing but lower than the CUTOFF. In addition, it prevents fishing for high volume/low value uses from preempting fishing for low volume/high value uses when both types of fishing are authorized.

The low-volume reserve for anchovy exists whenever biomass exceeds the overfishing level. For example, if estimated anchovy biomass is less than the CUTOFF but higher than the overfishing definition, then the U.S. harvest guideline and allocation to low volume fisheries are both 3,000 mt and fishing by small boat permit holders only is authorized.

At biomass levels above the CUTOFF parameter in the harvest level formula, the 3,000 reserve is subtracted or offset against the first 3,000 of the harvest guideline or quota for U.S. fisheries calculated using the harvest formula. For example, if anchovy biomass exceeds CUTOFF but the target harvest level for U.S. fisheries is only 2,500 mt, then the U.S. harvest guideline and allocation to low volume fisheries are both 3,000 mt and fishing by small boat permit holders only is authorized. If the target harvest level for U.S. fisheries was 10,000 mt, then 3,000 mt would be reserved for low volume uses, 7,000 mt would be unallocated and fishing by both small and large boat permit holders is authorized.

5.3 North-South Allocation for Directed Fishery

This FMP authorizes allocations of Pacific sardine and northern anchovy to participants in northern areas (defined below) of the CPS fishery.

For each species, the northern allocation and the remaining unallocated harvest guideline will be available at the beginning of the season. The northern fishery would be allowed to compete for whatever remained of the unallocated portion of the harvest guideline, once the northern reserve was exhausted. Any portion of the northern reserve that was unused nine months into the season would be made available to all segments of the directed fishery at that time.

5.3.1 Formulas for Allocating Pacific Sardine and Northern Anchovy

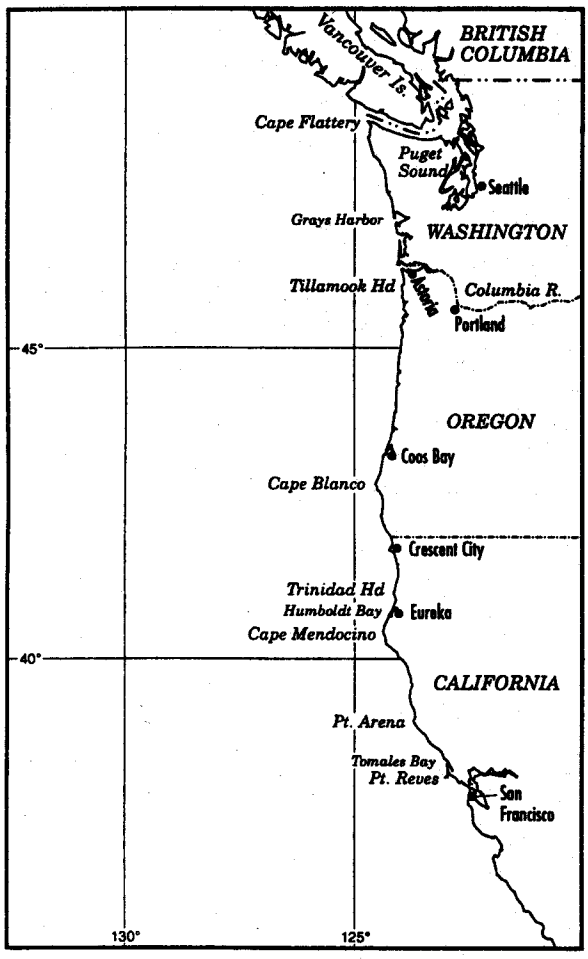
Northern allocations are a fraction of the total harvest for U.S. fisheries (after adjustments for low volume reserves), with an optional cap on the maximum size of the allocation.

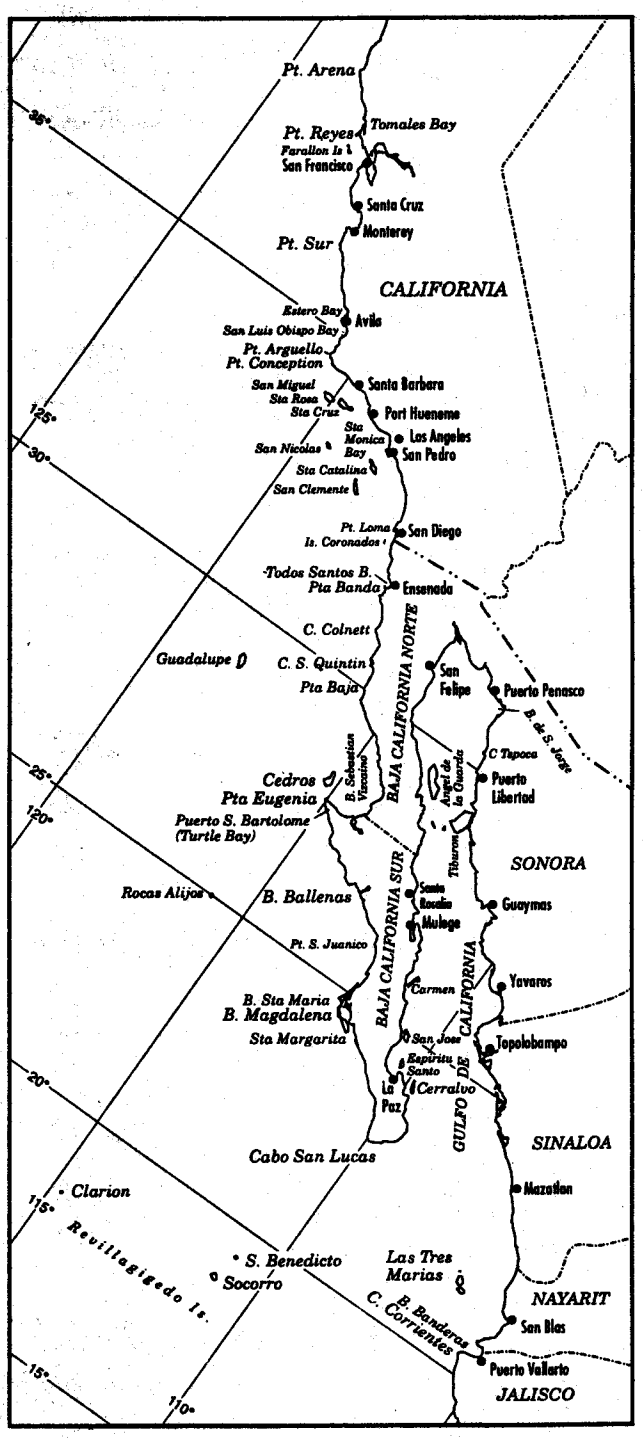
Species	Fraction	Cap (mt)
Northern Anchovy	10 percent	5,000
Pacific Sardine	10 percent	None

For example, if the target harvest level less the low volume reserve for northern anchovy is 40,000 mt, then the northern allocation is 4,000 mt. If the target harvest level less the low volume reserve for northern anchovy is 100,000 mt, then the northern allocation is 5,000 mt.

5.3.2 Definition of Northern and Southern Fishery Segments

The division between northern and southern areas in the CPS fishery for purposes of allocation is at Pt. Piedreas Blancas (35°40'N latitude). Landings (or catches if their location is known) north of the division apply to the northern area. Landings (or catches if their location is known) south of the division apply to the southern area.


BRITISH COLUMBIA
Vancouver Is.
Cape Flattery
Puget Sound
Seattle
Grays Harbor
WASHINGTON
Tillamook Hd
Columbia R.
Portland
45°
OREGON
Coos Bay
Cape Blanco
Crescent City
Trinidad Hd
Humboldt Bay
Eureka
Cape Mendocino
40°
CALIFORNIA
Pt. Arena
Tomales Bay
Pt. Reyes
San Francisco
130°
125°


Pt. Arena
35°
Pt. Reyes
Tomales Bay
Farallon Is
San Francisco
Santa Cruz
Monterey
Pt. Sur
CALIFORNIA
Estero Bay
Avila
San Luis Obispo Bay
Pt. Arguello
Pt. Conception
Santa Barbara
San Miguel
Sta Rosa
Sta Cruz
Port Hueneme
125°
Sta Monica Bay
Los Angeles
San Nicolas
San Pedro
30°
Sta Catalina
San Clemente
Pt. Loma
San Diego
Is. Coronados
Todos Santos B.
Pta Banda
Ensenada
C. Colnett
BAJA CALIFORNIA NORTE
Guadalupe
C. S. Quintin
Pta Baja
San Felipe
Puerto Penasco
B. de S. Jose
B. Sebastian Vizcaino
C Tiburon
Angel de la Guarda
Puerto Libertad
Cedros
Pta Eugenia
25°
120°
Puerto S. Bartolome (Turtle Bay)
Tiburon
SONORA
Rocas Alijos
B. Ballenas
Santa Rosalia
Guaymas
Mulege
Pt. S. Juanico
BAJA CALIFORNIA SUR
Carmen
Yavaros
B. Sta Maria
B. Magdalena
Sta Margarita
San Jose
Espiritu Santo
Topolobampo
GULFO DE CALIFORNIA
20°
La Paz
Cerralvo
SINALOA
Cabo San Lucas
Clarion
Mazatlan
115°
Revillagigedo Is.
S. Benedicto
Socorro
Las Tres Marias
B. Banderas
C. Corrientes
NAYARIT
San Blas
Puerto Vallarto
15°
110°
JALISCO

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 coastal pelagic species that are currently or could potentially be harvested with pelagic or midwater fishing gear. Not all of those species are actively managed under the Fisheries Management Plan (FMP) for CPS or by the Pacific Fishery Management Council (Council). Market squid, Pacific saury, Pacific herring and Pacific bonito, for example, are not actively managed by the Council under the CPS FMP but could be in the future.

Most CPS and the fishing they support are distributed internationally, with components in the exclusive economic zones of Canada and Mexico as well as in international waters outside the U.S. exclusive economic zone (EEZ). Individual components of the CPS fishery include or 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 coastal pelagic species or use them as bait. No Indian fisheries utilize CPS.

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 midwater trawls, pelagic trawls, purse seines, drum seines, lampara nets and dip nets. CPS are taken incidentally with gill nets, 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[a/]	*Engraulis mordax*
Market squid	*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 in the following sections.

1.1.1 Distribution and Habitat

Northern anchovy are distributed from the Queen Charlotte Islands, British Columbia, to Magdalena Bay, Baja California. The population is divided into northern, central and southern subpopulations, or stocks. The northern subpopulation supports a small fishery (1-4 boats) off Oregon and Washington that is described at the end of this section. 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 anchovies in the central subpopulation are typically found in waters that range from 12° to 21.5° C. There is a great deal of regional variation in age composition and size, with older and larger anchovies found farther offshore and to the north (Parrish 1985). The pattern is accentuated in warm years and during the summer (Methot 1989).

1.1.2 Life History

Northern anchovies are small, short-lived fish typically found in schools near the surface. Northern anchovy rarely exceed 4 years of age and 18 cm total length, although individuals as old as 7 years and 23 cm have been recorded. Natural mortality is thought to be M = 0.6 to 0.8 yr^{-1}, which means that 45-55 percent of the total stock would die each year of natural causes if no fishing occurred. Northern anchovy eat plankton 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. Females spawn batches of eggs throughout the spawning season at intervals as short as 7-10 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 are all sexually mature at age 2. The fraction of 1-year-olds that is sexually mature in a given year depends on water temperature and has been observed to range from 47 percent to 100 percent (Methot 1989).

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 in nearshore areas, anchovies are vulnerable to a variety of predators, including some recreationally and commercially important species of fish. As adults offshore, anchovies are fed upon by numerous fishes (some of which have recreational and commercial value), mammals, and birds—including the endangered California brown pelican (*Pelecanus occidentalis californicus*) and least tern (*Sterna albifrons browni*). Possible 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 and Pacific sardine.

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

TABLE 1.1.2-1. Continued.

Oceanodroma homochroa	Ashy petrel
Loomelania melania	Black petrel
Pelecanus occidentalis[a/]	Brown pelican[a/]
Phalacrocorax auritus	Double-crested cormorant
Phalacrocorax penicillatus	Brand't cormorant
Phalacrocorax pelagicus	Pelagic cormorant
Larus glaucescens	Glaucous-winged gull
Larus occidentalis	Western gull
Larus heermanni	Heerman's gull
Larus delawarensis	Ring-billed gull
Larus 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 FISHES	
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 salmon
Oncorhynchus tshawytscha	King salmon
Sebastes spp.	Rockfishes (many species)
Roccus saxatilis	Striped bass
Paralabrax nebulifer	Barred sand bass
Paralabrax clathratus	Kelp 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 mackerel
Sarda chiliensis	Pacific bonito
Thunnus alalunga	Albacore
Thunnus thynnus	Bluefin tuna
Xiphias gladius	Swordfish
Tetrapturus audax	Striped marlin
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 from 1780–1970 is available from scale counts taken from sediment cores obtained from the Santa Barbara and Soledad basins off California (Soutar and Issacs 1969, 1974). These data indicate that 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 and early 20th centuries. Scale counts indicated that northern anchovy varied less over time than Pacific sardine.

Recent biomass estimates (fish age 1+) for the central subpopulation of northern anchovy from 1964–1995 (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). Biomass declined to about 150,000 mt during 1991–1994 and then increased to 392,000 mt in 1995.

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 1964–1990 was 0.71 (Jacobson and Lo 1991). Strong yearclasses were observed in about 7 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 and 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 dead, 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 percent protein (meal from other fishes is 50–55 percent protein).

Anchovy harvested by the live bait fishery are not landed but are kept alive for sale to anglers as bait and chum. 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 partyboats 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 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 substock supports a small (1-4 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 1975-1976 based on the "Smith Larva Method" (Smith 1972) ranged from 737,000-1,005,263 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 1964-1966 (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 1975-1976, based on estimates from the Smith Larva Method and a correction factor of 8.6, is 87,000-116,000 mt. Landings of anchovy in Oregon and Washington during 1981-1994 (less than 60 mt/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 percent	611,947	39 percent	166,216	47 percent
1965	378,972	30 percent	356,272	33 percent	206,829	48 percent
1966	261,290	28 percent	236,177	27 percent	464,458	50 percent
1967	274,943	31 percent	229,927	29 percent	247,758	48 percent
1968	214,371	30 percent	205,661	30 percent	241,230	45 percent
1969	186,550	29 percent	173,049	29 percent	830,351	48 percent
1970	330,575	33 percent	198,006	29 percent	257,794	47 percent
1971	221,007	30 percent	172,431	31 percent	867,978	54 percent
1972	360,021	38 percent	137,774	28 percent	679,802	57 percent
1973	390,503	37 percent	382,657	37 percent	4,348,342	47 percent
1974	1,597,737	36 percent	474,403	28 percent	1,495,367	76 percent
1975	1,245,680	35 percent	931,981	31 percent	2,651,986	75 percent
1976	1,325,539	35 percent	1,068,744	31 percent	990,287	59 percent
1977	901,543	31 percent	900,606	31 percent	495,690	56 percent
1978	520,683	32 percent	519,875	32 percent	654,417	55 percent
1979	395,165	32 percent	337,401	30 percent	1,770,193	37 percent
1980	673,167	24 percent	654,146	24 percent	960,584	40 percent
1981	513,099	20 percent	490,381	19 percent	631,225	40 percent
1982	356,415	22 percent	320,201	20 percent	2,050,309	25 percent
1983	713,707	19 percent	711,225	19 percent	221,994	42 percent
1984	396,595	20 percent	395,006	20 percent	1,934,712	35 percent
1985	822,157	22 percent	555,245	18 percent	1,115,221	60 percent
1986	722,768	32 percent	715,217	32 percent	303,723	41 percent
1987	411,576	30 percent	408,704	30 percent	216,887	42 percent
1988	240,711	29 percent	226,903	28 percent	1,285,251	39 percent
1989	440,586	29 percent	167,168	29 percent	186,449	38 percent
1990	245,416	30 percent	239,345	29 percent	136,300	35 percent
1991	153,457	29 percent	151,970	29 percent	269,658	36 percent
1992	172,300	27 percent	170,557	27 percent	174,301	37 percent
1993	145,315	28 percent	144,536	28 percent	235,177	40 percent
1994	155,832	31 percent	153,863	31 percent	938,190	51 percent
1995	392,266	38 percent	387,618	38 percent	560,523	13 percent

1.2 Jack Mackerel

Detailed information about the biology of jack mackerel is available in MacCall et al. 1980, and MacCall and Stauffer 1983, and in the references cited in the following sections.

1.2.1 Distribution and Habitat

Jack mackerel range 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.

Although there is little evidence of subpopulations, small jack mackerel (10-30 cm FL and up to 8 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 (50-60 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 to 50 cm TL; 9 to 15 years of age) were recently found in considerable numbers around the 200-mile limit of the U.S. EEZ off southern California (SWFSC 1991).

Jack mackerel off southern California move inshore and offshore as well as north and south. The fish 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 located 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 may live for 30 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 0.25 yr^{-1}, which means that about 22 percent 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 macroplankton (copepods, pteropods and euphausiids), juvenile squid and anchovy. The larvae feed almost entirely on copepods.

Although immature jack mackerel can be found off southern California at all times of the year, 50 percent or more of all females reach sexual maturity during their first year of life. Young jack mackerel spawn fewer times and smaller batches of eggs than do older fish.

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.

Jack mackerel may be a major source of forage for billfish but are probably a minor source for smaller predators. Of course, jack mackerel may be a major food item at specific times and places for any predators large enough to eat them.

Adult jack mackerel probably do not contribute significantly to food supplies of marine birds because they are too large to be ingested by most bird species and tend to school inaccessibly deep. Brown pelicans have been observed feeding on fish presumed to be jack mackerel, but studies of stomach contents have not revealed jack mackerel remains. It seems unlikely that the abundance of jack mackerel significantly influences brown pelican populations.

Little information is available on predation of jack mackerel by marine mammals. Food analyses indicate that 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 1.2-2.6 million mt, with roughly 50 percent 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 or 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 1950-1980. Their analysis refined and extended earlier work by MacCall and Stauffer (1983). 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 1963-1990 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, pers. comm.). 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 increased dramatically during the mid-1970s and that jack mackerel biomass can remain at low levels for relatively long periods of time (ten or more years).

It would probably be difficult to detect changes in jack mackerel using existing CalCOFI or fish-spotter indices. None of the indices appear precise because variability in each is larger than the variability in abundance that could probably be expected for jack mackerel, which is a long-lived fish and not expected to change dramatically in abundance from year to year (MacCall and Stauffer 1983; MacCall and Prager 1988). In addition, the three indices are not well correlated.

Absolute magnitude of recruitment for jack mackerel cannot presently be determined, although an index of virtual year-class strength, obtained by summing the percentage contributions of a year-class to the various seasons in which it was fished, provides a rough indication of year-class variability (Table 1.2.3-2). An average year class will, using this measure, have a relative strength of 100 percent. 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 1947-1958 show a pattern in which strong year-classes appear every 5 years (Table 1.2.3-2). Recruitment was relatively low from 1959 to 1966. After 1966, strong year-classes appeared every two-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 8 are harvested by the inshore fishery off southern California and have a potential yield of about 100,000-200,000 mt. The potential yield of large fish in offshore and northern regions is about 10,000-25,000 mt. The potential yield of fish ages 9-15 years is about 20,000-50,000 mt. The total stock has a potential yield of 130,000-275,000 mt. As pointed out in PFMC (1990b), 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 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 1,000-2,000 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 Groundfish FMP (PFMC 1990c) 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. Begining 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			1971		0.09	0.66
1953	0.69			1972	1.63	0.07	0.61
1954	1.19			1973		0.05	0.02
1955	0.81			1974		0.15	0.18
1956	0.35			1975	0.35	0.19	0.69
1957	1.35			1976		0.51	0.61
1958	0.35			1977		1.13	4.80
1959	0.17			1978	0.13	5.19	3.93
1960	0.30			1979		2.01	1.06
1961	1.08			1980		2.23	0.64
1962	0.81		0.28	1981	0.08	2.93	0.41
1963	0.73	0.64	1.21	1982		1.50	0.53
1964	0.17	0.84	0.77	1983		1.51	0.12
1965	0.79	0.30	0.77	1984		0.35	0.39
1966	1.25	0.21	0.24	1985		0.70	0.33
1967	1.70	0.22	0.80	1986		0.84	0.14
1968	2.60	0.21	1.27	1987		0.58	0.09
1969	1.57	0.19	0.30	1988		3.14	0.05
1970		0.07	0.15	1989		2.66	0.15
				1990		0.39	0.04

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, pers. comm.). The label "CPUE" is for a catch-per-unit-effort-like index from fish-spotter data (Jim Squire, NMFS, SWFSC, pers. comm.). 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 1959-1966.

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

Information about the biology of Pacific sardine is available in Frey 1971, Clark and Marr 1955, Ahlstrom 1960, Murphy 1966, MacCall 1979, and in the references cited in the following sections. Common names include California pilchard, pilchard (in the northern part of its range), and sardina monterrey (in the southern part of its range).

1.3.1 Distribution and Habitat

Sardines are relatively small, pelagic fish inhabiting coastal temperate waters (between about 7° and 28° C) and are commonly found in schools. Sardines (Sardinops) exhibit an extensive antitropical distribution in eastern boundary currents in the Atlantic and Pacific, and in western boundary currents of the Indo-Pacific. Although Sardinops sagax has been the species name commonly reserved for sardines occurring off the western coasts of North and South America, recent studies (Parrish et al. 1989) consider the genus Sardinops to be monotypic and Sardinops sagax to be the correct scientific name for sardine populations in the Alguhas, Benguela, California, Kuroshio and Peru currents, and for populations off New Zealand and Australia.

In the California Current system, sardines occur from southern Baja California to southeastern Alaska and in the Gulf of California. In the northern portion of the range, occurrence is seasonal. It has been generally accepted that the sardine population off the West Coast of North America consists of three subpopulations. 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 seriological techniques (Vrooman 1964). A fourth, far northern, subpopulation was also postulated (Radovich 1982). Although the ranges of the northern and southern subpopulations overlapped, the stocks apparently moved north and south at similar times and did not overlap. Recent electrophoresis and examination of morphological variation (Hedgecock et al. 1989) showed no genetic variation among sardines from central and southern California, the Pacific coast of Baja California or the Gulf of California.

Historically, the sardines migrated extensively, 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) indicated that the fish moved farther northward with increased age. The migration was complex, and timing and extent of movement were affected to some degree by oceanographic conditions (Hart 1973).

At present, the population residing off the West Coast of North America is relatively small, and is found off central and northern California and Baja California. Abandonment of spawning area and contraction of range have been associated with decreases in size of sardine populations around the world (Parrish et al. 1989).

1.3.2 Life History

Pacific sardines reach about 41 cm, but usually are shorter than 30 cm. They live as long as 13 years, although most sardines in the historical and current commercial catch are 5 years and younger. There is a good deal of regional variation in growth rate, with average size at age increasing from south to north (Phillips 1948). Size and age at maturity may decline with a decrease in biomass, although latitudinal and temperature effects may also play a part (Butler 1987). At low biomass levels, sardines appear to be fully mature at age 2, whereas at high biomass levels only some of the 2-year-olds are mature (MacCall 1979). Natural mortality (M) for Pacific sardine has been estimated at 0.4 yr^{-1} (MacCall 1979) and 0.51 yr^{-1} (Clark and Marr 1955). A natural mortality rate of M = 0.04 yr^{-1} means that 33 percent 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 m of the water column probably year-round, with peaks from April to August from Point Conception to Magdalena Bay, and from January to April in the Gulf of California (Allen et al. 1990). Historically, spawning may also have been fairly regular off central California. Spawning has been observed off Oregon, and young fish have been seen in waters off British Columbia, but these were probably sporadic occurrences (Ahlstrom 1960). The main spawning area for the historical population off the U.S. west coast 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). Most spawning occurs between 13° and 17° C, with an apparent optimum between 15° and 16°, and a minimum temperature of 13° C (Ahlstrom 1960). The spatial and seasonal distribution of spawning is influenced by temperature. The center of sardine spawning has shifted northward and continued over a longer period of time during warm water conditions (Butler 1987; Ahlstrom 1960).

Pacific sardines are serial spawners and spawn several times over a season, though the number of spawnings is not well known. 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.

Sardines prey on crustaceans, mostly copepods, and consume other phytoplankton and zooplankton, including fish larvae. Larval sardines feed extensively on the eggs, larvae, and juvenile stages of copepods, as well as on other phytoplankton and zooplankton.

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 1951-1967 (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 (such as yellowtail, barracuda, bonito, tunas, marlin, mackerel, hake, 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 that utilize anchovy (Table 1.1.2-1). It is likely that sardines will, as they continue to increase, become more important as prey for numerous species, including endangered ones such as the California brown pelican (*Pelecanus occidentalis californicus*).

1.3.3 Abundance, Recruitment and Population Dynamics

Extreme natural variability and susceptibility to overfishing are characteristic of clupeiod stocks like Pacific sardine (Cushing 1971). Estimates of the abundance of sardines from 1780-1970 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 sardines 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 6,226,000 mt (Table 1.3.3-1).

Sardine spawning biomass (Table 1.3.3-1) estimated from catch-at-age analysis averaged 3,520,000 mt from 1932-1934, fluctuated from 2,844,000 to 1,206,000 over the next 10 years, then declined steeply from 1945-1965, with some short-term reversals following periods of particularly successful recruitment (Murphy 1966; MacCall 1979). During the 1960s and 1970s, biomass levels were thought to be as low as 5,000 mt.

The sardine stock began to increase by an average rate of 27 percent annually in the early 1980's (Table 1.3.3-1, Barnes et al. 1992). Recent estimates (Tom Barnes, California Department of Fish and Game [CDFG], Southwest Fisheries Science Center, La Jolla, California) indicate that the spawning biomass had increased to about 330,000 mt by 1994.

Recruitment of Pacific sardines is highly variable (Table 1.3.3-1). Recruitment occurs in strings, with several years of successful recruitment followed by similar periods of poor recruitment. Analyses of the sardine stock-recruitment relationship have been controversial, with some studies showing a density-dependent relationship (production of young sardines 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 growth rate of sardine was 8.5 percent during the historical fishery while the population was declining. He concluded that, even with no fishing mortality, the population on average was capable of replacement only. Jacobson and MacCall (in press) obtained similar results for cold, unproductive regimes but also found that the stock was very productive during warmer regimes which tend to be more productive.

Sardines age-3 and older were nearly fully recruited to the fishery until 1953, but age-2 and age-3 fish became less available as the population declined and southern fish migrated north (MacCall 1979). Analysis of recent catch data indicates that fish begin to recruit at age-1 and are fully vulnerable at age-3 (Barnes et al. 1992). Sardines probably become vulnerable to the live bait fishery, which is located close to shore, at an earlier age.

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 sardines during the historical fishery. Jacobson and MacCall (1995) found that MSY depends on environmental conditions.

1.3.4 Fishery Utilization

The sardine fishery first developed in response to demand for food during World War I. Landings increased from 1916-1936, 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 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 1947-1948, and in San Francisco in 1951-1952. 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, sardines began to be taken incidentally with Pacific 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.

Sardines landed in the directed sardine fisheries off southern and central California are primarily 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. Sardines landed in California are not now used for reduction. Sardine landings data are given in Table 2.1.1-1.

1.3.5 Current Management

California state regulations allow a directed sardine fishery in years when the spawning biomass exceeds 18,200 mt (20,000 short tons). In years when directed fishing is authorized, the bait fishery is allocated a minimum of 318 mt (350 short tons) and 227 mt (250 short tons) are allocated for dead bait. A reserve, based on the expected level of sardine bycatch in mackerel fisheries, is subtracted from the overall quota and, if bycatch levels remain low, released to the directed fisheries late in the season.

The overall quota in recent years has been set by CDFG on the basis of scientific advice and industry input. No explicit formula for setting the U.S. quota was used prior to the 1994 season; quotas were according to informal policies regarding desired recovery rates, Mexican catches, etc. U.S. sardine quotas have been adjusted either directly or indirectly for expected catches in Mexico. Since 1994, sardine quotas have been set by CDFG at 15 percent of total biomass.

TABLE 1.3.3-1. Estimates of sardine biomass (1,000 mt). Data prior to 1984 are biomass of sardine age-2+ and recruits in millions of age-2 fish. Data beginning in 1984 are biomass of sardine age-1+ and recruits in millions of age-1 fish. Age-2 fish prior to 1984 and age-1 fish beginning in 1984 were of similar size, maturity, and biologically equivalent.[a/]

	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	1,738				1953		202	6	972
1915	2,444				1954		239	216	1,197
1920	5,055				1955		170	166	382
1925	6,226				1956		108	124	264
1930	5,300				1957		90	132	588
1932		3,523		3,981	1958		177	284	1,586
1933		3,414		8,860	1959		122	267	905
1934		3,624		14,202	1960		88	176	288
1935		2,844		4,098	1961		54	78	111
1936		1,688		2,821	1962		27	24	74
1937		1,206		5,383	1963		21	30	56
1938		1,201		6,940	1964		11		11
1939		1,607		6,763	1965		3		
1940		1,760		11,808		Data Not Available 1966-1982			
1941		2,457		14,442	1983		8		88
1942		2,064		6,152	1984		20		57
1943		1,677		3,268	1985		21		212
1944		1,206		3,720	1986		31		161
1945		720		2,385	1987		54		161
1946		566		1,625	1988		69		238
1947		405		1,667	1989		90		
1948		740		3,875	1990		102		
1949		793		4,261	1991		205		
1950		780		3,690	1992		192		
1951		277	176	290	1993		167		
1952		136	101	397	1994		330		

a/ For example, there were 3,532,000 mt of sardines in 1932, and the 1932 year class produced 3,981,000 age-2 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 1945-1965 (MacCall 1979), and CANSAR for 1983-1994 (Deriso 1993).

d/ Estimates from a general linear model (Barnes et al. 1992).

1.4 Pacific Mackerel

Pacific mackerel found off the Pacific coast of the U.S. are often called chub or blue mackerel and are probably the same species as mackerel of various names (Scomber spp.) found in the Atlantic and western Pacific oceans (Hart 1973). Detailed information about the biology of Pacific mackerel is available in Frey 1971 and in the references cited below.

1.4.1 Distribution and Habitat

Pacific 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 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 northeastern stock is harvested by fishers in the U.S. and managed under this FMP.

Pacific mackerel adults are found in water ranging from 10.0 to 22.2° C (MBC 1987), and larvae may be found in water around 14° C (Allen et al. 1990). Subadults and adults 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; MacCall et al. 1985). 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 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 mackerel often school with other pelagic species, including jack mackerel and Pacific sardine.

1.4.2 Life History

The largest recorded Pacific mackerel was 63 cm long and weighed 2.8 kg, but Pacific mackerel taken by commercial fishing seldom exceed 40 cm or 1 kg (Hart 1973; Roedel 1938). The oldest recorded age for a Pacific mackerel was 11 years, but most caught commercially are less than 4-years-old (Fitch 1951). Some Pacific mackerel mature as 1-year-olds, and all are sexually mature by age 4 (Prager and MacCall 1988). The annual rate of natural mortality (M) is thought to be about 0.5 yr^{-1}, which means that 39 percent of the stock would die each year of natural causes in the absence of fishing (Parrish and MacCall 1978).

Pacific mackerel larvae eat copepods and each other (Collette and Nauen 1983; MBC 1987). Juveniles and adults feed on small fishes, fish larvae, squid and pelagic crustaceans such as euphausiids (Clemens and Wilby 1961; Turner and Sexsmith 1967; Fitch 1969; Fitch and Lavenberg 1971; Frey 1971; Hart 1973; Collette and Nauen 1983).

Pacific mackerel in the northeastern Pacific stock spawn from Eureka, California, south to Cabo San Lucas in Baja California (Frey 1971; MBC 1987) between 3 and 320 km from shore. The fish seldom spawn north of Point Conception (Fritzsche 1978; MBC 1987). Spawning occurs primarily from late April to July (MacCall and Prager 1988). An individual fish may spawn more than once and release 100,000-400,000 eggs each time (Clemens and Wilby 1961; Hart 1973).

Pacific 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).

1.4.3 Abundance, Recruitment and Population Dynamics

Biomass of Pacific mackerel (Table 1.4.3-1) declined from almost 400,000 mt in the early 1930s to less than 100,000 mt in the late 1940s and early 1950s (Parrish and MacCall 1978; MacCall et al. 1985). After a brief resurgence in the early 1960s, the biomass declined to around 10,000 mt (or lower) and remained low until strong year classes appeared in the late 1970s. Abundance increased dramatically after 1977 to a peak of 754,000 mt in 1982 (Jacobson et al. 1994). After 1982, Pacific mackerel biomass declined steadily but remained greater than 200,000 mt until 1991. By 1994, biomass had declined further to about 65,000 mt. Analyses of scale-deposition data for Pacific 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 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).

Pacific mackerel become available to the commercial fishery in their first year of life. They become fully available to the fishery at about 4 years of age.

MacCall et al. (1985) estimated that Pacific mackerel might sustain average yields of from 26,000-29,000 mt per year under management systems similar to that currently used to manage the stock.

1.4.4 Fishery Utilization

Pacific mackerel in the northeastern Pacific are harvested by commercial fisheries in California and Mexico; some recreational harvest also occurs. Pacific mackerel are sold as fresh fish, canned for human consumption and pet food, and reduced to fish meal and oil. Landings data are given in Table 2.1.1-1.

Pacific mackerel are often taken by anglers, though seldom as a target species (Allen et al. 1990). From 1980-1989, the recreational catch averaged 1,330 mt per year (Wolf 1989).

1.4.5 Current Management

Pacific 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 and 135,000 mt, then a quota equal to 30 percent of the biomass above 18,000 short tons is applied. If the biomass is below 18,000 mt, commercial fishing stops (CDFG Code 1991). The history of Pacific mackerel fishery and management is described in Klingbeil (1983).

TABLE 1.4.3-1. Biomass estimates (1,000 mt) for Pacific mackerel from Parrish and MacCall (1978), MacCall et al. (1985), and unpublished CDFG sources.

Year	Biomass	Year	Biomass
1929	237	1957	55
1930	281	1958	32
1931	365	1959	61
1932	440	1960	71
1933	433	1961	106
1934	370	1962	125
1935	272	1963	99
1936	195	1964	57
1937	174	1965	22
1938	164	Data Not Available 1966-1977	
1939	171	1966	
1940	135	1978	96
1941	120	1979	275
1942	148	1980	330
1943	146	1981	499
1944	122	1982	754
1945	92	1983	710
1946	65	1984	629
1947	38	1985	453
1948	76	1986	458
1949	86	1987	437
1950	59	1988	403
1951	36	1989	310
1952	17	1990	255
1953	29	1991	196
1954	75	1992	87
1955	73	1993	57
1956	93	1994	65

1.5 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.

1.5.1 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 fishes 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 fishes 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 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.

1.5.2 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.

1.5.3 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 fisheries management plan 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 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 fishes in the ecosystem is dominated by the pelagic component. As in the other major eastern boundary currents, anchovy, sardine, whiting, jack mackerel, and Pacific 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 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.

1.5.4 Climate and Distribution of Species

Fishes 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 fishes 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 fishes, 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 fishes 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 fishes 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 and jack mackerels were very abundant in the region during the 1982-1983 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.

1.5.5 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 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 has, however, probably exacerbated the natural variability in recent decades because reduced stock size and loss of old fish, the inescapable results of fishing, 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.

1.6 Marine Mammal Predators

CPS are eaten by a number of marine mammals (Table 1.6-1), 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.

1.6.1 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 percent 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.

1.6.2 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 5,000-7,000 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 percent 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 1956-1968 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 fishes, squids 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 mackerel. Anchovy was the most important prey (43 percent 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 percent 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 (1 percent of the diet) off California. Northern fur seals in Oregon and Washington did not eat jack mackerel.

1.6.3 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 percent a year and currently numbers about 100,000–114,000; the population off western Baja California is stable at 68,000–78,000 (Lowry, in prep.). 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 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 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; Mark Lowry, Southwest Fishery Science Center, NMFS, unpublished data). 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, but the U.S. sea lion population probably consumes a total of 115,000–415,000 mt of forage per year (Lowry, in prep.).

1.6.4 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 percent between 1969 and 1989. Off Alaska, the number of juveniles and adults declined 80 percent between the late 1950s and 1990, and as much as 91 percent 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.

1.6.5 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).

1.6.6 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 mackerel, other small schooling fishes, and squid.

1.6.7 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 percent. There are an estimated 35,000 elephant seals in Mexico, 74,000 in the United States and 109,000 in total (Barlow, in prep.). 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).

1.6.8 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 173-240 (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, in prep.; Forney, in prep.). Bottlenose dolphins in California are not listed as depleted, threatened, or endangered.

The primary prey of coastal bottlenose dolphins in California are fishes 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).

1.6.9 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 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, in prep.; Forney, in prep.). Pacific white-sided dolphins in California are not listed as depleted, threatened or endangered.

Pacific white-sided dolphins primarily eat small schooling fishes and cephalopods from the epipelagic and mesopelagic zones. Northern anchovy appear to be important, but jack mackerel, Pacific mackerel, and sardines are also eaten (Walker et al. 1984).

1.6.10 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 during summer and fall (Barlow, in prep.; Forney, in prep.). 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 fishes in spring and summer (Leatherwood et al. 1982).

1.6.11 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 fishes, especially schooling fishes 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).

1.6.12 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 prep.; Forney, in prep.). 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 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).

1.6.13 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 prep.). 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).

1.6.14 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 prep.; Forney, in prep.). 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).

1.6.15 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 percent 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.

1.6.16 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 prep.; Forney, in prep.). Minke whales in California are not listed as threatened or endangered.

Minke whales prey on krill, copepods, and schooling fishes such as herring, anchovy, and sand lances (Leatherwood et al. 1982; Dorsey et al. 1990).

TABLE 1.6-1. References describing diets of marine mammals that eat northern anchovy, Pacific sardines, Pacific mackerel and jack mackerel.

Marine Mammal	Anchovy	Sardine	Pacific Mackerel	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 1.6-1 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

1.7 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 2-7 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 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; David Ainley, Point Reyes Bird Observatory, unpubl. 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, 1982-1983 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).

1.7.1 CPS as Forage for Seabirds

CPS are consumed by a large number of seabirds off the coasts of California, Oregon, and Washington (Table 1.7.1-1). 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 mackerel are likely to be important to seabirds, especially in southern California. Pacific mackerel have been observed in the 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 1.7.1-1. Seabird species of the West Coast known to forage on anchovies, sardines and Pacific mackerel. Endangered (ES) and threatened species (TS) are indicated.

Seabird		Forage Species		
		Anchovy	Sardine	Pacific
GREBES & LOONS				
Gavia pacifica			*	
Podiceps grisegena			*	
PETRELS & ALBATROSSES				
Diomedea nigripes		*		
Fulmarus glacialis			*	
Puffinus griseus			*	*
Puffinus creatopus			*	
Puffinus tenuirostris			*	
Puffinus opisthomelas			*	
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

Two general groups of West Coast pelagic and midwater fisheries are described in this section. The first is the "inshore component" which has historically been most important in harvesting coastal pelagic species (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 second component consists of fisheries for Pacific whiting and a few species of pelagic and semi-pelagic groundfish off Washington, Oregon, and California, as well as for walleye pollock and other species in the north Pacific. These fisheries' current take of CPS is minimal but may increase in the future.

2.1 Inshore Component

The inshore component includes fisheries for Pacific sardine (*Sardinops sagax*), jack mackerel (*Trachurus symmetricus*), Pacific 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; (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; and (3) industry representatives have asked that squid as well as CPS landings be considered in developing criteria for license limitation.

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 fin fish 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 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 1994, 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 1916-1994 (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 and squid landings have been consistently high in recent years. In contrast, market and biological conditions are contributing to declining landings of anchovy and Pacific 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 percent of all fish landed in the U.S. (Frey 1971). Coast wide landings exceeded 350,000 mt each season from 1933/1934 to 1945/1946; 83-93 percent 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 over fishing 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 percent by weight in mixed loads (primarily jack mackerel, Pacific 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 1986-90; it was increased to 7,394 mt (8,150 short tons) in 1991, 18,597 mt (20,500 short tons) in 1992, 18,145 mt in 1993, 11,000 mt in 1994, and 52,145 mt in 1995. 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 1986-90 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 mackerel (Frey 1971; Mason 1991). The market for jack mackerel was small, since Pacific mackerel was preferred by consumers. In 1947, the industry began marketing jack mackerel as a substitute for Pacific 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 1947-1978, 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 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 is sketchy but 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 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°, which includes southern California's coastal fishery, is not regulated.

2.1.1.3 Pacific Mackerel

Before 1928, Pacific mackerel was taken incidentally with sardines and sold as fresh fish (Frey 1971). As markets developed for canned Pacific mackerel, landings increased to a high of 66,000 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 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 mackerel in mixed loads, and establishing a directed quota. By 1979, with the advent of another strong year class in 1978, Pacific mackerel was contributing more than jack mackerel to the "mackerel" fishery (Klingbeil 1983), a pattern which continues (CDFG 1991b). Pacific 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 percent of the population above 18,144 mt (20,000 short tons) when total biomass is between 18,144 and 136,079 mt (20,000-150,000 short tons) and (2) allow unrestricted harvest when the biomass exceeds 136,079 mt.

Pacific mackerel is also harvested in California's recreational fishery as bait and incidental take and as a target species. During 1981-1994, the recreational harvest of Pacific mackerel in southern California averaged about 1,150 mt (2.6 million fish) per year and accounted for 10-15 percent by weight (13-27 percent by number) of the sport harvest (Table 2.1.1.3-1). Pacific mackerel is also caught by anglers in northern California but in very modest amounts. The statewide sport harvest constitutes a small fraction (2-3 percent by weight) of total combined sport and commercial landings of Pacific mackerel.

There is no directed fishery for mackerel in Oregon or Washington. Small amounts are taken incidentally by commercial jig boats and trawlers (Table 2.1.1.3-2).

2.1.1.4 Northern Anchovy

Anchovy landings, which were relatively low during 1916-1946, 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 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 3,500-7,000 mt per year. Landings for other nonreduction uses (such as dead bait and canned, fresh or frozen products for human consumption) during 1965-94 ranged from about 250 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 (PFMC 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 percent 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 United States and Mexico regarding anchovy management. In the absence of an agreement, the FMP for northern anchovy allocates 70 percent of total OY to the U.S. reduction fishery and 30 percent to Mexican fisheries. Similarly, 70 percent or 4,900 mt of the 7,000 mt quota for nonreduction uses (other than live bait) can be taken in the U.S. EEZ.

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 1950-60, 7,947 mt during 1961-1970, 11,547 mt during 1971-1980, 20,023 mt during 1980-90, and 37,294 mt during 1991-1994 (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 percent during 1970-1985, increased to about 75 percent during 1986-1994 (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 1987-1988 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.

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 2.1.2-10 are based on vessel summaries generated from Washington, Oregon, and California fish ticket data converted to PacFIN (Pacific Coast Fisheries Information Network) 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 2.1.2-10, although they include unspecified net gears as well as round haul gears.

2. The gear category described in Tables 2.1.2-1 through 2.1.2-10 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 1981-1994, 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 1981-1994, 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 1981-1994, 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, Washington or joint venture [JV]) they made most of their landings. On an annual basis, about 50-75 percent 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 1981-1994 on the basis of whether or not their principal gear was round haul, and on where (California, Oregon, Washington or JV) 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 increased significantly from the early to the late 1980s and then declined in the 1990s (Table 2.1.2-3). Two possible reasons for the increase are:

1. Anecdotal information indicates that the fresh market for CPS expanded in the mid to late 1980s, largely in response to demand by California's increasing Asian immigrant population. The expansion of this market, which is serviced by a small-volume directed fishery, may be reflected by an increased number of round haul vessels landing small amounts of CPS/squid.

2. As indicated previously, the PacFIN gear code that includes round haul gear also includes unspecified net gears. Thus, the apparent increase in the number of round haulers landing less than 50 mt of CPS+squid may partially represent an increased number of boats whose principal gear is an unspecified net gear, as well as a true increase in the number of round haulers landing small amounts of CPS/squid.

Landings categories (2) through (4) include round haul vessels that landed at least 50 mt of squid, CPS+squid or CPS annually during 1981-1994. The 40-80 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 1981-1994 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 1981-1994 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 83.9 percent of all vessels that landed any CPS or squid in 1990, but accounted for only 3.9 percent of total CPS landings and 4.7 percent 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 3.1 percent of all vessels that landed any CPS or squid and accounted for 0.2 percent of total CPS landings and 25.3 percent of total squid landings.

3. Category (4) round haulers landed a disproportionate amount of both CPS and squid during 1981-1994. For instance, while these vessels constituted 13.0 percent of all vessels landing any CPS or squid during 1990, they accounted for 95.9 percent of total CPS landings and 70.0 percent of total squid landings during that year.

Tables 2.1.2-5 through 2.1.2-11 describe vessels in landing categories (1) to (4) in terms of selected characteristics. Table 2.1.2-12 summarizes information from tables 2.1.2-5 to 2.1.2-11. The main points are:

1. During 1981-1990, about 75 round haulers fell into landings category (1), 5 into category (2), 10 into category (3) and 50 into category (4). After 1990, the number of round haulers in all categories, but particularly in category (1) declined (Table 2.1.2-5).

2. The median vessel length was 31-40 feet for category (1) vessels, 41-50 feet for categories (2) and (3) vessels, and 51-60 feet for category (4) vessels (Table 2.1.2-5).

3. Vessels in categories (2) and (3) constitute a fairly modern fleet; about 90 percent of these boats were built after 1970. Category (1) vessels include a higher proportion of older boats; about 55 percent of these boats were built after 1970, and about 13 percent were built before 1951. Category (4) vessels fall into two distinctly different age groups; about 50 percent were built before 1951 during the heydey of the sardine fishery, and a little less than 50 percent were built after 1970 (Table 2.1.2-6).

4. Category (1) vessels are dispersed throughout southern and central California (Table 2.1.2-7). The major ports of landing for vessels in categories (2) and (3) are in the Monterey area and, to a lesser extent, in Ventura and Santa Barbara counties. 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.

5. During 1981-1990, category (1) vessels made an average of about 50 fishing trips per vessel year (Table 2.1.2-8), landing about 20 mt of fish (all species, Table 2.1.2-9) with an exvessel value of about $30,000 (Table 2.1.2-10). During 1991-1994, the number of trips by category (1) vessels declined to 9-20 trips per vessel year as average landings per trip declined slightly and average exvessel revenues declined to only about $5,000.

6. During 1981-1994, vessels in categories (2) and (3) exhibited very similar patterns of fishing activity (Tables 2.1.2-8 to 2.1.2-10). Both groups made about 55 fishing trips per vessel year and earned more than about $160,000 per vessel year in revenues. For both groups, squid accounted for over three-fourths of total landings and over 60 percent of total revenues.

7. During 1981-1994, category (4) vessels made an average of about 65 fishing trips per vessel year, landing about 1,500 mt with an exvessel value of $450,000 activity (Tables 2.1.2-8 to 2.1.2-10). CPS accounted for about 75 percent of their landings and 60 percent of their revenues, while squid accounted for abut 15 percent of landings and 10 percent of revenues activity (Tables 2.1.2-9 to 2.1.2-10).

In addition to CPS 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 2.1.2-12). 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 2.1.2-13 describes mean exvessel prices of anchovy, mackerel, sardine, squid, bonito and bluefin tuna caught with round haul gear during 1981-1994. All prices are based on Washington, Oregon, and California fish ticket data converted to PacFIN format.[1/]

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.[2/] 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.

1/ 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.

2/ Live bait harvests are reported on logbooks maintained by bait haulers and not on the fish tickets.

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 1981-1982 is reflected in the low average prices (Table 2.1.2-13) during those years. From 1983 onward, total landings were lower (Table 2.1.1.4-1) but prices were higher (Table 2.1.2-13), 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 2.1.2-13 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 2.1.2-13 are averages for all types of products. The average sardine price, which was $233/mt in 1986 when the moratorium was lifted, declined to $132/mt by 1994.

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 2.1.2-13).

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 2.1.2-9 and 2.1.2-10). 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 $250 to $800/mt and averaged about $420/mt during 1990-1994.

The bluefin price was extraordinarily high ($5,437/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 1990-1994 was about $1,300/mt.

2.1.2.3 Fish Dealers

Tables 2.1.2-14 to 2.1.2-17 provide information on California fish dealers who received any CPS or squid during 1986-1994. These tables are based on dealer summaries generated from California fish ticket data. Several points should be kept in mind in interpreting the tables:

1. Fish sometimes pass through several middlemen 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 data base.

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 from several different ports. Thus each dealer's principal landing area is defined in Tables 2.1.2-14 and 2.1.2-15 as the area from which he received most of his landings.

During 1986-1994, 134 to 155 California dealers purchased CPS or squid from commercial fishing vessels each year (Table 2.1.2-14). Tables 2.1.2-15 to 2.1.2-17 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 1986-1994, about 50 percent of the category (1) dealers received most of their landings in southern California (San Diego to Santa Barbara counties); about 40 percent received most of their landings in central California (San Luis Obispo to San Francisco Bay); and about 5 percent received most of their landings in northern California (Table 2.1.2-15). These dealers received an average of 210 mt of fish (all species) per year, of which about 5 percent consisted of CPS and 5 percent consisted of squid (Table 2.1.2-16). Although these dealers accounted for more than 80 percent of all dealers who received any CPS or squid during the year, they accounted for less than 5 percent of total CPS landings and less than 5 percent of total squid landings made in California (Table 2.1.2-16).

2. During 1986-94, about 40 percent 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 2.1.2-15). These dealers tend to handle higher volumes of raw product and to be much more dependent on squid than category (1) dealers. During 1986-94, they received an average about 2,000 mt of fish (all species) per year, about 5 percent of which was CPS, and about 80 percent squid (Table 2.1.2-16). While categories (2) and (3) made up less than 5 percent of all CPS/squid dealers in California on average, they received about 40 percent of total squid landings in California (Table 2.1.2-17).

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 1986-1994, about 85 percent of the category (4) dealers received most of their landings in southern California, and about 15 percent received most of their landings in central California. These dealers received an average of about 7,000 mt of fish (all species) per year, about 55 percent of which was CPS and about 25 percent squid (Table 2.1.2-16). Although these dealers made up less than 10 percent of dealers receiving any CPS or squid during the year, they accounted for about 95 percent of total CPS landings and about 60 percent of total squid landings in California (Table 2.1.2-17).

2.1.3 Recreational Fisheries

According to the Marine Recreational Fishery Statistics Survey, about 7-10 million marine recreational fishing trips are taken in California each year (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)[3/] and private boats that originate in the United States but fish 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).

3/ CPFV's transport paying passengers to and from the fishing grounds and provide bait, food, beverage service, gear rental, and fish cleaning.

As indicated in Section 2.1.1.3, Pacific mackerel accounts for about 8-12 percent (by weight) of the sport harvest of all species in southern California. In addition, anchovy is the 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 percent of beach trips, 66 percent of pier trips, 84 percent of CPFV trips and 71 percent of private boat trips (Table 2.1.3-2), and is more likely to be used live than dead (at least for 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 percent of the live bait harvest is sold to anglers aboard private boats for $20 per scoop. At 5.67 kg (12.5 lbs) per scoop, the exvessel price for such sales is about $3,500 per mt. 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 12.5-16.0 percent 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 258,700 mt in 1981, fell to 178,000 mt in 1982, and ranged from 79,000 mt to 124,000 mt per year during 1983-1989. Mexican anchovy landings surpassed U.S. landings during 1977-1989 and constituted more than 90 percent of total landings during 1983-1989. 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 closed, although smaller plants remain open. Over fishing, changing environmental conditions and low demand have been cited as reasons for the fishery's demise.

Sardine and Pacific 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.

TABLE 2.1.1-1. Landings of northern anchovy, Pacific sardine, jack mackerel, Pacific mackerel and market squid in California (mt), 1916-1994.

Year	Northern Anchovy	Pacific Sardine	Jack Mackerel	Pacific 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	1,678	73,410
1920	258	53,761	n.a.	n.a.	1,360	231	55,609
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	114,801
1925	42	143,017	n.a.	n.a.	1,590	858	145,507
1926	27	130,065	107	1,638	1,744	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	207,643
1929	174	295,642	317	26,297	26,614	2,114	324,543
1930	145	227,734	167	7,499	7,666	4,976	240,521
1931	140	165,269	255	6,466	6,721	789	172,918
1932	136	191,695	243	5,658	5,901	1,919	199,650
1933	144	284,132	459	31,577	32,035	374	316,685
1934	117	507,997	717	51,641	52,359	694	561,167
1935	81	497,033	4,529	66,419	70,948	370	568,432
1936	89	663,859	2,086	45,606	47,692	429	712,068
1937	103	486,025	2,967	27,641	30,608	228	516,963
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	469,940
1941	1,862	572,657	938	35,456	36,395	649	611,563
1942	769	439,874	2,426	23,838	26,264	428	467,336
1943	713	441,019	5,760	34,117	39,887	4,157	485,766
1944	1765	520,370	5,796	37,947	43,742	4,961	570,838
1945	733	383,318	4,097	24,366	28,463	6,906	419,421
1946	872	231,679	6,846	24,438	31,284	17,248	281,082
1947	8,591	115,900	58,536	21,082	79,619	6,597	210,707
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	404,293
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	19,382	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	57,051	8,838	123,258
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	8,915	79,971
1960	2,295	26,097	33,995	16,696	50,691	1,162	80,244
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	52,854	7,454	68,524
1965	2,601	873	30,240	3,198	33,438	8,446	45,357
1966	28,250	398	18,535	2,100	20,635	8,630	57,914
1967	31,575	68	17,319	529	17,848	8,891	58,381
1968	14,096	56	25,251	1,421	26,672	11,309	52,134
1969	61,362	48	24,459	1,070	25,529	9,426	96,365
1970	87,311	201	21,658	282	21,940	11,154	131,478
1971	40,690	135	27,162	71	27,233	14,296	82,355
1972	62,688	169	23,187	49	23,236	9,144	104,332
1973	120,327	69	9,351	26	9,377	5,471	140,689
1974	75,017	6	11,547	61	11,609	13,111	112,816
1975	143,799	2	16,683	130	16,813	10,715	181,915
1976	113,326	24	20,207	298	20,524	9,211	143,065
1977	10,1131	5	45,508	5,420	50,928	12,811	164,876
1978	11,437	5	31,258	11,376	42,635	17,145	71,221

TABLE 2.1.1-1. Landings of northern anchovy, Pacific sardine, jack mackerel, Pacific mackerel and market squid in California (mt), 1916-1994. (Continued).

Year	Northern Anchovy	Pacific Sardine	Jack Mackerel	Pacific Mackerel	Total Mackerel	Squid	Grand Total
1979	48,881	16	16,602	27,643	44,245	19,982	113,123
1980	42,946	34	20,347	29,615	49,962	15,383	108,325
1981	52,308	28	14,218	38,930	53,149	23,510	128,995
1982	42,061	132	26,408	28,372	54,781	16,285	113,259
1983	4,300	352	18,391	32,552	50,943	1,815	57,410
1984	2,956	235	10,676	42,213	52,889	564	56,643
1985	1,626	592	9,360	34,609	43,969	10,275	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	53,475	19,984	77,000
1988	1,468	3,785	10,323	42,890	53,213	37,231	95,697
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	28,399	71,186
1991	4,252	7,750	1,695	30,957	32,652	37,388	81,466
1992	1,124	16,682	720	19,699	20,419	13,110	51,335
1993	1,959	16,143	1,685	12,392	14,077	42,709	73,821
1994[a/]	1,924	11,354	2,648	9,750	12,398	55,770	81,446

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.
1990-1991 CPS data from E. Konno, CDFG, Long Beach.
1991 squid data from B. Leos, CDFG, Monterey.

TABLE 2.1.1.1-1. West Coast Pacific sardine landings (mt), 1916-1917 through 1967-1968 seasons.

Season	British Columbia	Washington	Oregon	Baja California	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 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), 1981-1994.

Year	Pacific Mackerel		All Species	
	Thousands of Fish	Metric Tons	Thousands of Fish	Metric Tons
1981	3,029	1,272	14,000	8,729
1982	3,550	1,559	16,405	10,476
1983	3,386	1,347	12,533	8,748
1984	3,450	1,228	14,203	9,937
1985	2,587	1,067	13,812	8,294
1986	2,074	1,002	15,571	9,611
1987	3,402	1,279	13,787	9,734
1988	1,890	829	14,153	7,947
1989	1,669	747	10,569	6,375
1990	No Surveys		No Surveys	
1991	No Surveys		No Surveys	
1992	No Surveys		No Surveys	
1993[a/]	1,553	567	8,627	5,493
1994[a/]	2,878	1,297	13,460	8,011

a/ Preliminary data.

Sources: 1981-1986 data from NMFS (1984, 1985a, 1985b, 1987). 1987-1989 data from J. Witzig, NMFS, Silver Spring, Maryland.

TABLE 2.1.1.3-2. Landings of anchovy and mackerel in Oregon and Washington (mt), 1981-1994.

Year	Oregon			Washington		
	Anchovy	Mackerel	Total	Anchovy	Mackerel	Total
1981	0.00	0.01	0.01	1.18	0.00	1.18
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	0.00	10.09
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	35.78	0.00	35.78
1989	0.01	4.74	4.75	61.85	0.00	61.85
1990	0.00	10.24	10.24	50.30	0.14	50.44
1991	0.00	0.00	0.00	54.49	0.00	54.49
1992	0.00	0.00	0.00	41.66	0.00	41.66
1993	0.00	0.00	0.00	44.15	0.00	44.15
1994	0.91	0.00	0.91	65.02	0.00	65.02

Sources: Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, and PacFIN.

TABLE 2.1.1.4-1. Northern anchovy harvest in California, by disposition of catch, and Mexico (mt), 1916-1994.

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), 1916-1994. (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	140,001	157,471
1979	47,408	5,836	53,244	5,364	58,608	204,585	263,193
1980	43,699	5,338	49,037	4,921	56,234	245,797	302,031
1981	51,290	246	51,536	4,698	56,234	258,700	314,934
1982	43,742	1,117	44,859	6,978	51,837	177,587	229,424
1983	2,854	1,446	4,300	4,187	8,487	79,389	87,876
1984	1,722	1,183	2,905	4,397	7,302	101,118	108,420
1985	825	1,184	2,009	3,775	5,784	121,081	126,865
1986	546	1,002	1,548	3,956	5,504	96,417	101,921
1987	149	1,154	1,303	3,572	4,875	124,475	129,350
1988	234	1,234	1,468	4,188	5,656	79,230	84,886
1989	109	2,341	2,450	4,594	7,044	80,823	87,867
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[c/]	0	1,924	1,924	1,923	3,847	876	4,723

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.
1975-1988 Mexican landings from L. Jacobson, NMFS, SWFSC, La Jolla, 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.

TABLE 2.1.1.5-1. California landings of market squid (mt), 1970-1994.

	Southern		Statewide	
Year	Monterey	California	Other	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	12,822	10,686	2	23,510
1982	10,587	5,694	5	16,285
1983	492	862	462	1,815
1984	391	76	97	564
1985	3,812	6,386	77	10,275
1986	5,488	14,958	832	21,277
1987	4,780	14,861	343	19,984
1988	4,834	31,420	386	37,231
1989	7,146	33,743	4	40,893
1990	7,902	20,367	130	28,399
1991	6,703	29,212	1,473	37,388
1992	6,111	4,551	2,448	13,110
1993	6,026	35,655	1,018	42,709
1994[a/]	13,625	39,904	2,241	55,770

a/ Preliminary.
Sources: 1970-1990 data from CDFG 1991a. 1991-1994 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, 1981-1994. Figures may differ from those in Table 2.1.1-1 because of differences between California and PacFIN databases.

Year	RoundHaul	Line	Pot/Trap	Dip Net	Trawl	Gill Net	Other/Unknown	Total
				Northern Anchovy				
1981	52,202.40	22.30	0.10	0.00	0.00	trace	25.00	52,250.00
1982	41,735.30	7.00	0.00	0.10	0.00	0.30	412.70	42,155.40
1983	1,615.20	0.00	0.00	0.00	0.00	trace	2,814.00	4,429.20
1984	2,088.40	trace	0.00	0.00	0.00	0.10	829.10	2,917.60
1985	1,205.20	0.10	0.00	0.00	0.00	0.00	432.20	1,637.50
1986	1,110.80	trace	0.00	trace	0.00	0.00	440.90	1,551.80
1987	1,301.60	0.30	0.00	0.20	trace	0.00	165.30	1,467.30
1988	1,292.90	0.10	0.30	0.30	trace	0.00	224.60	1,518.20
1989	2,264.80	trace	0.20	0.00	0.00	0.00	245.30	2,510.30
1990	2,671.20	23.50	0.20	0.10	0.00	0.00	563.70	3,258.50
1991	2,747.10	24.30	0.00	441.20	106.60	0.00	749.00	4,068.20
1992	1,018.50	4.40	0.00	19.30	0.00	0.00	123.30	1,165.50
1993	2,053.20	41.70	0.00	3.00	0.00	0.00	44.00	2,149.90
1994	1,722.70	14.90	6.60	0.00	0.00	0.00	78.30	1,822.50
				Pacific and Jack Mackerel				
1981	52,970.10	41.70	0.20	9.10	5.80	79.70	46.70	53,153.30
1982	54,728.50	33.20	0.30	44.70	6.30	57.40	771.60	55,642.00
1983	39,029.40	25.30	0.20	0.00	5.80	25.80	12,214.70	51,301.10
1984	45,524.80	144.10	0.00	3.60	2.80	127.00	6,822.60	52,624.90
1985	42,126.10	80.00	0.10	4.30	5.10	77.50	2,233.90	44,527.10
1986	47,723.80	64.70	0.90	21.00	0.20	0.90	4,958.50	52,770.00
1987	47,844.00	27.00	1.00	0.00	1.20	0.10	6,850.10	54,723.30
1988	54,074.30	95.30	1.30	0.20	35.30	0.10	1,665.60	55,872.00
1989	55,425.50	47.80	0.10	8.30	4.70	0.00	2,982.30	58,468.80
1990	40,603.20	61.70	0.20	0.10	12.70	0.00	2,473.10	43,151.00
1991	18,742.70	27.60	25.80	148.90	19.90	41.00	14,725.00	33,730.90
1992	17,018.30	67.60	1.90	1,967.50	787.60	28.10	677.90	20,548.90
1993	9,703.70	51.60	1.70	2,422.70	591.50	29.10	497.40	13,297.70
1994	10,262.20	63.30	0.50	1,477.60	490.10	8.10	380.50	12,682.30
				Pacific Sardine				
1981	14.80	0.00	0.00	0.00	0.00	trace	0.00	14.80
1982	1.80	0.00	0.00	0.00	0.00	0.00	0.00	1.80
1983	0.60	0.00	0.00	0.00	0.00	0.00	trace	0.60
1984	0.50	0.00	0.00	0.00	0.00	trace	0.50	1.00
1985	4.80	0.00	0.00	0.10	0.00	0.00	1.00	5.80
1986	323.90	0.00	0.00	4.00	0.00	trace	60.50	388.40
1987	352.80	0.00	0.00	0.00	0.00	0.00	86.50	439.30
1988	1,094.30	0.00	0.00	0.00	0.00	0.00	52.00	1,146.20
1989	739.90	trace	0.00	0.00	0.00	0.00	6.80	746.80
1990	1,559.20	0.10	0.00	0.10	0.00	0.00	61.10	1,620.40
1991	4,103.50	0.20	0.00	25.50	0.00	0.80	3,457.40	7,587.40
1992	15,231.60	1.10	34.20	1,926.80	3.90	0.00	756.00	17,953.60
1993	11,652.30	6.60	0.00	1,623.30	0.20	0.40	583.20	13,866.00
1994	10,487.10	1.60	33.60	1,164.80	0.00	0.10	245.90	11,933.10
				Market Squid				
1981	15,268.90	9.90	0.00	8,080.10	6.20	0.40	4.60	23,370.00
1982	12,487.90	57.20	0.30	3,579.10	6.50	10.90	183.50	16,325.30
1983	837.60	0.90	0.20	515.00	2.10	1.20	641.30	1,998.30
1984	537.30	0.10	0.30	73.10	3.00	0.40	391.70	1,006.00
1985	7,924.10	29.10	0.50	492.30	15.70	201.90	2,249.70	10,913.40
1986	16,890.60	26.80	5.10	54.20	6.10	0.00	4,305.00	21,287.70
1987	16,590.10	28.30	0.90	213.80	7.80	0.00	3,143.40	19,984.20
1988	31,057.70	515.40	0.10	137.30	6.20	0.00	5,513.40	37,230.10
1989	35,587.30	499.40	0.60	221.60	127.00	0.00	4,500.90	40,936.70
1990	25,846.10	50.10	1.40	0.10	2.20	0.00	2,541.80	28,441.70
1991	32,537.60	38.00	11.50	108.40	0.30	14.10	4,500.90	37,210.80
1992	12,442.60	1.70	0.90	408.30	10.60	0.10	246.20	13,110.40
1993	40,356.70	0.70	1.40	1,083.10	0.20	0.70	1,265.90	42,708.70
1994	45,552.30	84.20	40.70	314.70	16.40	0.00	775.50	46,783.80

a/ Includes unspecified net gears as well as round haul gear.

Source: Washington, Oregon, and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-2. Number of California, Oregon, Washington and joint-venture vessels landing CPS or squid, by principal gear[a/], 1981-1994.

Principal Gear/Year	CPS>0, Squid=0					CPS>0, Squid>0				CPS=0, Squid>0					Grand Total
	CA	OR	WA	JV	Sum	CA	OR	WA	Sum	CA	OR	WA	JV	Sum	
Round Haul[b/]															
1981	41	0	2	0	43	50	0	1	51	10	0	3	0	13	107
1982	51	0	0	0	51	53	0	0	53	8	0	0	0	8	112
1983	53	0	1	0	54	22	1	0	23	5	1	1	0	7	84
1984	96	0	1	0	97	8	1	0	9	1	4	0	0	5	111
1985	126	0	2	0	128	48	0	0	48	11	6	1	0	18	194
1986	105	0	2	0	107	50	0	0	50	8	1	0	0	9	166
1987	104	0	2	0	106	51	0	0	51	11	0	0	0	11	168
1988	82	0	2	0	84	49	0	0	49	25	0	0	0	25	158
1989	80	0	2	0	82	47	0	0	47	17	0	0	0	17	146
1990	81	0	2	0	83	52	0	0	52	15	0	0	0	15	150
1991	97	29	5	0	131	1	0	0	1	6	0	0	0	6	138
1992	285	24	3	0	312	3	0	0	3	6	0	0	0	6	321
1993	142	7	3	0	152	2	0	0	2	8	0	1	0	9	163
1994	124	0	1	0	125	2	0	0	2	6	0	0	0	6	133
Line:															
1981	80	0	0	0	80	4	0	0	4	6	0	0	0	6	90
1982	76	1	0	0	77	2	0	0	2	5	0	0	0	5	84
1983	33	3	0	0	36	2	0	0	2	1	0	1	0	2	40
1984	37	0	0	0	37	0	1	0	1	6	0	0	0	6	44
1985	40	0	0	0	40	3	0	0	3	5	1	0	0	6	49
1986	22	0	0	0	22	1	0	0	1	4	0	0	0	4	27
1987	32	3	0	0	35	1	0	0	1	2	0	0	0	2	38
1988	38	4	1	0	43	2	0	0	2	5	0	0	0	5	50
1989	64	20	0	0	84	0	0	0	0	1	0	0	0	1	86
1990	73	64	5	0	142	2	0	0	2	5	0	0	0	5	149
1991	17	0	2	0	19	36	0	0	36	9	0	0	0	9	64
1992	28	0	1	0	29	25	0	0	25	16	0	0	0	16	70
1993	18	0	1	0	19	42	0	0	42	15	0	0	0	15	76
1994	21	0	0	0	21	43	0	0	43	25	0	0	0	25	89
Pot/Trap:															
1981	8	0	0	0	8	0	0	0	0	2	0	0	0	2	12
1982	4	0	0	0	4	0	0	0	0	2	0	0	0	2	8
1983	5	0	0	0	5	0	0	0	0	5	1	0	0	6	11
1984	8	0	0	0	8	1	0	0	1	3	0	1	0	4	13
1985	8	0	0	0	8	0	0	0	0	2	3	0	0	5	13
1986	7	0	0	0	7	1	0	0	1	1	0	0	0	1	9
1987	12	0	0	0	12	1	0	0	1	5	0	0	0	5	18
1988	5	0	0	0	5	3	0	0	3	1	0	0	0	1	9
1989	10	1	0	0	11	0	0	0	0	3	0	0	0	3	14
1990	8	3	0	0	11	2	0	0	2	1	0	0	0	1	14
1991	27	2	0	0	29	1	0	0	1	1	0	0	0	1	31
1992	29	4	1	0	34	0	0	0	0	4	0	0	0	4	38
1993	23	3	2	0	28	0	0	0	0	4	0	0	0	4	32
1994	1	1	2	0	4	0	0	0	0	1	0	0	0	1	5

TABLE 2.1.2-2. Number of California, Oregon, Washington and joint-venture vessels landing CPS or squid, by principal gear[a/], 1981-1994. (Continued).

Principal Gear/Year	CPS>0, Squid=0					CPS>0, Squid>0				CPS=0, Squid>0					Grand Total
	CA	OR	WA	JV	Sum	CA	OR	WA	Sum	CA	OR	WA	JV	Sum	
Trawl:															
1981	4	1	0	0	5	8	0	0	8	8	1	5	0	14	27
1982	10	0	0	0	10	3	0	0	3	12	3	5	0	20	33
1983	13	6	0	0	19	1	0	0	1	8	7	2	0	17	37
1984	5	1	0	0	6	2	0	0	2	2	6	3	0	11	19
1985	2	0	0	1	3	4	1	0	5	2	2	4	1	9	17
1986	1	0	0	0	1	2	0	0	2	3	2	12	0	17	20
1987	1	1	0	0	2	3	0	0	3	7	0	11	0	18	23
1988	2	1	0	0	3	2	0	0	2	2	0	8	0	10	15
1989	8	1	0	0	9	0	0	0	0	2	2	2	0	6	15
1990	6	2	0	3	11	1	0	0	1	7	1	1	0	9	21
1991	7	4	1	0	12	1	0	0	2	3	1	0	0	4	18
1992	17	18	2	0	37	1	0	0	1	5	0	0	0	5	43
1993	10	16	1	0	27	2	0	0	2	3	0	0	0	3	32
1994	9	35	2	0	36	0	0	0	0	2	0	0	0	2	38
Dip Net:															
1981	0	0	0	0	0	4	0	0	4	35	0	2	0	37	41
1982	1	0	0	0	1	4	0	0	4	26	0	1	0	27	32
1983	0	0	0	0	0	1	0	0	1	11	0	6	0	17	18
1984	0	0	0	0	0	0	0	0	0	1	0	6	0	7	7
1985	0	0	0	0	0	1	0	0	1	14	0	0	0	14	15
1986	1	0	0	0	1	0	0	0	0	6	0	1	0	7	8
1987	0	0	0	0	0	0	0	0	0	4	0	0	0	4	4
1988	0	0	0	0	0	0	0	0	0	3	0	0	0	3	3
1989	0	0	0	0	0	1	0	0	1	1	0	0	0	1	2
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1992	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1
1993	1	0	0	0	1	4	0	0	4	4	0	0	0	4	9
1994	2	0	0	0	2	2	0	0	2	3	0	0	0	3	7
Gill Net:															
1981	48	0	0	0	48	6	0	0	6	5	0	0	0	5	59
1982	46	0	1	0	47	1	0	0	1	3	0	0	0	3	51
1983	48	0	0	0	48	4	0	0	4	14	0	1	0	15	67
1984	13	0	0	0	13	1	0	0	1	0	0	0	0	0	14
1985	3	0	0	0	3	0	0	0	0	0	0	0	0	0	3
1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1988	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1991	61	0	0	0	61	5	0	0	5	3	0	0	0	3	69
1992	39	0	0	0	39	3	0	0	3	4	0	0	0	4	46
1993	42	0	0	0	42	4	0	0	4	0	0	0	0	0	46
1994	13	0	0	0	13	0	0	0	0	0	0	0	0		13
Other/Unknown															
1981	8	0	0	0	8	0	0	0	0	3	0	1	0	4	12
1982	12	0	0	0	12	0	0	0	0	3	0	3	0	6	18
1983	41	0	1	0	42	11	0	0	11	12	0	7	0	19	72
1984	78	0	1	0	79	17	0	0	17	11	0	4	0	15	111
1985	36	0	1	0	37	14	0	0	14	12	0	2	0	14	65
1986	26	0	0	0	26	11	0	0	11	14	1	3	0	18	55
1987	12	0	0	0	12	5	0	0	5	9	0	2	0	11	28
1988	7	0	1	0	8	10	0	0	10	18	0	0	0	18	36
1989	12	0	0	0	12	7	0	0	7	11	0	0	0	11	30
1990	10	0	0	0	10	5	0	0	5	5	0	0	0	5	20
1991	16	0	0	0	16	12	0	0	12	4	0	0	0	4	32
1992	14	1	2	0	17	4	0	0	4	6	0	0	0	6	27
1993	6	2	0	0	8	0	0	0	0	3	1	0	0	4	12
1994	17	2	0	0	19	3	0	0	3	2	0	0	0	2	24

TABLE 2.1.2-2. Number of California, Oregon, Washington and joint-venture vessels landing CPS or squid, by principal gear[a/], 1981-1994. (Continued).

Principal Gear/Year	CPS>0, Squid=0					CPS>0, Squid>0				CPS=0, Squid>0					Grand Total
	CA	OR	WA	JV	Sum	CA	OR	WA	Sum	CA	OR	WA	JV	Sum	
ALL GEARS:															
1981	189	1	2	0	192	72	0	1	73	69	1	11	0	81	346
1982	200	1	1	0	202	63	0	0	63	59	3	9	0	71	336
1983	193	9	2	0	204	41	1	0	42	56	9	18	0	83	329
1984	237	1	2	0	240	29	2	0	31	24	10	14	0	48	319
1985	215	0	3	1	219	70	1	0	71	46	12	7	1	66	356
1986	162	0	2	0	164	65	0	0	65	36	4	16	0	56	285
1987	161	4	2	0	167	61	0	0	61	38	0	13	0	51	279
1988	135	5	4	0	144	66	0	0	66	54	0	8	0	62	272
1989	174	22	2	0	198	55	0	0	55	35	2	2	0	39	292
1990	178	69	7	3	257	62	0	0	62	33	1	1	0	35	354
1991	225	35	8	0	268	56	0	0	57	26	1	0	0	27	352
1992	413	47	9	0	469	36	0	0	36	41	0	0	0	41	546
1993	242	28	7	0	277	54	0	0	54	37	1	1	0	39	370
1994	187	38	5	0	220	50	0	0	50	39	0	0	0	39	309

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, Washington and joint-venture vessels landing CPS or squid, by landing category, 1981-1994.

						Round Haul Vessels[a/]													
	Non-round Haulers					CPS+Squid<50				CPS=0, Squid≥50[b/]			0<CPS<50 CPS+Squid≥50[b/]			CPS≥50[c/]			
Year	CA	OR	WA	JV	Sum	CA	OR	WA	Sum	CA	OR	Sum	CA	OR	Sum	CA	WA	Sum	Grand Total
1981	229	2	8	0	239	22	0	6	28	5	0	5	16	0	16	58	0	58	346
1982	210	4	10	0	224	26	0	0	26	4	0	4	26	0	26	56	0	56	336
1983	210	17	18	0	245	24	1	2	27	1	0	1	2	1	2	53	0	53	329
1984	185	8	15	0	208	58	2	1	61	0	2	2	0	0	0	47	0	47	319
1985	146	7	7	2	162	124	3	3	130	3	3	6	13	0	13	45	0	45	356
1986	100	3	16	0	119	105	1	2	108	2	0	2	9	0	9	47	0	47	285
1987	94	4	13	0	111	104	0	1	105	4	0	4	9	0	9	49	1	50	279
1988	99	5	10	0	114	88	0	2	90	18	0	18	7	0	7	43	0	43	272
1989	120	24	2	0	146	82	0	2	84	11	0	11	6	0	6	45	0	45	292
1990	125	70	6	3	204	91	0	2	93	5	0	5	6	0	6	46	0	46	354
1991	245	36	6	0	287	20	0	1	21	3	0	3	7	0	7	32	1	33	351
1992	421	47	8	0	476	15	0	1	16	11	0	11	8	0	8	35	0	35	546
1993	258	29	7	0	294	18	0	1	19	13	0	13	10	0	10	34	0	34	370
1994	216	38	5	0	259	29	0	0	29	17	0	17	7	0	7	36	0	36	348

a/ Includes vessels whose principal gear is round haul or an unspecified net gear.
b/ No Washington boats in this category in any year.
c/ No Oregon 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, 1981-1994.

			Round Haul Vessels			
Year	Total	Non-Round Haulers	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 Squid≥50	CPS≥50
1981	346	69.1	8.1	1.4	4.6	16.8
1982	336	66.7	7.7	1.2	7.7	16.7
1983	329	74.5	8.2	0.3	0.9	16.1
1984	319	65.3	19.1	0.6	0.3	14.7
1985	356	45.5	36.5	1.7	3.7	12.6
1986	285	41.7	37.9	0.7	3.2	16.5
1987	279	39.9	37.6	1.4	3.2	17.9
1988	272	41.8	33.1	6.7	2.6	15.8
1989	292	49.9	28.8	3.8	2.1	15.4
1990	354	57.6	26.3	1.4	1.7	13.0
1991	352	82.0	6.0	0.9	2.0	9.4
1992	548	87.2	2.9	2.0	1.5	6.4
1993	376	79.8	5.1	3.5	2.7	9.0
1994	348	74.4	8.3	4.9	2.0	10.3
			CPS Landings			
1981	105,418.1	0.1	0.2	0.0	0.1	99.6
1982	97,799.2	0.1	.02	0.0	0.3	99.4
1983	55,730.9	18.2	.06	0.0	0.1	81.1
1984	55,543.5	10.5	.06	0.0	---	88.9
1985	46,170.4	1.8	.07	0.0	0.3	97.2
1986	54,710.2	1.8	.04	0.0	0.2	97.6
1987	56,629.9	1.4	0.3	0.0	0.2	98.1
1988	58,536.4	1.0	0.4	0.0	0.1	98.5
1989	61,725.9	3.7	0.5	0.0	0.1	95.7
1990	48,029.9	3.2	0.7	0.0	0.2	95.9
1991	45,386.5	46.9	0.5	0.0	0.3	52.4
1992	39,668.0	4.3	0.4	0.0	0.4	94.9
1993	29,305.5	3.8	0.5	0.0	0.5	95.2
1994	26,437.3	14.5	0.7	0.0	0.3	84.5
			Squid Landings			
1981	23,370.0	31.3	0.6	5.9	28.5	33.7
1982	16,325.3	22.2	0.7	4.7	45.8	26.6
1983	1,998.3	54.1	5.8	7.6	6.2	26.3
1984	1,006.0	48.1	5.5	17.5	13.3	15.6
1985	10,913.4	16.6	2.1	8.0	16.7	56.6
1986	21,287.7	7.4	0.4	2.1	11.9	78.1
1987	19,984.2	8.8	0.6	7.6	15.4	67.6
1988	37,230.1	9.3	0.6	20.5	3.0	66.6
1989	40,936.7	7.4	0.5	29.1	6.4	56.6
1990	28,441.7	4.2	0.5	14.9	10.4	70.0
1991	37,211.0	13.0	0.6	9.0	13.8	63.7
1992	13,110.2	8.8	0.6	32.5	14.2	43.9
1993	42,708.8	7.7	0.2	29.2	10.3	52.7
1994	46,783.8	1.7	0.5	21.3	16.2	60.4

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 vessel length, 1981-1994.

Fishing Year/ Vessel Length	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 Squid≥50	CPS≥50	Total
1981					
11-20'	5	0	0	0	5
21-30'	8	0	1	0	9
31-40'	11	1	7	6	25
41-50'	3	4	8	18	33
51-60'	1	0	0	7	8
61-70'	0	0	0	12	12
71-80'	0	0	0	13	13
>80'	0	0	0	2	2
Total	28	5	16	58	107
1982					
11-20'	3	0	0	0	3
21-30'	8	0	1	0	9
31-40'	8	2	11	6	27
41-50'	4	0	14	16	36
51-60'	1	0	0	7	8
61-70'	1	0	0	12	13
71-80'	0	0	0	14	14
>80'	0	0	0	1	1
Unknown	1	0	0	0	1
Total	26	2	26	56	112
1983					
11-20'	0	0	0	0	0
21-30'	1	0	0	0	1
31-40'	11	0	1	7	19
41-50'	9	1	2	13	25
51-60'	5	0	0	7	12
61-70'	0	0	0	13	13
71-80'	0	0	0	12	12
>80'	1	0	0	1	2
Total	27	1	3	53	84
1984					
11-20'	4	0	0	0	4
21-30'	20	0	0	0	20
31-40'	24	1	0	4	29
41-50'	9	1	0	14	24
51-60'	4	0	1	5	10
61-70'	0	0	0	11	11
71-80'	0	0	0	12	12
>80'	0	0	0	1	1
Total	61	2	1	47	111
1985					
11-20'	8	0	0	0	8
21-30'	48	0	0	1	49
31-40'	54	0	4	3	61
41-50'	16	2	9	12	39

TABLE 2.1.2-5. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by vessel length, 1981-1994. (Continued).

Fishing Year/ Vessel Length	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 Squid≥50	CPS≥50	Total
71-80'	1	0	0	11	12
>80'	0	0	0	1	1
Total	130	6	13	45	194
1986					
11-20'	5	0	0	0	5
21-30'	44	0	0	1	45
31-40'	45	0	1	5	51
41-50'	8	1	7	12	28
51-60'	4	0	1	9	14
61-70'	0	1	0	9	10
71-80'	2	0	0	10	12
>80'	0	0	0	1	1
Total	108	2	9	47	166
1987					
11-20'	2	0	0	0	2
21-30'	39	0	1	2	42
31-40'	47	0	2	2	51
41-50'	12	3	5	15	35
51-60'	3	1	1	10	15
61-70'	2	0	0	10	12
71-80'	0	0	0	10	10
>80'	0	0	0	1	1
Total	105	4	9	50	168
1988					
11-20'	2	0	0	0	2
21-30'	31	1	1	1	34
31-40'	36	3	3	1	43
41-50'	17	10	2	13	42
51-60'	4	2	1	10	17
61-70'	0	1	0	7	8
71-80'	0	1	0	10	11
>80'	0	0	0	1	1
Total	90	18	7	43	158
1989					
11-20'	5	0	0	0	5
21-30'	26	0	0	1	27
31-40'	38	1	1	6	46
41-50'	9	6	4	10	29
51-60'	5	2	1	10	18
61-70'	1	1	0	8	10
71-80'	0	1	0	9	10
>80'	0	0	0	1	1
Total	84	11	6	45	146
1990					
11-20'	3	0	0	0	3
21-30'	30	0	0	0	30
31-40'	38	0	0	4	42
>80'	0	0	0	1	1
Total	93	5	6	46	150

TABLE 2.1.2-5. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by vessel length, 1981-1994. (Continued).

Fishing Year/ Vessel Length	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 Squid≥50	CPS≥50	Total
1991					
11-20'	5	0	0	0	5
21-30'	4	0	0	0	4
31-40'	1	0	1	0	2
41-50'	5	1	1	4	11
51-60'	4	2	3	17	26
61-70'	1	0	2	3	6
71-80'	0	0	0	6	6
>80'	1	0	0	3	4
Total	21	3	7	33	64
1992					
11-20'	6	0	0	0	6
21-30'	1	0	0	0	1
31-40'	1	1	1	0	3
41-50'	1	3	3	2	9
51-60'	6	6	4	11	27
61-70'	1	1	0	4	6
71-80'	0	0	0	13	13
>80'	0	0	0	5	5
Total	16	11	8	35	70
1993					
11-20'	0	0	0	0	0
21-30'	5	0	0	0	5
31-40'	4	0	2	1	7
41-50'	5	3	3	3	14
51-60'	3	8	3	12	26
61-70'	1	2	2	3	8
71-80'	1	0	0	12	13
>80'	0	0	0	3	3
Total	19	13	10	34	76
1994					
11-20'	0	0	0	0	0
21-30'	2	0	0	0	2
31-40'	1	1	0	0	2
41-50'	3	3	0	2	8
51-60'	2	6	1	11	20
61-70'	0	0	2	2	4
71-80'	0	0	1	4	5
>80'	0	0	0	1	1
Total	8	10	4	20	42

a/ Vessels whose principal gear is round haul or an unspecified net gear.

TABLE 2.1.2-6. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by vessel length, 1981-1990. Data not available for later years.

Fishing Year/ Year Built	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 Squid≥50	CPS>50	Total
1981					
<1930	1	0	2	1	4
1931-1940	0	0	3	16	19
1941-1950	2	0	5	17	24
1951-1960	3	1	0	4	8
1961-1970	2	2	0	6	10
1971-1980	6	2	4	12	24
1981-1990	0	0	0	0	0
Unknown	14	0	2	2	18
Total	28	5	16	58	107
1982					
<1930	1	0	2	2	5
1931-1940	1	1	2	16	20
1941-1950	3	2	8	13	26
1951-1960	4	0	2	3	9
1961-1970	1	1	2	7	11
1971-1980	3	0	8	13	24
1981-1990	1	0	1	2	4
Unknown	12	0	1	0	13
Total	26	4	26	56	112
1983					
<1930	1	0	0	1	2
1931-1940	1	0	1	15	17
1941-1950	5	0	0	16	21
1951-1960	4	0	0	2	6
1961-1970	4	1	0	4	9
1971-1980	7	0	2	7	16
1981-1990	2	0	0	3	5
Unknown	3	0	0	5	8
Total	27	1	3	53	84
1984					
<1930	3	0	0	1	4
1931-1940	0	0	0	15	15
1941-1950	7	0	0	13	20
1951-1960	4	0	0	2	6
1961-1970	7	0	0	1	8
1971-1980	18	2	1	10	31
1981-1990	2	0	0	2	4
Unknown	20	0	0	3	23
Total	61	2	1	47	111

TABLE 2.1.2-6. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by vessel length, 1981-1990. Data not available for later years. (Continued).

Fishing Year/ Year Built	CPS+Squid<50	CPS=0 Squid≥50	0<CPS>50 Squid≥50	CPS≥50	Total
1985					
<1930	3	0	0	1	4
1931-1940	2	0	1	13	16
1941-1950	11	0	3	12	26
1951-1960	11	1	0	1	13
1961-1970	12	0	1	2	15
1971-1980	30	4	5	11	50
1981-1990	1	0	1	1	3
Unknown	60	1	2	4	67
Total	130	6	13	45	194
1986					
<1930	3	0	0	1	4
1931-1940	0	0	0	12	12
1941-1950	9	0	2	12	23
1951-1960	9	1	0	2	12
1961-1970	6	0	1	3	10
1971-1980	23	1	6	11	41
1981-1990	0	0	0	1	1
Unknown	58	0	0	5	63
Total	108	2	9	47	166
1987					
<1930	5	0	0	1	6
1931-1940	1	0	0	12	13
1941-1950	8	0	3	9	20
1951-1960	7	0	0	1	8
1961-1970	5	0	0	3	8
1971-1980	25	3	5	14	47
1981-1990	0	0	0	2	2
Unknown	54	1	1	8	64
Total	105	4	9	50	168
1988					
<1930	0	0	0	1	1
1931-1940	3	1	0	8	12
1941-1950	5	4	2	8	19
1951-1960	5	0	0	1	6
1961-1970	10	0	0	2	12
1971-1980	26	10	1	12	49
1981-1990	3	1	1	9	14
Unknown	38	2	3	2	45
Total	90	18	7	43	158

TABLE 2.1.2-6. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by vessel length, 1981-1990. Data not available for later years. (Continued).

Fishing Year/ Year Built	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 Squid≥50	CPS≥50	Total
1989					
<1930	0	0	0	1	1
1931-1940	2	1	1	8	12
1941-1950	5	3	0	9	17
1951-1960	8	0	0	1	9
1961-1970	8	0	1	2	11
1971-1980	15	6	4	9	34
1981-1990	3	1	0	12	16
Unknown	43	0	0	3	46
Total	84	11	6	45	146
1990					
<1930	0	0	0	1	1
1931-1940	1	0	0	10	11
1941-1950	6	0	1	11	18
1951-1960	9	0	0	0	9
1961-1970	9	0	0	1	10
1971-1980	22	4	4	10	40
1981-1990	8	1	1	11	21
Unknown	38	0	0	2	40
Total	93	5	6	46	150

a/ 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 2.1.2-7. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal fishing area, 1981-1994.

Fishing Year and Principal Fishing 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	5	2	0	40	47
Vent/SBarb	2	0	0	5	7
SanLuisObispo	1	0	0	0	1
Monterey/StaCruz	13	3	16	11	43
SanFran Bay Area	0	0	0	2	2
Oregon	0	0	0	0	0
Washington	6	0	0	0	6
Total	28	5	16	58	107
1982					
San Diego	1	0	0	0	1
Orange/LA	8	0	0	42	50
Vent/SBarb	2	1	0	6	9
SanLuisObispo	2	0	0	0	2
Monterey/StaCruz	11	3	26	7	47
SanFran Bay Area	2	0	0	1	3
Oregon	0	0	0	0	0
Washington	0	0	0	0	0
Total	26	4	26	56	112
1983					
San Diego	1	0	0	0	1
Orange/LA	10	0	0	42	52
Vent/SBarb	4	0	0	1	5
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	3	1	0	8	12
SanFran Bay Area	6	0	2	2	10
Oregon	1	0	1	0	2
Washington	2	0	0	0	2
Total	27	1	3	53	84
1984					
San Diego	15	0	0	0	15
Orange/LA	28	0	0	37	65
Vent/SBarb	13	0	0	1	14
SanLuisObispo	2	0	0	0	2
Monterey/StaCruz	0	0	0	9	9
SanFran Bay Area	0	0	0	0	0
Oregon	2	2	1	0	5
Washington	1	0	0	0	1
Total	61	2	1	47	111

TABLE 2.1.2-7. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal fishing area, 1981-1994. (Continued).

Fishing Year and Principal Fishing Area	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 Squid≥50	CPS≥50	Total
1985					
San Diego	17	0	0	0	17
Orange/LA	48	1	0	33	82
Vent/SBarb	19	1	0	4	24
SanLuisObispo	6	0	0	0	6
Monterey/StaCruz	23	0	13	8	44
SanFran Bay Area	11	1	0	0	12
Oregon	3	3	0	0	6
Washington	3	0	0	0	3
Total	130	6	13	45	194
1986					
San Diego	16	0	0	0	16
Orange/LA	34	0	1	32	67
Vent/SBarb	14	1	0	7	22
SanLuisObispo	4	0	0	0	4
Monterey/StaCruz	17	1	7	8	33
SanFran Bay Area	20	0	1	0	21
Oregon	1	0	0	0	1
Washington	2	0	0	0	2
Total	108	2	9	47	166
1987					
San Diego	12	0	0	0	12
Orange/LA	34	0	1	35	70
Vent/SBarb	20	2	2	7	31
SanLuisObispo	3	0	0	0	3
Monterey/StaCruz	14	2	5	6	27
SanFran Bay Area	21	0	1	1	23
Oregon	0	0	0	0	0
Washington	1	0	0	1	2
Total	105	4	9	50	168
1988					
San Diego	13	0	0	0	13
Orange/LA	40	2	0	31	73
Vent/SBarb	13	9	2	8	32
SanLuisObispo	1	0	0	0	1
Monterey/StaCruz	9	6	5	3	23
SanFran Bay Area	12	1	0	1	14
Oregon	0	0	0	0	0
Washington	2	0	0	0	2
Total	90	18	7	43	158

TABLE 2.1.2-7. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal fishing area, 1981-1994. (Continued).

Fishing Year and Principal Fishing Area	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 Squid≥50	CPS≥50	Total
1989					
San Diego	12	0	0	0	12
Orange/LA	37	1	0	31	69
Vent/SBarb	10	5	1	7	23
SanLuisObispo	1	0	0	0	1
Monterey/StaCruz	9	5	5	6	25
SanFran Bay Area	13	0	0	1	14
Oregon	0	0	0	0	0
Washington	2	0	0	0	2
Total	84	11	6	45	146
1990					
San Diego	17	0	0	0	17
Orange/LA	35	0	0	28	63
Vent/SBarb	11	1	2	6	20
SanLuisObispo	3	0	0	0	3
Monterey/StaCruz	13	4	4	11	32
SanFran Bay Area	12	0	0	1	13
Oregon	0	0	0	0	0
Washington	2	0	0	0	2
Total	93	5	6	46	150
1991					
San Diego	3	0	0	2	5
Orange/LA	6	0	0	17	23
Vent/SBarb	6	1	4	7	18
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	5	0	3	6	14
SanFran Bay Area	0	2	0	0	2
Oregon	0	0	0	0	0
Washington	1	0	0	1	2
Total	21	3	7	33	64
1992					
San Diego	2	0	0	1	3
Orange/LA	6	0	0	29	35
Vent/SBarb	3	1	0	0	4
SanLuisObispo	0	0	0	0	0
Monterey/StaCruz	3	5	6	4	18
SanFran Bay Area	1	5	2	1	9
Oregon	0	0	0	0	0
Washington	1	0	0	0	1
Total	16	11	8	35	70

TABLE 2.1.2-7. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal fishing area, 1981-1994. (Continued).

Fishing Year and Principal Fishing 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	7	0	1	23	31
Vent/SBarb	3	6	2	6	17
SanLuisObispo	1	2	0	0	3
Monterey/StaCruz	3	5	7	4	19
SanFran Bay Area	2	0	0	1	3
Oregon	0	0	0	0	0
Washington	1	0	0	0	1
Total	18	13	10	34	75
1994					
San Diego	1	0	0	0	1
Orange/LA	8	1	1	18	28
Vent/SBarb	8	7	2	9	26
SanLuisObispo	1	0	0	0	1
Monterey/StaCruz	11	9	3	6	29
SanFran Bay Area	0	0	1	3	4
Oregon	0	0	0	0	0
Washington	0	0	0	0	0
Total	29	17	7	36	89

a/ Vessels whose principal gear is round haul or an unspecified net gear.

Principal fishing 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 2.1.2-8. Average number of trips made by Washington, Oregon, and California round haul vessels[a/] landing CPS or squid, and proportion of trips including CPS or squid, 1981-1994.

	CPS+Squid<50				CPS=0, Squid≥50			
Year	Number of Trips	Percent CPS	Percent Squid	Percent CPS + Squid	Number of Trips	Percent CPS	Percent Squid	Percent CPS + Squid
1981	18.8	27.10%	17.1%	43.0%	53.0	0%	87.2%	87.2%
1982	23.2	19.10%	9.3%	27.9%	49.0	0%	72.4%	72.4%
1983	24.0	32.50%	9.9%	42.1%	102.0	0%	12.7%	12.7%
1984	63.7	13.00%	0.2%	13.2%	35.0	0%	41.4%	41.4%
1985	59.1	14.90%	1.0%	15.8%	40.2	0%	33.2%	33.2%
1986	64.5	13.90%	0.9%	14.7%	63.5	0%	45.7%	45.7%
1987	54.7	12.30%	1.4%	13.6%	37.3	0%	67.1%	67.1%
1988	54.5	14.00%	1.0%	14.9%	38.6	0%	66.2%	66.2%
1989	56.9	17.70%	0.9%	18.6%	57.1	0%	82.3%	82.3%
1990	52.9	20.60%	1.0%	21.5%	67.4	0%	88.4%	88.4%
1991	15.3	52.50%	12.1%	63.7%	53.3	0%	73.1%	73.1%
1992	9.0	66.70%	14.6%	81.3%	38.9	0%	81.5%	81.5%
1993	11.7	65.80%	17.1%	80.1%	61.2	0%	90.2%	90.2%
1994	18.0	43.90%	9.5%	52.3%	63.8	0%	99.3%	99.3%

	0<CPS<50, CPS+Squid≥50				CPS>50			
Year	Number of Trips	Percent CPS	Percent Squid	Percent CPS + Squid	Number of Trips	Percent CPS	Percent Squid	Percent CPS + Squid
1981	88.4	3.5%	84.1%	86.4%	83.3	70.1%	17.8%	88.0%
1982	67.8	6.8%	78.2%	82.0%	74.0	84.5%	9.6%	93.3%
1983	46.7	16.4%	26.4%	41.4%	51.8	80.0%	3.2%	82.6%
1984	48.0	2.1%	41.7%	43.8%	50.3	78.1%	2.5%	80.4%
1985	46.9	6.1%	57.5%	60.6%	51.8	70.0%	17.6%	86.0%
1986	62.8	14.0%	66.4%	77.7%	66.0	61.8%	29.1%	88.4%
1987	61.7	8.1%	63.0%	68.8%	65.2	67.2%	20.2%	86.7%
1988	51.7	7.5%	55.3%	59.1%	75.6	58.5%	31.9%	88.7%
1989	66.7	3.8%	72.0%	74.5%	75.3	61.5%	27.7%	87.1%
1990	36.8	5.0%	69.2%	72.4%	63.3	58.3%	29.2%	86.3%
1991	65.9	5.9%	83.1%	87.9%	61.3	48.8%	47.3%	93.8%
1992	56.4	10.4%	81.8%	90.9%	50.7	77.9%	14.1%	91.4%
1993	46.3	8.0%	84.4%	91.4%	77.7	54.7%	41.1%	95.1%
1994	91.3	1.8%	98.3%	99.1%	79.1	47.3%	48.1%	93.4%

%CPS and %Squid do not necessarily sum to the percentage of trips on which CPS or squid were landed (%CPS+Sqd), since both CPS and squid are sometimes (though infrequently) landed on a single trip.

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 2.1.2-9. Average landings (mt) by Washington, Oregon, and California round haul vessels[a/] landing CPS or squid, by species, 1981-1994.

Year	Anchovy	Mackerel	Sardine	Squid	Herring	Bonito	Tuna	All Else	Total
CPS+Squid<50 mt:									
1981	3.1	2.7	0.0	4.8	4.6	0.1	trace	1.0	16.3
1982	2.5	3.8	trace	4.1	1.8	0.2	0.9	1.9	15.2
1983	3.4	8.7	0.0	4.3	18.9	0.3	0.4	5.4	41.4
1984	3.2	2.2	0.0	0.9	0.7	0.2	1.1	8.6	16.9
1985	1.2	1.4	0.0	1.8	1.2	0.2	0.8	16.2	22.8
1986	0.9	1.2	trace	0.8	2.1	0.3	0.1	15.8	21.2
1987	0.9	0.8	trace	1.1	1.5	0.5	0.2	13.6	18.6
1988	1.2	1.6	0.1	2.3	2.3	0.4	0.6	11.0	19.5
1989	3.1	0.8	trace	2.4	1.9	0.1	0.1	9.3	17.7
1990	2.2	1.4	trace	1.6	2.3	0.4	0.2	10.1	18.2
1991	9.8	0.1	trace	9.8	trace	0.0	0.0	0.4	20.3
1992	6.9	2.1	1.4	5.2	0.0	trace	trace	0.1	15.8
1993	4.1	2.5	1.9	4.3	2.8	trace	0.0	1.0	16.6
1994	1.5	2.1	2.7	7.5	trace	trace	0.5	0.5	14.8
CPS=0, Squid≥50 mt:									
1981	0.0	0.0	0.0	275.6	9.8	0.0	16.4	2.2	304.0
1982	0.0	0.0	0.0	192.4	10.2	0.0	5.9	15.4	223.9
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	87.2	21.0	0.0	0.8	34.4	143.4
1985	0.0	0.0	0.0	144.8	10.4	trace	6.1	68.7	230.0
1986	0.0	0.0	0.0	227.1	13.8	0.0	0.1	11.9	252.9
1987	0.0	0.0	0.0	381.6	32.9	5.4	0.0	13.5	433.4
1988	0.0	0.0	0.0	423.3	26.4	0.0	2.7	13.5	465.9
1989	0.0	0.0	0.0	1081.7	41.5	0.0	5.8	7.4	1,136.4
1990	0.0	0.0	0.0	848.3	36.0	0.0	0.0	1.0	885.3
1991	0.0	0.0	0.0	1111.0	62.3	0.0	0.0	6.3	1,179.6
1992	0.0	0.0	0.0	387.9	40.4	0.0	0.0	1.9	430.2
1993	0.0	0.0	0.0	957.8	12.3	0.0	0.3	11.8	982.2
1994	0.0	0.0	0.0	585.9	0.0	trace	0.0	5.6	591.5
0<CPS<50 mt,squid≥50 mt: CPS+Squid									
1981	0.1	7.6	0.0	416.9	29.4	0.0	1.6	5.0	460.6
1982	0.6	10.3	0.0	287.5	40.6	0.0	trace	7.0	346.0
1983	6.2	15.9	0.0	41.6	49.4	trace	0.9	14.6	128.6
1984	0.3	0.0	0.0	133.5	0.0	0.0	7.0	57.8	198.6
1985	3.0	5.9	0.0	140.6	34.5	0.0	0.3	12.9	197.2
1986	6.8	5.8	0.0	280.6	27.2	0.0	0.0	10.6	331.3
1987	1.1	10.6	0.3	341.5	42.4	0.1	0.0	10.8	406.8
1988	1.8	10.2	0.4	157.0	33.0	0.0	0.1	3.6	206.1
1989	6.6	8.4	0.0	439.9	32.3	trace	0.5	4.3	492.0
1990	0.0	19.5	0.2	491.7	0.0	0.9	3.6	12.9	528.8
1991	3.5	7.0	6.3	773.4	22.9	0.0	trace	6.0	779.1
1992	6.9	6.4	4.6	232.8	38.5	0.0	0.0	0.4	289.4
1993	1.7	5.8	6.8	440.9	11.5	0.0	0.0	1.9	468.6
1994	0.0	4.5	7.3	1083.5	0.0	12.2	1.9	2.1	1,111.5

TABLE 2.1.2-9. Average landings (mt) by Washington, Oregon, and California round haul vessels[a/] landing CPS or squid, by species, 1981-1994. (Continued).

Year	Anchovy	Mackerel	Sardine	Squid	Herring	Bonito	Tuna	All Else	Total
CPS>50 mt:									
1981	899.4	909.8	0.3	135.9	12.6	94.1	33.9	1.6	2,087.6
1982	751.2	984.7	trace	77.5	15.1	43.0	29.5	2.4	1,903.4
1983	21.7	831.2	trace	9.9	11.9	61.8	43.5	3.2	983.2
1984	43.8	1006.3	trace	3.3	5.5	55.4	94.9	9.4	1,218.6
1985	26.1	970.8	0.1	137.3	9.3	60.8	43.1	2.6	1,249.3
1986	19.7	1109.8	7.0	354.0	8.8	4.3	82.5	2.0	1,587.2
1987	25.6	1078.0	7.7	270.2	10.4	85.7	27.4	4.5	1,509.7
1988	30.4	1284.5	26.1	576.5	10.2	89.9	33.4	4.4	2,054.2
1989	47.0	1249.5	15.6	514.5	12.1	22.1	22.7	3.1	1,886.7
1990	64.6	901.9	35.1	432.9	18.6	85.1	30.6	3.2	1,570.3
1991	77.9	519.7	122.5	718.6	14.6	1.6	2.5	9.3	1,466.7
1992	21.0	549.4	504.9	164.3	4.9	29.6	44.0	0.8	1,318.8
1993	59.1	362.0	399.1	661.5	6.4	9.0	35.8	3.0	1,535.9
1994	47.4	284.1	288.9	784.7	1.1	11.1	78.0	4.1	1,499.3
All Round Haul Vessels:									
1981	488.3	495.0	0.1	150.1	12.9	51.0	19.4	2.1	1,218.9
1982	376.3	495.6	trace	113.3	17.8	21.5	15.2	3.8	1,043.5
1983	15.0	527.8	trace	10.9	15.4	39.1	27.6	4.3	640.1
1984	20.3	427.3	trace	4.7	3.1	23.5	40.8	10.0	529.7
1985	7.0	226.5	trace	46.9	5.6	14.2	10.8	14.4	325.4
1986	6.5	313.4	2.0	118.0	5.5	1.4	23.3	11.2	481.3
1987	8.3	321.9	2.3	108.5	7.1	25.9	8.3	10.8	493.1
1988	9.0	350.9	7.1	213.4	8.6	24.7	9.7	8.9	632.3
1989	16.5	385.9	4.8	259.5	9.3	6.9	7.5	7.1	69.5
1990	21.2	278.2	10.8	181.7	8.3	26.4	9.6	7.3	543.5
1991	43.8	268.8	63.8	506.1	13.0	0.8	1.3	5.9	903.4
1992	12.9	275.9	253.3	170.9	13.2	14.8	22.0	0.8	763.7
1993	27.7	163.3	179.9	518.8	7.2	4.0	16.0	3.9	920.9
1994	19.6	116.0	118.3	517.0	0.4	5.4	31.8	3.1	811.7

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 2.1.2-10. Average exvessel revenues ($1,000s; base year=1989) by Washington, Oregon, and California round haul vessels[a/] landing CPS or squid, by species, 1981-1994.

Year	Anchovy	Mackerel	Sardine	Squid	Herring	Bonito	Tuna	All Else	Total
CPS+Squid < 50 mt:									
1981	1.1	0.9	0	2.1	3.6	0.1	trace	2.4	10.2
1982	0.9	1	0	2.6	2.7	0.1	2.5	4.4	14.2
1983	1.3	2	0	2.5	25.6	0.4	0.7	15.7	48.2
1984	1.1	0.8	0	0.3	0.2	0.1	1.9	30	34.4
1985	0.5	0.7	0	0.9	3.2	0.1	1.3	32.5	39.2
1986	0.5	0.3	0	0.2	1	0.2	0.3	32.7	35.2
1987	0.4	0.2	trace	0.4	0.8	0.3	0.5	28.7	31.3
1988	0.6	0.5	trace	0.5	1.3	0.2	1.3	24.1	28.5
1989	2.5	0.2	0	0.5	1.4	0.1	0.2	19.8	24.7
1990	1.1	0.4	trace	0.3	2.4	0.3	0.4	22.2	27.1
1991	2.5	trace	trace	1.7	0.1	0	0	0.8	5.2
1992	2	0.3	0.1	1	0	trace	trace	0.3	3.7
1993	1.5	0.7	0.2	1.1	0.5	trace	0	1.6	5.6
1994	0.4	0.6	0.3	2.8	trace	trace	1.2	1	6.4
CPS=0, Squid≥50 mt:									
1981	0	0	0	62.9	12.8	0	42.9	9.4	128.0
1982	0	0	0	42.5	18.2	0	11.5	2.2	80.2
1983	0	0	0	81.5	0	0	2.7	32.7	116.9
1984	0	0	0	45.8	13.5	0	1	68.4	128.7
1985	0	0	0	62.6	11.7	trace	8.3	145.1	227.7
1986	0	0	0	89.4	9	0	0.1	12.7	111.2
1987	0	0	0	89.3	19.7	3.4	0	26.3	153.4
1988	0	0	0	87.1	7.4	0	5.2	24.7	125.6
1989	0	0	0	243.6	8.3	0	9.9	5.7	269.2
1990	0	0	0	241.9	23.2	0	0	3.6	267.3
1991	0	0	0	209.4	31.6	0	0	17	258.0
1992	0	0	0	67.4	34.6	0	0	2.6	104.6
1993	0	0	0	204.7	2.8	0	0.3	22.1	230.1
1994	0	0	0	193.5	1.1	trace	0	49.3	243.9
0<CPS<50 mt, CPS+Squid≥50 mt:									
1981	trace	1.7	0	162.1	31.3	0	4.1	3.3	202.0
1982	0.1	2.6	0	100.4	30.5	0	0.1	11.3	139.5
1983	1.3	5	0	24.8	70.5	trace	1.3	0.1	136.4
1984	0.1	0	0	75.3	0	0	9	297.3	381.7
1985	0.7	1.2	0	74.7	36.5	0	0.4	24	128.9
1986	1.5	1.3	0.1	81.2	17.3	0	0	28.7	119.2
1987	0.2	2.8	0.1	86.1	26.5	trace	0	33.1	146.3
1988	0.6	18.9	0.1	94.1	11.6	0	2.1	2.7	132.4
1989	1.1	1.4	trace	95.1	13.4	trace	0.7	2	123.7
1990	0	4.7	trace	90	0	0.4	10.3	11	125.6
1991	0.5	1	0.7	111	11.8	0	0.1	5.8	130.8
1992	0.8	0.9	0.4	45.1	33.4	0	0	0.5	80.8
1993	0.4	1.3	0.6	97.9	1.6	0	0	0.6	102.3
1994	0	0.6	0.7	296.9	0	5.2	1.5	0.5	305.3

TABLE 2.1.2-10. Average exvessel revenues ($1,000s; base year=1989) by Washington, Oregon, and California round haul vessels[a/] landing CPS or squid, by species, 1981-1994. (Continued).

Year	Anchovy	Mackerel	Sardine	Squid	Herring	Bonito	Tuna	All Else	Total
CPS>50 mt:									
1981	78.4	259.8	0.1	44.4	7.2	76.2	64.6	2.5	533.2
1982	46.1	260.2	trace	18.6	6.7	24.7	45.9	1.7	403.9
1983	4.6	200.4	0	4.9	16.7	29	61.3	4.8	321.7
1984	3.7	225.9	trace	2	2.1	18.9	141.3	5.6	399.5
1985	8.5	198.7	trace	46.6	7.1	14.7	48.6	3.7	327.9
1986	2.8	263.3	1.6	89.7	6.5	1.2	172.6	3.8	541.5
1987	6	282.9	1.2	62.6	7	50.6	97.7	6.7	514.7
1988	8.2	227	4.1	123.6	4.5	42.5	144.5	5.9	560.3
1989	8.5	207.7	6.4	91.2	4.2	8.9	83.8	8.2	418.9
1990	27.3	189.5	4.6	69.6	11.2	39.4	62.7	13.8	418.1
1991	10.4	89.9	14.5	105.6	7.4	0.7	2.2	2.9	233.6
1992	3.1	103.7	45.8	26.3	2.9	10.8	27.6	0.3	220.5
1993	11.2	40.2	34.2	136	1.8	2.9	24.2	0.9	251.4
1994	11.4	30	38.2	229.8	0.8	6.5	62.8	5.9	385.4
All Round Haul Vessels:									
1981	42.8	141.3	trace	51.8	10.1	41.4	37.6	2.9	327.9
1982	23.3	131	0	34.7	11.7	12.4	24	3.3	270.1
1983	3.4	127.3	0	5.7	21.3	18.4	38.9	7.5	222.5
1984	2.2	96.1	0	2.5	1.3	8.1	61	21.9	193.1
1985	2.3	46.6	trace	18.3	6.6	3.5	12.4	28.2	117.9
1986	1.2	74.4	0.5	30.8	3.5	0.5	48.8	23.0	182.7
1987	2	84.5	0.4	25.6	4.4	15.3	29.4	22.7	184.3
1988	2.6	62.9	1.1	48	3.3	11.7	40.7	17.9	188.2
1989	4.1	64.2	2	50.6	3.2	2.8	26.7	15.3	168.9
1990	9.1	58.5	1.4	33.2	5.7	12.3	19.9	19.1	159.2
1991	6.2	46.5	7.5	77	6.5	0.4	1.2	3.2	148.5
1992	2.1	52	22.9	29.1	10.7	5.4	13.8	0.6	136.6
1993	5.4	18.3	15.4	109.1	1.6	1.3	10.9	4.7	166.7
1994	4.7	12.3	15.6	154.2	0.5	3.1	25.9	12.1	228.4

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 2.1.2-11. Selected characteristics of Washington, Oregon, and California round haul vessels[a] landing CPS or squid during 1981-1994, by landings category.

Characteristic	Landings Category			
	CPS+Squid<50	CPS=0 Squid≥50	0<CPS<50 Squid≥50	CPS≥50
Mean # vessels	60	7	9	45
Median boat length	31-40'	41-50'	41-50'	51-60'
Year built (1990 fleet):				
<1950	12.70%	0.00%	16.70%	50.00%
1951-1970	32.70%	0.00%	0.00%	2.30%
1971-1990	54.50%	100.00%	83.30%	47.70%
1991-1994		Data Not Available		
Principal area fished:				
Orange/Los Angeles	36.60%	6.90%	3.10%	69.70%
Ventura/Santa Barbara	15.30%	34.30%	11.70%	11.80%
Monterey/Santa Cruz	16.00%	43.10%	78.10%	15.40%
Elsewhere	32.10%	15.70%	7.00%	3.00%
Mean # trips (1981-1990)	47.2	54.3	57.8	65.7
%CPS	18.50%	0.00%	7.30%	69.00%
%Squid	4.30%	59.70%	61.40%	18.90%
Mean # trips (1991-1994)	46.3	40	54.3	58.8
%CPS	53.40%	0.00%	5.70%	55.90%
%Squid	12.40%	91.20%	88.80%	39.10%
Mean total landings (mt):		538.8	417.7	1,577.20
%CPS	30.00%	0.00%	3.80%	69.60%
%Squid	17.60%	90.10%	84.20%	21.80%
Mean total revenue	22.1	177.5	161.9	396.8
%CPS	9.20%	0.00%	2.80%	54.40%
%Squid	6.50%	68.50%	67.50%	19.10%

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 2.1.2-12. Mean exvessel price ($/mt; base year=1989) of fish caught in Washington, Oregon, and California with round haul gear, 1981-1994.

Year	Anchovy	Mackerel	Sardine	Squid	Bonito	Bluefin Tuna
1981	$88	$286	$282	$361	$811	$2,053
1982	$62	$267	$304	$305	$582	$1,481
1983	$179	$242	$322	$532	$462	$1,983
1984	$328	$226	---	$539	$347	$1,605
1985	$291	$204	$287	$380	$245	$1,119
1986	$240	$186	$233	$255	$342	$1,947
1987	$245	$271	$158	$236	$596	$3,340
1988	$291	$177	$138	$220	$428	$5,437
1989	$212	$152	$183	$174	$429	$1,834
1990	$450	$211	$132	$184	$464	$2,100
1991	$143	$173	$118	$152	$389	$916
1992	$162	$188	$91	$170	$363	$766
1993	$196	$112	$86	$210	$327	$1,186
1994	$242	$107	$132	$298	$563	$1,355

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.

--- No price reported on fish tickets.

Source: Washington, Oregon, and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-13. Number of California fish dealers who received any CPS or squid, by principal landing area, 1986-1994.

County	CPS>0,Squid=0	CPS>0,Squid>0	CPS=0,Squid>0	Total
1986				
San Diego/Orange	20	2	0	22
Los Angeles	15	12	2	29
Vent/SBarb	5	10	8	23
SanLuisObispo	7	2	1	10
Monterey/StaCruz	13	15	3	31
SanFran Bay Area	17	2	4	23
Northern Calif	1	0	2	3
Unknown	0	1	0	1
Total	78	44	20	142
1987				
San Diego/Orange	17	4	2	23
Los Angeles	18	9	3	30
Vent/SBarb	5	14	4	23
SanLuisObispo	7	2	0	9
Monterey/StaCruz	7	14	5	26
SanFran Bay Area	13	5	6	24
Northern Calif	4	0	1	5
Unknown	1	0	0	1
Total	72	48	21	141
1988				
San Diego/Orange	13	7	1	21
Los Angeles	19	11	1	31
Vent/SBarb	10	11	5	26
SanLuisObispo	4	1	3	8
Monterey/StaCruz	6	11	5	22
SanFran Bay Area	16	2	2	20
Northern Calif	3	1	1	5
Unknown	0	1	0	1
Total	71	45	18	134
1989				
San Diego/Orange	23	3	1	27
Los Angeles	19	15	1	35
Vent/SBarb	10	9	6	25
SanLuisObispo	6	3	1	10
Monterey/StaCruz	9	8	6	23
SanFran Bay Area	19	1	3	23
Northern Calif	4	0	1	5
Unknown	1	0	0	1
Total	91	39	19	149
1990				
San Diego/Orange	26	7	3	36
Los Angeles	18	13	1	32
Vent/SBarb	8	6	4	18
SanLuisObispo	5	3	0	8
Monterey/StaCruz	8	11	5	24
SanFran Bay Area	20	6	0	26
Northern Calif	4	0	3	7
Unknown	1	0	0	1
Total	90	46	16	152

TABLE 2.1.2-13. Number of California fish dealers who received any CPS or squid, by principal landing area, 1986-1994. (Continued).

County	CPS>0,Squid=0	CPS>0,Squid>0	CPS=0,Squid>0	Total
1991				
San Diego/Orange	31	0	0	31
Los Angeles	13	11	2	26
Vent/SBarb	6	6	3	15
SanLuisObispo	3	1	1	5
Monterey/StaCruz	17	5	1	23
SanFran Bay Area	10	7	3	20
Northern Calif	1	0	1	2
Unknown	8	0	2	10
Total	89	30	13	132
1992				
San Diego/Orange	27	0	0	27
Los Angeles	21	5	0	26
Vent/SBarb	7	6	4	17
SanLuisObispo	2	4	0	6
Monterey/StaCruz	17	4	1	22
SanFran Bay Area	24	15	4	43
Northern Calif	3	1	2	6
Unknown	8	0	0	8
Total	109	35	11	155
1993				
San Diego/Orange	25	2	0	27
Los Angeles	15	7	3	25
Vent/SBarb	11	6	2	19
SanLuisObispo	2	7	5	14
Monterey/StaCruz	14	4	0	18
SanFran Bay Area	14	5	2	21
Northern Calif	2	0	0	2
Unknown	1	2	0	3
Total	84	33	12	129
1994				
San Diego/Orange	22	2	0	24
Los Angeles	15	8	1	24
Vent/SBarb	6	7	8	21
SanLuisObispo	1	5	6	12
Monterey/StaCruz	13	5	2	20
SanFran Bay Area	11	3	4	18
Northern Calif	6	0	1	7
Unknown	8	6	1	15
Total	82	36	23	141

Principal landing area is the area from which a dealer received the most landings

Source: PacFIN and summaries from fish ticket data.

TABLE 2.1.2-14. Number of California fish dealers who received any CPS or squid, by principal landing area, 1986-1994.

Year/Principal Landing Area	CPS+Squid<500	CPS=0 Squid≥500	0<CPS<500 CPS+Squid≥500	CPS≥500	Total
1986					
San Diego/Orange	22	0	0	0	22
Los Angeles	21	0	2	6	29
Vent/SBarb	19	1	0	3	23
SanLuisObispo	10	0	0	0	10
Monterey/StaCruz	27	0	2	2	31
SanFran Bay Area	22	1	0	0	23
Northern Calif	3	0	0	0	3
Unknown	1	0	0	0	1
Total	125	2	4	11	142
1987	PM				
San Diego/Orange	23	0	0	0	23
Los Angeles	19	0	1	10	30
Vent/SBarb	20	0	0	3	23
SanLuisObispo	8	0	0	1	9
Monterey/StaCruz	21	2	2	1	26
SanFran Bay Area	23	1	0	0	24
Northern Calif	5	0	0	0	5
Unknown	1	0	0	0	1
Total	120	3	3	15	141
1988	PM				
San Diego/Orange	21	0	0	0	21
Los Angeles	19	0	1	11	31
Vent/SBarb	22	1	0	3	26
SanLuisObispo	7	1	0	0	8
Monterey/StaCruz	20	1	0	1	22
SanFran Bay Area	20	0	0	0	20
Northern Calif	5	0	0	0	5
Unknown	1	0	0	0	1
Total	115	3	1	15	134
1989					
San Diego/Orange	27	0	0	0	27
Los Angeles	23	0	2	10	35
Vent/SBarb	20	2	1	2	25
SanLuisObispo	9	1	0	0	10
Monterey/StaCruz	20	1	1	1	23
SanFran Bay Area	22	0	0	1	23
Northern Calif	5	0	0	0	5
Unknown	1	0	0	0	1
Total	127	4	4	14	149

TABLE 2.1.2-14. Number of California fish dealers who received any CPS or squid, by principal landing area, 1986-1994. (Continued).

Year/Principal Landing Area	CPS+Squid<500	CPS=0 Squid≥500	0<CPS<500 CPS+Squid≥500	CPS≥500	Total
1990	1				
San Diego/Orange	36	0	0	0	36
Los Angeles	23	0	1	8	32
Vent/SBarb	16	0	1	1	18
SanLuisObispo	8	0	0	0	8
Monterey/StaCruz	18	1	3	2	24
SanFran Bay Area	24	0	1	1	26
Northern Calif	7	0	0	0	7
Unknown	1	0	0	0	1
Total	133	1	6	12	152
1991					
San Diego/Orange	31	0	0	0	31
Los Angeles	19	0	0	7	26
Vent/SBarb	11	1	2	1	15
SanLuisObispo	5	0	0	0	5
Monterey/StaCruz	21	0	1	1	23
SanFran Bay Area	17	1	1	1	20
Northern Calif	2	0	0	0	2
Unknown	10	0	0	0	10
Total	116	2	4	10	132
1992					
San Diego/Orange	27	0	0	0	27
Los Angeles	20	0	0	6	26
Vent/SBarb	12	1	1	3	17
SanLuisObispo	6	0	0	0	6
Monterey/StaCruz	22	0	0	0	22
SanFran Bay Area	38	0	4	1	43
Northern Calif	6	0	0	0	6
Unknown	8	0	0	0	8
Total	139	1	5	10	155
1993					
San Diego/Orange	26	0	0	1	27
Los Angeles	20	0	0	5	25
Vent/SBarb	15	1	0	3	19
SanLuisObispo	9	2	3	0	14
Monterey/StaCruz	17	0	1	0	18
SanFran Bay Area	20	0	0	1	21
Northern Calif	2	0	0	0	2
Unknown	2	0	1	0	3
Total	111	3	5	10	129

TABLE 2.1.2-14. Number of California fish dealers who received any CPS or squid, by principal landing area, 1986-1994. (Continued).

Year/Principal Landing Area	CPS+Squid<500	CPS=0 Squid≥500	0<CPS<500 CPS+Squid≥500	CPS≥500	Total
1994					
San Diego/Orange	24	0	0	0	24
Los Angeles	21	0	1	2	24
Vent/SBarb	16	1	2	2	21
SanLuisObispo	8	2	2	0	12
Monterey/StaCruz	19	0	1	0	20
SanFran Bay Area	17	1	0	0	18
Northern Calif	7	0	0	0	7
Unknown	10	0	1	4	15
Total	122	4	7	8	141

Principal landing area is the area from which the dealer received the most landings.

Source: Dealer summaries generated from California fish ticket data.

TABLE 2.1.2-15. Mean annual landings received by California CPS/squid dealers and percentage of landings consisting of CPS and squid, by purchase category, 1986-1994.

	Category I CPS+Squid<500				Category II CPS=0, Squid≥500		
Year	mt	%CPS	%Squid	Year	mt	%CPS	%Squid
1986	242.9	4.8	6.5	1986	---	---	---
1987	183.1	5.9	5.8	1987	1,361.4	0.0	63.9
1988	249.8	5.1	5.6	1988	---	---	---
1989	221.4	3.1	7.6	1989	1,128.0	0.0	88.5
1990	240.9	4.9	2.1	1990	---	---	---
1991	168.2	11.2	4.1	1991	---	---	---
1992	169.4	4.1	3.7	1992	---	---	---
1993	165.5	4.1	4.1	1993	3,297.7	0.0	100.0
1994	254.5	5.5	6.8	1994	1,963.7	0.0	94.2
Avg.	210.6	5.4	5.1	Avg.	---	---	

	Category III 0<CPS<500, CPS+Squid≥500				Weighted Average of Categories II and III		
Year	mt	%CPS	%Squid	Year	mt	%CPS	%Squid
1986	---	---	---	1986	1,528.4	6.3	69.8
1987	917.6	31.4	45.0	1987	1,139.5	15.7	54.5
1988	---	---	---	1988	1,950.4	3.4	84.0
1989	5,789.0	2.4	63.1	1989	3,458.5	1.2	75.8
1990	---	---	---	1990	1,595.5	10.5	81.3
1991	1,932.2	8.7	77.1	1991	2,172.1	5.8	84.4
1992	1,599.2	1.0	71.1	1992	1,581.7	0.8	76.0
1993	2,987.6	2.8	78.2	1993	3,104.8	1.7	86.5
1994	2,732.5	6.7	82.9	1994	2,455.2	4.3	89.1
Avg.	---	---	---		2,109.6	5.5	77.9

	Category IV: CPS≥500		
Year	mt	%CPS	%Squid
1986	8,649.1	55.3	13.9
1987	6,800.9	53.3	14.6
1988	7,904.8	47.8	24.6
1989	7,057.2	61.1	20.4
1990	6,509.9	58.2	23.9
1991	7,260.5	55.9	33.1
1992	5,175.8	73.1	9.8
1993	5,840.3	47.1	34.9
1994	6,299.0	49.4	43.3
Avg.	6,873.1	55.7	24.3

--- As indicated in Table 2.1.2-15, fewer than three dealers 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 dealers in the two categories.

Source: Dealer summaries generated from California fish ticket data.

TABLE 2.1.2-16. Percentage of total California CPS/squid dealers and percentage of landings of CPS and squid accounted for by dealers in each of four purchase categories, 1986-1994.

	Category I CPS+Squid<500				Category II CPS=0, Squid≥500		
Year	%Dealers	%CPS	%Squid	Year	%Dealers	%CPS	%Squid
1986	88.0	2.7	9.3	1986	---	---	---
1987	84.4	2.3	6.4	1987	2.1	0.0	13.1
1988	85.8	2.5	4.3	1988	---	---	---
1989	85.2	1.4	5.2	1989	2.7	0.0	9.8
1990	87.5	3.3	2.3	1990	---	---	---
1991	87.3	4.6	2.0	1991	---	---	---
1992	89.2	2.3	6.3	1992	---	---	---
1993	85.9	2.6	1.8	1993	2.3	0.0	23.2
1994	87.1	6.9	4.8	1994	2.9	0.0	16.6
Avg.	86.7	3.2	4.7	Avg.	---	---	---

	Category III 0<CPS<500, Squid≥50				Sum of Categories II and III		
Year	mt	%CPS	%Squid	Year	mt	%CPS	%Squid
1986	---	---	---	1986	4.2	1.3	28.5
1987	2.1	1.5	6.2	1987	4.2	1.5	19.3
1988	---	---	---	1988	2.9	0.8	17.4
1989	2.7	0.9	35.7	1989	5.4	0.9	45.5
1990	---	---	---	1990	24.6	2.4	32.0
1991	3.2	1.5	16.0	1991	4.8	1.5	30.2
1992	3.4	0.0	43.4	1992	4.1	0.0	54.8
1993	3.9	1.5	27.3	1993	6.2	1.5	50.5
1994	5.0	5.2	35.6	1994	7.9	5.2	52.3
Avg.	---	---	---	Avg.	4.9	1.7	36.7

	Category IV CPS≥500		
Year	%Dealers	%CPS	%Squid
1986	7.7	96.0	62.3
1987	10.6	96.2	74.4
1988	11.2	96.7	78.2
1989	9.4	97.7	49.3
1990	7.9	94.3	65.7
1991	7.9	93.9	67.8
1992	6.8	97.4	38.9
1993	7.8	95.9	47.7
1994	5.0	87.9	42.9
Avg.	8.3	95.1	58.6

--- Fewer than three dealers 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 dealers in the two categories.

Source: Dealer summaries generated from California fish ticket data.

TABLE 2.1.3-1. Estimated number of recreational fishing trips on commercial party fishing vessels (CPFV) in California (thousands of trips), 1981-1994. Excludes trips targeted on salmon and striped bass and all boat trips that originated in the U.S. but fished in Mexican waters.

Year	Shore	CPFV[a/]	Private Boat	Total
1981	3,748	1,429	2,775	7,952
1982	3,483	2,274	2,546	8,302
1983	3,613	1,629	2,893	8,135
1984	3,742	1,349	3,199	8,292
1985	3,438	1,378	2,989	7,804
1986	3,539	1,538	3,801	8,876
1987[b/]	2,835	1,073	3,695	7,603
1988[b/]	4,540	1,535	3,862	9,937
1989[b/]	3,221	1,352	2,483	7,056
1990		No survey		
1991		No survey		
1992		No survey		
1993[b/]	1,553	567	8,627	5,493
1994[b/c/]	2,878	1,297	13,460	8,011

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.

c/ Northern California data for January-February and November-December not available.

Sources: 1981-1986 data from NMFS (1984, 1985a, 1985b, 1987).
1987-1989 data from J. Witzig, NMFS, Silver Spring, Maryland.
1993-1994 data from D. Van Voorhees, NMFS, Silver Spring, Maryland.

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 mackerel (mt) in Ensenada, Baja California, 1961-1994, as available.

Year	Pacific Sardine	Pacific 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	
1983	274	135
1984	0	128
1985	3,722	2,582
1986	243	4,833
1987	2,432	2,082
1988	2,035	4,484
1989	6,222	13,887
1990	11,375	35,767
1991	31,392	17,500
1992	34,568	24,345
1993	32,045	7,742
1994	20,877	13,318

Sources: 1961-1974 data from Osuna, et al. 1976. 1983-1994 data from W. Garcia, Instituto Nacional de Pesca, Ensenada, Baja California.

2.2 Other Fisheries Component

The other fisheries component consists of three overlapping commercial fisheries. One segment harvests Pacific whiting off northern California, Oregon and Washington; another segment harvests pelagic and midwater rockfish in the same area; and the last segment harvests walleye pollock and other species in the north Pacific, and processes them at sea.

2.2.1 Pacific Whiting

2.2.1.1 History

Before 1965, Pacific coast fishers considered whiting a nuisance; the only landings of consequence were taken incidentally by U.S. vessels using otter trawls off central and northern California (Nelson 1970). Annual landings of whiting in California averaged only 225 mt from 1959 through 1965 and most of the catch was used for pet food and as food in the fur industry. Because whiting did not keep well, it was not marketed as food for humans. It was thought that whiting could not be economically harvested on a large scale for industrial markets because of its low abundance and distribution.

In 1964, surveys off the Washington and Oregon coasts found dense schools of whiting that were large enough to be economically harvested by a midwater trawl fishery. By 1966, the relatively unexploited resource had attracted a large distant-water Soviet trawl fleet, and a directed foreign fishery for whiting and Pacific ocean perch began (Hitz 1970). By 1967, the annual Soviet harvest of Pacific whiting (113,000 mt) was about fourteen times larger than the harvest of Pacific ocean perch.

The Soviet whiting fleet of the 1960s consisted of side trawlers, stern and side trawlers with onboard processing facilities, freezer ships or freezer/processors, and various support ships (including refrigerated transports, tankers and rescue tugs). Smaller side trawlers, without processing and storage capacity, delivered their catches to freezer ships on completion of a tow. Freezer ships would then process, freeze and store the product for delivery to port at the end of the season, or transfer it to refrigerated transport vessels. Larger side trawlers and stern trawlers could also freeze or process their catches on board and transfer the processed product to refrigerated transports. Factory trawlers produced frozen product, meal and oil. The largest of the freezer ships had freezing, canning and salting capability, as well as reduction equipment.

The Pacific whiting fishery continued to be dominated by foreign interests until the late 1970s, when the Magnuson Fishery Conservation and Management Act (MFCMA) was implemented. Under the MFCMA, foreign vessels are allowed to harvest whiting in the U.S. EEZ only if the U.S. fishing industry has not demonstrated intent to harvest the entire optimum yield (OY). Under this system, needs of domestic processors are satisfied first, then JV operations involving U.S. catcher boats that deliver whiting to foreign vessels for processing at sea and, finally, needs of purely foreign segments of the fishery. JV arrangements were mutually beneficial because U.S. fishers were paid for delivering species for which there was little or no demand in U.S. markets. Under the MFCMA, the Soviet Union, Poland, Bulgaria, the People's Republic of China, the Republic of Korea and Japan fished for whiting off Washington, Oregon, and California.

Consistent with the intent of the MFCMA, JV and shore-based deliveries of whiting by U.S. vessels increased significantly after 1978 and by 1989 displaced the foreign fishery entirely (Table 2.2.1.1-1). In 1978, the directed foreign harvest was 98 percent of the total whiting harvest, but in 1988 the directed foreign fishery accounted for only 11 percent of total whiting landings while the JV fleet accounted for 85 percent, and shore-based landings accounted for 4 percent.

The first JV was initiated in September of 1978, when two U.S. trawlers delivered about 900 mt of whiting to two Soviet factory trawlers during a six-week period. In 1979, JV interests announced intentions to harvest 35,000 mt of whiting, although only about 9,000 mt (taken by seven U.S. trawlers) were actually taken. These vessels, fully equipped for midwater trawling, ranged from 70 to 110 feet and had engines

of 365 to 1,100 horsepower. Daily deliveries of 100-600 mt were made to as many as seven USSR processing vessels. Most whiting taken in the JV fishery were headed, gutted and frozen; a small portion was filleted; the remainder was reduced to meal. The bulk of this production was exported to the Orient, eastern Europe and the Soviet Union.

By 1988, 40 U.S. vessels were participating in JV whiting operations (Table 2.2.1.1-2). Vessels ranged in length from 540117 feet and had engines of 340-1,700 horsepower. During the 1988 season, vessels averaged 69 days of fishing and 2.8 deliveries per day. Daily deliveries averaged 2,000 mt in total and 47 mt per vessel.

In 1989, 65 U.S. catcher vessels delivered a record 204,000 mt of whiting to foreign processors. This number, together with shore-based landings of 7,000 mt, made up 94 percent of the total OY of 225,000 mt.

In 1989 and subsequently, there was no foreign fishing for whiting because domestic needs exhausted the available supply. The 1990 OY and quota for whiting (196,000 mt) was 13 percent lower than in 1989, and JV requests alone were greater than the total OY.

The number of foreign trawlers varied considerably from 1981 to 1989—from 31 in 1981 to 0 in 1989 (Table 2.2.1.1-3). In the JV fishery, the number of foreign processor vessels as well as the number of domestic catcher vessels increased. From July 1984 through December 1989, 117 vessels had both JV and shoreside whiting landings; 55 vessels had JV landings only; and 19 vessels had shoreside landings only (NMFS data).

In 1990, another major change occurred when three domestic catcher-processor vessels entered the fishery for the first time. Before 1990, the U.S. at-sea processing fleet operated almost exclusively in north Pacific groundfish fisheries.

When the Bering Sea pollock fishery was closed during 1991, factory trawlers again participated in the whiting fishery off Washington, Oregon and California. Preliminary catch reports issued by NMFS indicate that 16 vessels, 3 operating as mother ships and 13 as catcher/processors, caught and processed whiting during 1991. Seventy-eight thousand mt were processed by mother ships, and 117,000 mt were harvested and processed by catcher/processors. Because domestic processing needs take precedence, this development, together with increased requests from shore-based processors, completely displaced the JV fishery in 1991.

2.2.1.2 Bycatch

Species caught incidentally during foreign and domestic fishing for whiting include salmon, Pacific halibut, Pacific ocean perch, jack mackerel, rockfish (mainly widow and yellowtail rockfish), flatfish (mainly Dover sole and arrowtooth flounder), sablefish, jelly fish, squid and other species. Bycatch in the bygone JV fishery for whiting was not counted against quotas used to manage directed fisheries for species in the bycatch. In order to discourage discard, only small allowances for bycatch were permitted.

Bycatch allowances in the JV whiting fishery were based on historical proportions of bycatch species in deliveries of whiting to foreign processor vessels. Beginning in 1980, the incidental catch allowances in the JV whiting fishery were: jack mackerel (north of 39° N) 3.0 percent; Pacific ocean perch 0.062 percent; other rockfish (except Pacific ocean perch) 0.738 percent; flatfish 0.1 percent; sablefish 0.173 percent; and other species 0.5 percent. Less than 5 percent of the annual U.S. catch of "whiting" delivered to foreign processing vessels (including species that were subsequently discarded) was bycatch species (Table 2.2.1.2-1). From 1980 to 1990, catches of jack mackerel, the only CPS taken incidentally in appreciable amounts in the JV whiting fishery, averaged less than 100 mt annually.

2.2.1.3 Fishing Gear

U.S. fishers use midwater trawl gear principally to harvest whiting, but this gear is also useful for catching widow rockfish, shortbelly rockfish and jack mackerel. Midwater trawling by U.S. fishers developed in the late 1970s, when larger trawlers began towing specialized, off-the-bottom trawl nets at varying depths. Because of the difficulty in towing and positioning the net, this type of fishing requires a vessel that has more horsepower and electronics than vessels typically used for bottom or shrimp trawling.

2.2.1.4 Seasonal Patterns

The whiting fishery is seasonal (spring and summer), and vessels that harvest whiting usually engage in other fisheries during the off-season. Vessels participating in the whiting fishery also operate in the Pacific coast midwater trawl fisheries for widow rockfish and pink shrimp, as well as in the bottom trawl fishery for groundfish. Vessels that have participated in the whiting fishery have also participated in Alaskan fisheries during the off-season. However, with the dramatic increase in the number of large factory trawlers operating in Alaska, off-season opportunities in Alaska have been greatly curtailed.

2.2.1.5 Capability of Vessels to Engage in Other Fisheries

Vessels used to harvest whiting can participate in other fisheries because they tend to be relatively new, highly powered and electronically advanced. The fishery for widow rockfish is the most important alternate midwater trawl fishery for U.S. vessels that harvest whiting. Jack mackerel and shortbelly rockfish, currently underutilized species, are alternative targets that may become important in the near future. Of the total number of fishing trips (48,995) made by U.S. vessels that landed JV or shoreside whiting from July 1984 through December 1989, 36 percent were non-whiting trips, 26 percent were whiting trips, 17 percent were halibut trips, 10 percent were shrimp trips, and 6 percent were crab trips.

2.2.1.6 Landings and Revenues in the Midwater Trawl Fishery

Annual midwater trawl landings averaged 109,000 mt from 1981 to 1989, and ex-vessel revenues averaged $18 million. Midwater trawl landings and ex-vessel revenues fell to respective lows of 45,000 mt and $10 million in 1985, then climbed to highs of 224,000 mt and $29 million in 1989 (Table 2.2.1.6-1).

2.2.1.7 Operating Costs

As indicated by an NMFS survey, the annual fixed costs associated with owning and operating a vessel that participated in the JV fishery during 1987 averaged $255,224 per vessel, and variable costs averaged $6,085 per week fished. In 1987, the JV whiting fleet fished approximately 377 vessel weeks (an average of 12.2 weeks per vessel), and total variable costs for JV whiting fishing therefore averaged $74,237 per vessel. Average revenue per vessel from the JV whiting fishery in 1987 was $194,000.

2.2.1.8 Processing Sector

Before 1991, 95 percent of the total U.S. whiting harvest was taken by JV vessels that delivered to foreign processors, and less than 5 percent went to shoreside processors for heading and gutting. In 1991 more than 163,000 mt of whiting were processed at sea by nine U.S. companies. A survey by NMFS in June 1991 revealed that production by U.S. at-sea processors was 48 percent surimi, 28 percent fillet blocks, 7 percent minced blocks, and 17 percent meal.

2.2.1.9 Management

Since 1982, fishing operations for whiting within the U.S. EEZ have been managed through the FMP for Pacific coast groundfish (PMFC 1990). Annual OY levels and quota for whiting have been specified since 1978. When the total OY for whiting could not be fully utilized by domestic processors, the surplus was allocated to JV processing and—if any surplus remained after JV needs were met—to directed foreign

fishing in the form of a quota or TALFF (total allowable level of foreign fishing). The allocation to JV processing was either a quota or harvest guideline. In addition to restrictions on whiting catches, incidental allowances have been instituted for species or species groups that are caught incidentally with whiting. Whenever a quota or incidental allowance is reached, the fishery can be shut down.

In terms of their operations, U.S. vessels fishing in the JV whiting fishery were treated in the same way as groundfish vessels delivering shoreside. Foreign vessels fishing whiting under a TALFF could operate in the EEZ only outside 12 miles, between 39° and 47° 30' N latitude and from June 1 to October 31. The JV fishery was restricted to north of 39° N latitude. Furthermore, foreign vessels engaged in JVs or directed foreign fishing were subject to a number of reporting and record keeping requirements.

TABLE 2.2.1.1-1. Landings, harvest guidelines and quotas for Pacific whiting, 1984-1994.

Year	Foreign Fishing (mt)	Joint Venture (mt)	U.S.[a/] Process (mt)	Total Landings (mt)	Quota or Harvest Guideline Landed (percent)	Quota or Guideline Landed
1978	96,827	856	689	98,372	130,000	76
1979	114,910	8,834	937	124,681	198,900	63
1980	44,023	27,537	793	72,353	175,000	41
1981	70,366	43,557	838	114,761	175,000	66
1982	7,098	67,465	1,024	75,578	175,500	43
1983	0	72,100	1,051	73,151	175,500	42
1984	14,772	78,889	2,721	96,382	175,500	55
1985	49,853	31,692	3,894	85,439	175,000	49
1986	69,861	81,639	3,463	154,963	295,800	52
1987	49,656	105,997	4,795	160,448	195,000	82
1988	18,041	135,871	6,876	160,698	232,000	69
1989	0	203,578	7,418	210,996	225,000	94
1990	0	170,972	12,828	183,825	196,000	94
1991	0	0	217,505	217,505	228,000	95
1992	0	0	208,575	208,575	208,800	100
1993	0	0	141,222	141,222	142,000	99
1994	0	0	252,729	252,729	260,000	97

a/ U.S. processing was entirely shore-based until 1990, when three domestic catch/processor vessels entered the fishery.

Source: NMFS, Northwest Region.

TABLE 2.2.1.1-2. Deliveries (thousand mt), revenues and boats in the joint-venture Pacific whiting fishery, 1978-1990 (the last year of JV fishing).

	Number of Vessels		U.S. Catcher Vessels			
Year	U.S. Catcher	Foreign Processors	Tonnage Delivered	Revenue	Tonnage/ Vessel	Revenue/ Vessel
1978	2	2	.9	NA	.45	NA
1979	11	10	8.8	1.8	.8	.164
1980	16	11	27.5	4.7	1.7	.294
1981	21	20	43.6	8.0	2.1	.381
1982	19	15	67.5	12.5	4.0	.735
1983	19	15	72.1	12.0	3.8	.632
1984	21	20	78.9	13.3	3.8	.633
1985	18	15	31.7	4.1	1.9	.241
1986	25	23	81.6	4.7	3.3	.188
1987	31	30	106.1	6.0	3.4	.194
1988	40	31	135.8	7.3	3.2	.175
1989	65	45	203.8	20.9	3.1	.321
1990	48	34	171.0	NA	3.6	NA
Average	26	21	79.2	8.7	2.73	.36

Source: PacFIN Management Database.

TABLE 2.2.1.1-3. Number of vessels and catches (thousands of mt) for foreign, domestic and JV fisheries for Pacific whiting, 1981-1994. There were no JVs after 1990.

	Foreign Vessels				Percent of Total Harvest		
Year	Foreign Trawlers	JV Processing	U.S. Catcher Vessels	Total Harvest	Direct Foreign Fishery	JV Fishery	Domestic Shore-based
1981	31	20	21	114.8	61.3	38.0	0.7
1982	4	15	19	75.6	9.3	89.3	1.4
1983	0	15	19	73.2	0.0	98.6	1.4
1984	17	20	21	96.4	15.3	81.9	2.8
1985	22	15	18	85.4	58.4	37.1	4.5
1986	24	23	25	155.0	45.1	52.7	2.2
1987	33	30	31	160.4	31.0	66.0	3.0
1988	16	31	40	160.7	11.2	84.5	4.3
1989	0	44	65	211.0	0.0	96.7	3.3
1990	0	34	48	183.8	0	93.0	7.0
1991	0	0	57	217.5	0	0	100.0
1992	0	0	76	208.6	0	0	100.0
1993	0	0	49	141.2	0	0	100.0
1994	0	0	NA	252.7	0	0	100.0

TABLE 2.2.1.2-1. Bycatch of various species in the Pacific whiting fishery, 1980-1994. "Other" includes other groundfish, Pacific mackerel and Pacific sardine.

	Species							
Year	Jack Mackerel[a/]	Rockfish[a/]	POP[a/]	Flatfish[a/]	Sablefish[b/]	Other[a/]	Salmon[b/]	Halibut[a/]
1980	75	448	29	46	213	122	3,602	0
1981	73	591	30	1	254	635	6,422	0
1982	T[c]	832	25	6	54	770	11,694	43
1983	30	727	7	2	30	350	5,143	46
1984	79	561	9	1	25	90	10,192	26
1985	2	294	1	1	4	39	1,575	31
1986	42	773	20	5	22	326	32,051	96
1987	410	643	2	15	13	67	8,636	49
1988	182	659	2	36	72	162	13,984	131
1989	12	426	3	81	9	136	9,199	110
1990	187	635	3	93	16	118	9,387	77
1991	228	1,490	38	1	27	261	6,330	29
1992	855	1,212	341	5	73	1,284	5,071	17
1989	6	510	1	T	11	112	9,373	32
1994[d/]	62	1,053	62	3	1	160	4,001	54

a/ Bycatch in metric tons.
b/ Bycatch in number of fish.
c/ Less than .5 metric tons.
d/ Preliminary.

Source: NMFS, Northwest Region.

TABLE 2.2.1.6-1. Quantity (thousand mt) and exvessel value (millions 1988 dollars) of midwater trawl landings, 1981-1994.

	Widow Rockfish		Shoreside Whiting		JV Whiting	
Year	Landings	Value	Landings[a/]	Value[b/]	Landing	Value
1981	28.2	10.9	0.8	0.3	43.6	8.0
1982	26.0	10.9	1.0	0.1	67.5	12.5
1983	10.5	5.2	1.1	0.1	72.1	12.0
1984	9.6	5.5	2.7	0.3	78.9	13.3
1985	8.9	5.4	3.9	0.4	31.7	4.1
1986	9.4	6.0	3.5	0.4	81.6	4.7
1987	12.2	8.9	4.8	0.5	106.0	6.0
1988	10.9	6.9	6.9	0.9	135.8	7.3
1989	12.7	7.0	7.0	0.9	204.0	20.9
1990	7.4	3.9	12.8	1.5	171.0	20.0
1991	5.5	2.9	217.5	22.3	0.0	0.0
1992	6.0	3.1	208.6	18.7	0.0	0.0
1993	7.8	4.0	141.2	8.0	0.0	0.0
1994	6.1	3.5	252.7	14.0	0.0	0.0

a/ Includes shoreside landings and at-sea deliveries.
b/ Based on shoreside exvessel prices for years with at-sea deliveries.

2.2.2 Domestic Fisheries in the North Pacific That Harvest and Process at Sea

Before 1989, there was little domestic offshore processing except for a few pot and longline vessels that dressed their sablefish catches at sea. Domestic offshore processing of whiting did not begin until the winter of 1990. But in the north Pacific, a fleet of factory trawlers had grown rapidly during the late 1980s. This fleet was concentrated in Alaskan waters, but more restrictive management measures in the walleye pollock and north Pacific groundfish fisheries, and the inability of resources in the north Pacific to support continued expansion of the fleet prompted interest by domestic factory trawlers and offshore processors in the harvest of Pacific whiting, jack mackerel and shortbelly rockfish.

2.2.2.1 Number of Vessels

The north Pacific U.S. factory trawler fleet did not exist before 1980. The fleet grew quickly after 1986 from 12 vessels (ranging in size from 130 to 340 feet) to 50 vessels in 1989 and more than 60 in 1991. The 1991 fleet represents an investment of over $1.0 billion, and a harvesting capacity greater than 2.0 million mt per year. Because of the enormous capital expenditure and relatively low value of products, the factory trawler fleet depends on large harvests and year-round fishing for profitable operations.

2.2.2.2 Value and Volume of Landings

Factory trawlers operating in the Bering Sea and Gulf of Alaska target walleye pollock, Pacific cod, flatfish, rockfish, Atka mackerel and sablefish. Total groundfish catches by the factory trawler fleet have risen from 106,000 mt valued at $29 million in 1986, to 1,036,000 mt valued at $234 million in 1989 (Table 2.2.2.2-1). Catch per vessel increased from 8,800 mt to 21,000 mt while revenues per vessel increased from $2 million to $5 million.

2.2.2.3 Future Developments

As opportunities for operations off Alaska and in the Pacific whiting fishery decline, the probability that the factory trawler fleet will move into the Pacific coast CPS fishery increase. U.S. factory trawlers have expressed an interest in fishing for jack mackerel and shortbelly rockfish, although exploratory fishing by a few vessels resulted in very small catches.

TABLE 2.2.2.2-1. Landings and revenues for the Alaskan factory trawler fleet, 1986-1994.

	Pollock		Sablefish		Pacific Cod		Flatfish		Rockfish		Atka Mackerel		All Groundfish	
Year	Land.	Rev.	Land.	Rev.	Land.	Rev.	Land.	Rev.	Land.	Rev.	Land.	Rev.	Land.	Rev.
1986	56.2	9.2	8.3	9.2	28.3	6.2	6.8	2.3	6.0	2.1			106.2	29.3
1987	148.4	23.8	11.4	13.4	44.2	15.8	21.6	6.5	13.5	6.9			239.4	66.7
1988	380.3	62.0	14.3	29.4	73.8	20.9	39.4	12.5	19.2	10.9	2.0	0.1	529.5	136.8
1989	836.6	145.7	12.1	20.6	101.6	33.8	37.5	10.6	29.1	17.1	18.4	6.4	1035.5	234.4
1990	1097.1	213.0	11.7	18.0	142.2	58.3	48.7	12.8	44.4	15.5	21.9	5.1	1371.1	324.1
1991	921.7	177.7	5.6	12.8	142.3	71.5	115.5	35.6	19.1	9.3	25.5	7.5	1232.9	316.0
1992	913.1	251.1	6.69	14.6	174.0	89.3	218.7	51.6	36.8	18.8	59.6	16.5	1433.4	453.0
1993	917.1	143.0	7.3	15.4	109.8	49.9	122.2	29.8	23.8	8.1	51.3	14.7	1239.0	262.9
1994[a/]	880.7	147.6	6.5	17.3	126.5	55.0	138.9	26.5	17.5	4.5	62.5	17.0	1234.5	270.3

a/ Preliminary.

Landings in thousands of mt round weight, revenues based on exvessel prices that do not include value added by at-sea processing (in nominal dollars).
Source: NMFS, Alaska Fisheries Science Center.

2.2.3 Rockfish

Widow and shortbelly rockfish form pelagic and midwater aggregations. Widow rockfish currently support a significant fishery; shortbelly rockfish are underutilized.

Widow rockfish congregate over rocky banks from Baja California to Kodiak Island, Alaska. They frequently form dense midwater schools at night, allowing for large catches with minimal effort. Pacific coast landings of widow rockfish were negligible before the midwater trawl fishery developed in 1978–1979. Coastwide landings increased rapidly from 4,941 mt in 1979 to approximately 27,000 mt in 1981 and 1982. Landings dropped dramatically after implementation of the groundfish FMP in 1982, when trip limits were imposed to prevent catch levels from exceeding the ABC. Since then, trip limits have maintained landings at about the 10,000–12,000 mt range. There is no TALFF or JV allowance for widow rockfish because this species is completely utilized by domestic processors.

Shortbelly rockfish are underutilized by domestic fishermen and available for foreign exploitation within the U.S. EEZ. A small experimental JV for shortbelly rockfish was conducted in 1982 and produced landings of 638 mt, but markets for the product did not develop and there have been no further JVs. Shortbelly rockfish are most common south of 39° N latitude, but current regulations prohibit any JV harvest of shortbelly rockfish south of 39° N latitude. A request to conduct a JV for shortbelly rockfish in 1989 was denied on the basis that much of the area needed for the fishery should be closed to foreign vessels for national security reasons. In 1991, U.S. factory trawlers expressed an interest in fishing for shortbelly rockfish south of 39° N latitude.

2.2.3.1 Bycatch

The fishery for widow rockfish results in little bycatch because the fish are usually found in nearly pure schools. Species sometimes caught incidentally include yellowtail rockfish, Pacific ocean perch, bocaccio, canary rockfish, sharpchin rockfish and Pacific whiting (Tagart 1987).

2.2.3.2 History

Prior to 1978, widow rockfish were an underutilized species in the Pacific coast groundfish fishery. In 1978, a directed midwater trawl fishery for widow rockfish began to develop as new technology incorporating electronic navigation, fish-finding equipment and midwater nets extended fishing operations into previously unfished areas and enabled vessels to follow shifts in widow rockfish concentrations throughout the year (Demory 1987; Quirollo 1987; Tagart 1987). The fishery for widow rockfish is almost exclusively a single-species, midwater trawl fishery. But widow rockfish have also been taken in setnet, bottom trawl and longline operations.

2.2.3.3 Seasonal Patterns

Widow rockfish are available year-round, and management under trip limits is intended to maintain landings throughout the year without exceeding the annual quota. Under these circumstances the directed fishery for widow rockfish would not be considered a naturally occurring seasonal fishery. However, vessels that harvest widow rockfish can also participate in the seasonal Pacific whiting, pink shrimp and other (e.g., crab and salmon) seasonal fisheries and therefore may harvest widow rockfish only part of the year.

2.2.3.4 Processing Sector

Widow rockfish are processed onshore. Individual trawl catches are iced immediately and delivered as quickly as possible to shoreside processors to maintain top quality. Processors like widow rockfish because they generally give relatively high recovery rates during the filleting process.

Both onshore and offshore processing capacity for shortbelly rockfish exists should market for this species develop. Offshore processors also can make surimi.

2.2.3.5 Capability of Vessels to Engage in Other Fisheries

The Pacific whiting fishery is the most important alternate midwater fishery for U.S. vessels. Jack mackerel and shortbelly rockfish, currently underutilized species, can also be harvested with midwater trawl gear. Because the vessels in the midwater whiting fishery are relatively new, highly powered and electronically advanced, they can participate in a number of other trawl and nontrawl fisheries. From July 1984 through December 1989, U.S. vessels with midwater trawling capability made 48,995 fishing trips: 36 percent for non-whiting groundfish, 26 percent for whiting, 17 percent for halibut, 10 percent for shrimp and 6 percent for crab.

Any catcher vessel or factory trawler capable of harvesting Pacific whiting or widow rockfish could also harvest shortbelly rockfish.

2.2.3.6 Landings and Revenues

Annual midwater trawl landings of widow rockfish averaged 14,300 mt from 1981 through 1989, and exvessel revenues averaged $7.4 million (Table 2.2.3.6-1).

Shortbelly rockfish has not been significant in the Pacific coast groundfish fishery (Table 2.2.3.6-2).

2.2.3.7 Operating Costs

A NMFS survey indicated that annual fixed costs associated with owning and operating a midwater trawl vessel in 1987 averaged $117,215. Variable costs averaged $4,128 per week fished per vessel.

2.2.3.8 Horizontal and Vertical Integration

The shore-based harvesting and processing operations in the Pacific coast groundfish fishery are not vertically integrated. Shoreside processors have traditionally relied on independent vessels to supply them with widow rockfish.

Harvesting and processing would be totally integrated if the resource were completely utilized in a factory trawler operation.

2.2.3.9 Recreational Harvest

Widow rockfish is not important in the recreational fishery. A survey of the California recreational party boat fishery from 1977 through 1979 revealed that only 3.7 percent of the catch per unit of angling effort was from widow rockfish. The catch was greatest in the northern California ports, during winter (Cooperrider 1987).

2.2.3.10 Management

Since 1982, fishing operations for widow and shortbelly rockfish have been managed through the FMP for Pacific coast groundfish (PMFC 1990). Annual estimates of ABC for widow rockfish are used to set limits on total catch. In 1982, trip limits were first imposed to keep the annual catch from exceeding the ABC and to maintain landings through the end of the year. The OY and quota for shortbelly rockfish has risen from 10 mt in 1982 to 23.5 mt in 1994.

There is no directed foreign fishing or JV fishery for widow rockfish in the U.S. EEZ. The resource is fully utilized by the domestic fishery and is expected to remain that way. As an underutilized species, shortbelly rockfish may be taken by foreign fishers or JVs.

TABLE 2.2.3.6-1. Landings (thousand mt) and value (millions of 1988 dollars) for widow rockfish 1981-1994.

Year	Landings	Value
1981	28.2	10.9
1982	26.0	10.9
1983	10.5	5.2
1984	9.6	5.5
1985	8.9	5.4
1986	9.4	6.0
1987	12.2	8.9
1988	10.9	6.9
1989	12.7	7.0
1990	7.4	3.9
1991	5.5	2.9
1992	6.0	3.1
1993	7.8	4.0
1994	6.1	3.5

Source: PacFIN.

TABLE 2.2.3.6-2. Landings (mt) and OY levels for shortbelly rockfish, 1982-1994.

Year	Landings	OY Quota
1982	4	10.0
1983	0	10.0
1984	1	10.0
1985	11	10.0
1986	2	10.0
1987	0	10.0
1988	0	10.0
1989	2	10.0
1990	0	13.0
1991	4	13.0
1992	53	13.0
1993	7	13.0
1994	trace	23.5

Source: Pacific Fishery Management Council.

3.0 SOCIOECONOMICS OF THE COASTAL PELAGIC FISHERY

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 percent of its landings, gill nets to land 30 percent and hook-and-line to land 30 percent 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

Socioeconomic information is presented in this chapter for Los Angeles and Monterey counties because they are most important areas in the coastal pelagic species (CPS) fishery and likely to be affected by management of the CPS fishery. Most CPS landings (85 percent of 191,000 mt) and revenues (82 percent of $25 million) during 1990-1994 occurred in Los Angeles and Orange counties where the largest number of CPS vessels and trips also occurred (Table 3.1-1). Monterey and Santa Cruz counties were second, with 10 percent of total CPS landings and 12 percent of real revenues during 1990-1994. Other areas accounted for less than 5 percent of total landings and 6 percent of total revenues.

Vessels using round haul gear (purse seines and lampara nets) are responsible for 99 percent 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, built in the heyday of the Pacific sardine fleet, from 1930 to 1949 (Murphy 1966).

3.2 Setnet Fleet

California setnet (gill net 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 California Marine Resources Protection Act displaced them from state waters.

Bramel and Kronman (1991) found it technically feasible to convert small gill net 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 gill net boat might earn gross weekly revenues of $1,500 to $2,000, if markets were available.

In 1980, between 100-120 Vietnamese fishers and boat owners used setnets to fish from about 40 converted pleasure boats of the 20-30-foot range in the Monterey Bay area (Orbach and Beckwith 1980). The active Vietnamese fleet, however, comprised 40-60 fishers (in a single day as few as 3-15) who worked about 15 boats (in a single day as few as 1). 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 percent of the total) held permits to operate from Point Sal to Point Reyes; 67 percent of these were traditional (non-Vietnamese), and 33 percent 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

In 1984, 15 percent of California commercial fishers who operated trawl vessels and troll vessels earned all their income from fishing (ICF 1988). Another 66 percent 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 percent 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 percent of those sampled; 17 percent 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 1980-1989 from 2,408,000 to 1,390,000 anglers (Table 3.5-1). Coastal residents made up 70-80 percent of total anglers; out-of-state residents made up 18-25 percent; and non-coastal southern California residents made up only 1-4 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 89-90 percent of all trips in all years; out-of-state anglers made 7-9 percent of all trips and non-coastal residents made 1-2 percent. In 1980 pier fishing was most popular: 33 percent of sportfishing was done from man-made structures (Table 3.5.1-1). In 1985, private and rental boat fishing dominated (37 percent), and in 1989 bank (shore) fishing dominated (40 percent), 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 percent 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 non-Hispanic white (85 percent) and male (91 percent) with median ages of 25-45 years. Hispanics made up 7 percent of total key anglers.

Seventy-four percent of anglers were employed for more than 35 hours per week; 11 percent were retired. A large proportion (41 percent) had some college education.

The highest percentage of recreational fishing households had annual incomes in the range of $30,000-$40,000 (18 percent), with sizable fractions in the $40,000-$50,000 range (15 percent) and the $20,000-$30,000 range (13 percent).

3.5.4 Motivation to Fish

Sixty-two to 74 percent 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 sport and commercial fisheries (Huppert 1981; PMFC 1983). There was conflict over whether anchovy should be a commercial resource for reduction to fish meal 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

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 percent to 56.8 percent of the total population, and blacks from 12.6 percent to 11.2 percent. People of Hispanic ethnic origin increased from 27.6 percent of the population to 37.8 percent. The numbers of Asians or Pacific Islanders grew at an average rate of 13.3 percent annually, from 5.5 percent in 1980 to 10.8 percent in 1990 (Table 3.7.1-1).

In 1980, 27.2 percent of the population was younger than 18 years; 62.9 percent was between 18 and 64 years; and 9.9 percent was older than 64. 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 and 3,701,000 in 1991, about 50 percent of the population in each year (Table 3.7.3-1). Unemployment was 6.6 percent in 1980 and 5.8 percent in 1990. Income per employee was $25,000 in 1991 (Table 3.7.3-1).

Payrolls in the county grew for most major industrial sectors from 1980-1991 (Table 3.7.3-1). Total payroll grew at an average annual rate of 2.3 percent, from $73 billion-$92 billion. Agriculture, forestry and fishing ranked third among major industries with 4 percent average annual payroll growth but agriculture, forestry and fishing contributed a very small portion (0.3 percent) to total 1991 payrolls.

The number of persons employed in Los Angeles County grew 1.3 percent annually, from 3,185,000 workers in 1980 to 3,701,000 in 1991 (Table 3.7.3-1). Agriculture, forestry and fishing grew second fastest (3.1 percent annually), from 10,622 employees in 1980 to 16,059 (0.3 percent of total employees) in 1991.

3.7.4 Earnings

Average 1991 earnings (payroll divided by number of employees) were relatively low at $17,000 in the agriculture, forestry and fishing sector (Table 3.7.3-1).

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 non-Hispanic (59.7 percent of the total population in 1980 and 55.0 percent in 1990) although the proportion of non-whites (mainly Hispanics) has increased in recent years. Hispanics made up 30.8 percent of the population in 1980 and 34 percent in 1990; blacks made up 4.4 percent of the population in 1980 and 5 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 percent of the total population). Of the total jobs, 35.5 percent were manufacturing or service, 18.8 percent clerical, 10.9 percent professional, 9.6 percent sales, 9.1 percent management and administrative, 6.4 percent labor, 2.3 percent technical and 7.3 percent other.

In 1980, 8,500 people, or 13.6 percent 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 1890's 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 twenty 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 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 Terry Hoinsky, Fisherman's Union representative, in 1991 the AFL-CIO represented 184 crewmen, or about 30 percent of the crew members who worked on vessels out of San Pedro.

Crew members resided primarily (89.0 percent) in the San Pedro area. Some (5.4 percent) lived in the surrounding communities of Wilmington, Lomita, Palos Verdes Peninsula and South Gate; others (3.2 percent) 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 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 percent to 63 percent of the total (Table 3.8.6-1). Yugoslavs ranged from 14 percent to 34 percent 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 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 40-51 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 Yugoslav 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 - Monterey County, California

Monterey represents the third most important region in terms of landings and revenues by the CPS fishery.

3.9.1 Population and Housing

Total population in Monterey County was 290,444 in 1980, and grew on average by 2.2 percent annually to 355,660 in 1990 (Table 3.9.1-1). Population density also increased by 2.2 percent annually, from 88 persons per square mile in 1980 to 107 in 1990. Available housing units grew at 1.7 percent average annually, from 103,557 in 1980 to 121,224 in 1990.

3.9.2 Demographics

From 1980 to 1990, the white population of Monterey County grew at an average annual rate of 1.3 percent (Table 3.9.1-1). This rate was less than the county average. Hispanics increased at an average annual rate of 5.9 percent, from 25.9 percent of the population in 1980 to 33.6 percent in 1990. Although the

number of Asians and Pacific Islanders increased at an average annual rate of 3.9 percent, they still represented only small segments of the population: 6.9 percent in 1980 and 7.8 percent in 1990. Although the black population grew at 1.9 percent average annually, their proportion of the total population declined from 6.6 percent in 1980 to 6.4 percent in 1990. American Indians, Eskimos, and Aleutian Islanders constituted 1.2 percent of the total population (3,550) in 1980 and 0.8 percent (3,017) in 1990, a decline of 1.5 percent average annually.

In 1980, 28.3 percent (82,295) of Monterey County's population was younger than 18; 62.4 percent was between the ages of 18 and 64; and 9.2 percent were was 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.

3.9.3 General Economy

The civilian labor force in Monterey County was 64,801 persons in 1980, and 85,875 in 1991 (Table 3.9.3-1). The unemployment rate dropped from 9.1 percent in 1980 to 8.8 percent in 1990. Income per capita was $19,000 in 1991.

The total county payroll (in 1989 dollars) was $1,647,000 in 1988 (Table 3.9.3-1). Among Monterey's major industrial sectors, agriculture, forestry and fishing was second in payroll growth (6.1 percent 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 percent in 1991) to the total payroll.

The total number of employees in Monterey County grew 2.2 percent average annually, from 65,000 to 86,000 (Table 3.9.3-1). Agriculture, forestry and fishing grew at 3.3 percent average annually, the fourth fastest rate. Agriculture, forestry and fishing maintained 2.2 percent of the total employees in 1991.

3.9.4 Earnings

Monterey County earnings (payroll divided by number of employees) in 1988 averaged $19,000 (Tables 3.9.3-1). Among major industrial sectors, agriculture, forestry and fishing paid sixth highest, $21,000 per employee.

3.9.5 History

The history of the sardine fishery in the Monterey area is described by Reinstedt (1978).

3.9.6 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 percent (102) lived in the Monterey city area, and 11.7 percent in the Seaside area. Some came from Pacific Grove, Marina, King City and Carmel.

TABLE 3.1-1. Total commercial landings and revenues (1989 dollars) for northern anchovy, Pacific sardine, Pacific mackerel and jack mackerel in Washington, Oregon and California by area during 1990-1994. Areas are listed from north to south.

Area	Landings (Thousands of mt)	Percent of Total	Revenues (Thousands of $)	Percent of Total
Washington	0	0.2	174	0.7
Oregon	2	1.0	25	0.1
Northern California	0	0.0	12	0.0
San Francisco Bay Area	2	1.0	471	1.9
Monterey/Santa Cruz counties	19	9.9	2,993	11.8
San Luis Obispo County	0	0.1	15	0.1
Ventura/Santa Barbara Counties	5	2.5	609	2.4
Orange and Los Angeles Counties	162	84.9	20,854	82.2
San Diego County	1	0.3	203	0.8
Other California	0	0.0	11	0.0
Total	191	100.0	25,367	100.0

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
Non-coastal	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. Reports Nos. 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	Non-coastal	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
Prvt.[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
Prvt	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
Prvt	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, Reports Nos. 8321, 8328, (Washington, D.C.:1984 and 1986) and 1989 data tables.

TABLE 3.5.2-1. Total annual expenditures for saltwater fishing ($1,000's), by expenditure category and county of residence during 1989.

County of Residence	Licenses and Gear	Boat-related Expenditures	Trip-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
Non-coastal	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	
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 1 (not at all important) to 7 (very important).

Scale	Food	Challenge	Fish	Bait	Relax	Social	Please
				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 3.7.1-1. Socioeconomic profile for Los Angeles County, 1980-1990. Data for 1980 from Kearny/Centaur (1987a). Data for 1990 from Bureau of the Census (1991) and California Employment Development Department, Labor Information Division (personal communication). All dollar values are corrected for inflation and expressed in 1989 dollars. "Asian or Pacific Islander" includes persons who reported themselves as "Chinese," "Filipino," "Japanese," "Asian Indian," "Korean," "Vietnamese," "Other Asian," "Hawaiian," "Somoan," or "Other Pacific Islander." Note that "Hispanic" denotes an ethnic group not a racial group. Racial group statistics are givien for the whole population and non-hispanic population. Statistics by racial group for hispanics can be obtained by subtraction (e.g. population of white hispanics in 1990 was 5,035,103 - 3,618,850).

	1980 Number	1980 Percent	1990 Number	1990 Percent	Annual Change
Population	7,477,503	100.0%	8,863,164	100.0%	1.9%
Population Density (persons/square mile)	1,800		2,200		2.2%
Entire Population by Racial Group					
-White	5,135,540	68.7%	5,035,103	56.8%	-0.2%
-Black	943,124	12.6%	992,974	11.2%	0.5%
-American Indian, Eskomo or Aleut	53,542	0.7%	45,508	0.5%	-1.5%
-Asian or Pacific Islander	408,876	5.5%	954,485	10.8%	13.3%
-Other race	20,565	0.3%	1,835,094	20.7%	882.3%
Hispanic Origin all Races	2,063,791	27.6%	3,351,242	37.8%	6.2%
Non-Hispanic Population by Racial Group					
-White			3,618,850	40.8%	
-Black			934,776	10.5%	
-American Indian, Eskomo or Aleut			29,159	0.3%	
-Asian or Pacific Islander			907,810	10.2%	
-Other race			21,327	0.2%	
Age					
-Under 18	2,033,881	27.2%	2,326,110	26.2%	1.4%
-18 to 64	4,703,349	62.9%	5,676,467	64.0%	2.1%
-65 and older	740,273	9.9%	860,587	9.7%	1.6%
-Median age	30		31		0.3%
All Housing Units	2,855,555	38.2%	3,163,343	35.7%	1.1%
Avg. Civilian Labor Force	3,545,000	47.4%	4,427,800	50.0%	2.5%
Civilian Unemployment Rate	0		0		-1.2%
Per Capita Income	$17,743		$19,906		1.4%

Table 3.7.3-1. Annual payroll (1989 dollars) and employment during 1980 and 1991, 1991 payroll composition, annual percent change in payroll and employment, and payroll per employee by industry during 1991 for Los Angeles County, California. Data from County Business Patterns, U.S. Dept. of Commerce (1982, 1993). Excludes government employees, railroad employees and self employed persons. "D" denotes figures withheld to avoid disclosing data about specific companies. Employment sizeclasses are used in some cases to protect confidential information (size class A = 0 to 19 persons, B = 20 to 99 persons, C = 100 to 249 persons, E = 250 to 499 persons, F = 500 to 999 persons, G = 1,000 to 4,999 persons and H = 5,000 to 9,999 persons).

	1980 Payroll ($1,000)	1991 Payroll ($1,000)	1991 Payroll (%)	Payroll Annual % Change	Employment 1980	Employment 1991	Employment Annual % Change	1991 Payroll/ Employment ($1,000 (per Employee)
Total - All Industries	$73,189,138	$92,037,742	100.0%	2.3%	3,184,578	3,701,167	1.3%	$25
Agricultural Services, Forestry and Fis	$191,321	$275,253	0.3%	4.0%	10,622	16,059	3.1%	$17
- Fishing, Hunting and Trapping	$34,806	D			823	C		
Mining	$350,043	$234,872	0.3%	-3.0%	9,207	6,711	-3.4%	$35
Construction	$4,192,140	$3,732,593	4.1%	-1.0%	139,204	142,040	0.2%	$26
Manufacturing	$24,020,507	$22,845,718	24.8%	-0.4%	964,761	808,265	-1.8%	$28
- Canned and Cured seafoods	D	$17,195	0.0%		H	954	9.1%	$18
- Prepared Fresh and Frozen Fish	$23,418	$31,279	0.0%	3.1%	1,538	1,705	0.9%	$18
- Ship and Boat Building and Repair	$170,130	D			5,614	G		
- Ship Building and Repair	$148,750	$20,461	0.0%	-7.8%	4,559	566	-64.1%	$36
- Boat Building and Repair	$21,380	D			1,055	F		
Transportation and Public Utilites	$5,910,853	$6,233,968	6.8%	0.5%	189,591	214,839	1.1%	$29
Wholesale Trade	$6,786,725	$8,640,621	9.4%	2.5%	244,839	299,094	1.6%	$29
- Fish and Seafood	$25,847	$37,980	0.0%	4.3%	1,161	1,756	3.1%	$22
Retail Trade	$7,665,416	$8,794,434	9.6%	1.3%	532,703	633,987	1.5%	$14
- Meat and Fish (seafood) Markets	$27,515	$23,751	0.0%	-1.2%	1,903	21,217	8.3%	$1
- Sporting Goods Stores and Bicycle Sho	$47,049	$62,289	0.1%	2.9%	4,164	5,081	1.6%	$12
Finance, Insurance and Real Estate	$5,868,249	$8,681,228	9.4%	4.4%	253,572	286,760	1.1%	$30
Services	$17,311,456	$32,409,954	35.2%	7.9%	815,283	1,287,605	3.3%	$25
- Amusement and Recreation	$87,127	$1,671,703	1.8%	165.3%	5,200	49,780	8.1%	$34

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/]

		Ethnicity						
Fishing Year		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 3.9.1-1. Socioeconomic profile for Monterey County, 1980-1990. Data for 1980 from Kearny/Centaur (1987). Data for 1990 from Bureau of the Census (1991) and California Employment Development Department, Labor Information Division (personal communication). All dollar values are corrected for inflation and expressed in 1989 dollars. "Asian or Pacific Islander" includes persons who reported themselves as "Chinese," "Filipino," "Japanese," "Asian Indian," "Korean," "Vietnamese," "Other Asian," "Hawaiian," "Somoan," or "Other Pacific Islander." Note that "Hispanic" denotes an ethnic group not a racial group. Racial group statistics are givien for the whole population and non-hispanic population. Statistics by racial group for hispanics can be obtained by subtraction (e.g. population of white hispanics in 1990 was 227,008 - 186,166).

	1980 Number	1980 Percent	1990 Number	1990 Percent	Annual Change
Population	290,444	100.0%	355,660	100.0%	2.2%
Population Density (persons/square mile)	88	0.0%	107	0.0%	2.2%
Entire Population by Racial Group					
-White	201,278	69.3%	227,008	63.8%	1.3%
-Black	19,169	6.6%	22,849	6.4%	1.9%
-American Indian, Eskomo or Aleut	3,550	1.2%	3,017	0.8%	-1.5%
-Asian or Pacific Islander	20,072	6.9%	27,856	7.8%	3.9%
-Other race	46,761	16.1%	74,930	21.1%	6.0%
Hispanic Origin all Races	75,225	25.9%	119,570	33.6%	5.9%
Non-Hispanic Population by Racial Group					
-White			186,166	52.3%	
-Black			21,506	6.0%	
-American Indian, Eskomo or Aleut			2,124	0.6%	
-Asian or Pacific Islander			25,365	7.1%	
-Other race			929	0.3%	
Age					
-Under 18	82,295	28.3%	97,951	27.5%	1.9%
-18 to 64	181,364	62.4%	223,012	62.7%	2.3%
-65 and older	26,785	9.2%	34,697	9.8%	3.0%
-Median age	28		30		0.6%
All Housing Units	103,557	35.7%	121,224	34.1%	1.7%
Avg. Civilian Labor Force	124,740	42.9%	160,600	45.2%	2.9%
Civilian Unemployment Rate	0		0		-0.3%
Per Capita Income	$16,427		$17,622		0.8%

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Table 3.9.3-1. Annual payroll (1989 dollars) and employment during 1980 and 1991, 1991 payroll composition, annual percent change in payroll and employment, and payroll per employee by industry during 1991 for Monterey County, California. Data from County Business Patterns, U.S. Dept. of Commerce (1982, 1993). Excludes government employees, railroad employees and self employed persons. "D" denotes figures withheld to avoid disclosing data about specific companies. Employment sizeclasses are used in some cases to protect confidential information (size class A = 0 to 19 persons, B = 20 to 99 persons, C = 100 to 249 persons, E = 250 to 499 persons, F = 500 to 999 persons, G = 1,000 to 4,999 persons and H = 5,000 to 9,999 persons).

	1980 Payroll ($1,000)	1991 Payroll ($1,000)	1991 Payroll (%)	Payroll Annual % Change	Employment 1980	Employment 1991	Employment Annual % Change	1991 Payroll/ Employment ($1,000 (per Employee)
Total - All Industries	$1,134,817	$1,647,483	100.0%	4.1%	64,801	85,875	2.2%	$19
Agricultural Services, Forestry and Fish	$23,931	$41,206	2.5%	6.6%	1,224	1,938	3.3%	$21
Mining	$18,032	$1,778	0.1%	-8.2%	521	62	-67.3%	$29
Construction	$87,931	$103,935	6.3%	1.7%	3,402	4,422	2.1%	$24
Manufacturing	$190,153	$212,778	12.9%	1.1%	8,947	8,337	-0.7%	$26
- Prepared Fresh and Frozen Fish	D	D			C	E		
Transportation and Public Utilites	$87,773	$129,164	7.8%	4.3%	3,729	4,782	2.0%	$27
Wholesale Trade	$102,234	$146,701	8.9%	4.0%	4,246	5,042	1.4%	$29
Retail Trade	$251,514	$315,038	19.1%	2.3%	19,321	24,591	1.9%	$13
- Meat and Fish (seafood) Markets	$761	$624	0.0%	-1.6%	58	61	0.4%	$10
- Sporting Goods Stores and Bicycle Shops	$1,070	$2,594	0.2%	13.0%	114	208	4.1%	$12
Finance, Insurance and Real Estate	$86,939	$123,427	7.5%	3.8%	4,689	5,701	1.6%	$22
Services	$278,598	$570,487	34.6%	9.5%	18,055	30,821	3.8%	$19
- Amusement and Recreation	$2,127	$21,487	1.3%	82.8%	211	1,552	7.9%	$14

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 Is. 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

1.0 OPTIONS AND ANALYSES FOR COASTAL PELAGIC SPECIES FISHERY MANAGEMENT PLAN

This appendix explains the need and justification for the Fishery Management Plan (FMP) for Coastal Pelagic Species (CPS). All of the options and analyses considered in its development are described. Stocks and fisheries are described in detail in Appendix A to the FMP for CPS.

1.1 Introduction

CPS are found in the exclusive economic zone (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 market squid, 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, foreign catcher and processor vessels, foreign vessels engaged in joint ventures, party and charter boats that carry anglers, and other anglers who target coastal pelagic species or use them as bait.

CPS are taken directly and as bycatch 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 mackerel are currently managed by the California Department of Fish and Game (CDFG) under state laws. 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.

Northern anchovy and sardine are forage for (1) 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); (2) one marine mammal species (Northern or Steller's sea lion) classified as threatened under the ESA; and (3) one marine mammal species (northern fur seal) classified as depleted under the Marine Mammal Protection Act.

CPS are taken in both state and federal waters. CDFG staff estimate that roughly 95 percent 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 percent of Pacific mackerel, 50 percent of jack mackerel, and 50 percent 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 1994 are given in Table 1.0-1. Together, these species account for most of the landings in the CPS fishery. Landings of anchovy and mackerels were relatively low during 1994 due to poor availability and low prices. Landings of sardine were relatively low because of reduced quotas. Reduced sardine quotas in 1994 were likely due to El Niño effects on biomass estimates, rather than reduced abundance. The sardine quota for 1995 has been about 55,000 mt per year. In contrast, squid landings increased in 1994 to record levels due to improved availability and higher prices. Nineteen processing plants in California handled about 95 percent of total CPS and squid landings. Of these, there were eight plants that processed at least 500 mt of CPS and eleven plants that processed at least 500 mt of CPS plus squid.

Market squid are an important species in the CPS fishery but would not be managed by the Council at the outset of this FMP because: (1) no problem requiring immediate management attention exists in the squid fishery; (2) there is no industry support for Council management of squid at this time; (3) there is too little information available about biology, stock status and productivity; and (4) there is no way at present to track trends in abundance. It will be possible, however, for the Council to manage squid or other pelagic species taken in the CPS fishery in the future without amending this FMP if it becomes desirable or necessary.

Despite poor conditions in the fishery during 1994, CPS contributed a significant fraction of total commercial landings in California (Table 1.0-2) with all CPS and squid being among the nine species with highest landings. CPS contributions to total revenue (with the exception of squid) were smaller due to low prices. For comparison, total landings and revenues in California during 1994 were about 138,000 mt and $134 million. Species that would be actively managed under the CPS FMP (anchovy, mackerels and sardine) contributed about 21 percent of total landings and 5 percent of total revenues. Including market squid, CPS contributed about 55 percent of total landings and about 17 percent of total revenues. The condition of the CPS fishery is expected to improve in the near term because of increased sardine biomass and higher California sardine quotas (about 55,000 mt in the 1994 season worth, assuming $100/mt, about $5.5 million).

1.2 Need for FMP Management

Consolidation of responsibilities for CPS under a single FMP would make management of directed fisheries and bycatch more efficient and effective. Bycatch is common in the CPS fishery but would be difficult to manage under conditions that might well occur. For example, it would be difficult under current conditions for federal authorities to manage anchovy bycatch in the directed sardine fishery, which is managed by California, if the current downward trend in anchovy abundance were to continue and the stock became overfished.

Management of all CPS under a single FMP will facilitate cooperative international management. CPS are transboundary resources shared by the U.S., Mexico and, to a lesser extent, 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. Sardine and Pacific mackerel have been taken recently 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 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 is reduced further.

The United States, 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 United States ad Mexico will both sign. The new agreements and climate of cooperation between the United States 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.

In the absence of an FMP for CPS, it is likely that scientific expertise and capability in National Marine Fisheries Service (NMFS) will deteriorate rapidly in the short term to the point where collection of data, monitoring, stock assessment, and field studies are not possible. NMFS is downsizing and reductions in staff and support can be expected in areas where federal responsibilities are not clearly defined. Reductions may result from reprogramming or vacancies from retirement or transfers that are not filled. The number of NMFS staff working on CPS has declined over the last two decades and is currently at the minimum effective number. Thus, further reductions may permanently reduce science and management capacity of NMFS.

NMFS has informally agreed to continue assisting California with management of CPS if an FMP for CPS is not implemented but details have not been spelled out and the policy may not be possible beyond the short term without an FMP.

An FMP for CPS and continued federal involvement in the fishery will facilitate exchange of information necessary for management of CPS in U.S. waters. Landings, age composition, and other data from Mexico (and potentially Canada) are required for biomass assessments used by federal and state authorities to set harvest guidelines and quotas for CPS fisheries in U.S. waters. Federal involvement lends weight and urgency to international requests for data from federal agencies in Mexico and Canada.

An FMP for CPS and continued federal involvement in the fishery is 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 CalCOFI (California Cooperative Oceanic Fishery Investigation) 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, likely if the CPS FMP is not adopted and federal responsibilities not clearly defined, would make CalCOFI data useless and undermine management of all CPS.

An FMP for CPS and continued federal involvement in the fishery is essential for effective scientific cooperation. Field surveys for direct estimation of CPS biomass must be conducted in Mexican as well as U.S. waters. These surveys are too large and complicated in scope to be managed by California and Mexican scientists without assistance from NMFS.

There is a high probability for rapid development of CPS, particularly sardine, fisheries that could not be managed effectively without an FMP. Pacific sardine biomass has increased by about 35 percent per year since 1983 and is currently around 350,000 mt. As sardine biomass increased, fishing opportunities in northern areas (e.g. Monterey County, California) 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 1 million mt. Catches off Oregon, Washington, and outside state waters (50 percent of Pacific sardine are taken in federal waters) could not be managed under existing California regulations. The Magnuson Fishery Conservation and Management Act (MFCMA) may be amended to extend state regulations out to the 200 mile limit, but the problem of managing and enforcing regulations for a stock harvested in three states remains.

An FMP for CPS facilitates limited entry management in the CPS fishery. The CPS fishery is currently managed under open access although some form of limited entry would probably be beneficial. California could develop a limited entry plan unilaterally but vessels from other states could freely enter the fishery as long as fish were landed in Oregon, Washington or offshore.

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. The collapse of the historical sardine fishery in the 1950's 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 fishery (including the factory trawler fleet), for example, that could enter the CPS fishery in a matter of months if markets for sardine were to develop.

NMFS could manage CPS under emergency authority if a crisis were to develop. Recent experience in Alaska with management of the scallops suggests, however, that the 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. There would be substantial bycatch of other CPS if an offshore fishery for jack mackerel developed. 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 bycatch could not be managed in the absence of an FMP under current regulations.

At the present time, neither NMFS nor CDFG have enough scientific or monitoring resources to manage CPS on their own but their combined resources are 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 mackerel and sardine which are the mainstay of the CPS fishery. Federal resources available for management of northern anchovy are eroding slowly but at a rate that will probably 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.

Costs for implementing the CPS FMP are low relative to all alternatives including the status quo, even if a license limitation system is adopted. Estimates of annual recurrent costs prepared by NMFS are summarized below (see below and details in Appendix C). Most of the costs in writing the plan have already been expended.

Annual Costs of Options for Managing CPS

	Administrative Costs	Science Costs	Enforcement Costs	Total Costs
Drop the anchovy FMP	$162,460	$0	$0	$162,460
Status-quo	$10,398	$162,460	$13,250	$186,108
Amend the anchovy FMP	$10,398	$162,460	$13,250	$186,108
FMP for CPS (with license limitation)	$24,416	$290,695	$20,252	$335,363

Costs under the CPS FMP could be supported at near status-quo costs if necessary. The difference in total costs between the status-quo and the FMP for CPS ($149,000) is primarily increased science costs of about $128,000 due to increasing the frequency of research surveys. More frequent research surveys would be desirable but are not essential. If necessary, CPS could be managed with surveys conducted at current intervals.

Current regulations for northern anchovy prohibit reduction fishing at typical biomass levels and tend to reduce average biomass levels. The CPS FMP includes options that allow at least a moderate fishery at typical biomass levels while maintaining adequate forage for dependent species including the endangered brown pelican and least tern. This problem could be addressed by amending the FMP for northern anchovy but the anchovy fishery is relatively small and costs would be nearly the same as implementing a more comprehensive and effective FMP for all CPS.

Industry strongly supports an FMP and limited entry 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.

An FMP for CPS would conform to NMFS stated policy of risk averse management which is described in "The Strategic Plan of the National Marine Fisheries Service--Goals and Objectives, June 10, 1991" (see Goal 2) and in "Our Living Oceans" (December 1993, p. 24). Risk averse management is particularly important for CPS which are highly variable, currently at low abundance levels but potentially very productive, and ecologically important as forage for predators that include sportfish and endangered species. Pacific mackerel abundance has declined in recent years to low levels (Barnes 1995) and management actions in the near future will affect the long-term health of the resource. Pacific sardine abundance is increasing but the long-term condition of the stock is uncertain because abundance is still low relative to that would provide maximum sustained yield. Current state management regulations are less conservative and less risk averse than preferred options in the CPS FMP. Harvest of CPS in Mexican waters is not explicitly considered under state regulations so that combined harvest rates in the U.S. and Mexico could be too high.

The CPS FMP breaks new ground in fisheries management by using harvest policies that specify optimum yield (OY) directly as a function of biomass rather than by calculating allowable biological catch (ABC) and then making adjustments for socioeconomic conditions. The single step approach to specifying OY for CPS reduces the chances of overfishing due to OY being set higher than justifiable on biological grounds.

The Council and NMFS risk alienating constituents in central and southern California if the CPS FMP is not adopted. Industry and recreational fishing representatives support and invested considerable time and energy in developing the CPS FMP prior to the unexpected withdrawal of NMFS support in 1993. It is well known that one of the NMFS science centers (the Southwest Fisheries Science Center) was built to address problems in the sardine fishery. In addition, the importance of sardine and anchovy as forage and bait for gamefish is well known and perceptions about adverse effects of large scale commercial fishing on gamefish are common. Thus, it is likely that support among a large body of constituents for the Council and federal fisheries management processes would slip if the CPS FMP is not implemented. In addition, resources invested in developing the draft FMP would be wasted.

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 at relatively low, near status quo costs. Fisheries in southern and central California, other than a minor fishery for northern anchovy and the groundfish fishery that operates primarily in northern areas, are not adequately served by the Council or NMFS. Only one of the nine species with largest landings in California (Dover sole) is actively managed by the Council with support from NMFS (Table 1.0-2).

1.3 History of the FMP

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 Secretary of Commerce 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 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 5-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 MFCMA. 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.

1.3.1 History of Amendment 7

The Council began developing an FMP for CPS on a motion from NMFS and California in 1990. A complete draft was available in November of 1993 when Council suspended further work after 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. Costs and analysis for all options are given in an appendix.

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 CPS Plan Development Team. At the June meeting in 1994, the Council adopted a draft plan that had been revised to address comments provided by NMFS and the SSC.

TABLE 1.0-1. Landings, prices, revenues and percent of total revenues for the principal species in the CPS fishery during 1994.

	Landings (round wt, mt)	Average Price ($/mt)	Revenue ($1,000)	Percent Total Revenue
Anchovy[a/]	3,680	490	1,803	8 percent
Mackerel[b/]	12,194	141	1,718	8 percent
Sardine[c/]	13,420	207	2,783	12 percent
Squid	46,784	345	16,126	72 percent

a/ Includes 1,923 mt of live bait at $681/mt and 1,757 mt landed at $281/mt
b/ Pacific mackerel plus jack mackerel plus unspecified mackerel
c/ Includes 1,487 mt of live bait at $681/mt and 11,933 mt landed at $148/mt

TABLE 1.0-2. Landings and revenues for the most important species landed in California during 1994.

Species	Landings (round wt, mt)	Calif. Landings Rank Order	Revenue ($1,000)	Calif. Revenue Rank Order
*Market squid	46,784	1	16,126	2
*Sardine[a/]	13,420	2	2,783	13
*Mackeral[b/]	12,194	3	1,718	19
Red sea Urchin	9,636	4	21,853	1
Pink shrimp	5,125	5	6,604	5
Yellowfin tuna	4,652	6	4,210	9
Dungeness crab	4,588	7	14,537	3
Dover sole	4,326	8	2,788	11
*Anchovy[c/]	3,680	9	1,803	17

* Taken in the CPS fishery
a/ Includes 1,487 mt of live bait at $681/mt and 11,933 mt landed at $148/mt
b/ Pacific mackerel plus jack mackerel plus unspecified mackerel.
c/ Includes 1,923 mt of live bait at $681/mt and 1,757 mt landed at $281/mt

2.0 FRAMEWORK MANAGEMENT APPROACH

A framework approach to management of Coastal Pelagic Species (CPS) fisheries is essential because it allows necessary changes and modifications to be made in a timely and efficient manner without the need to amend the fishery management plan (FMP). CPS stocks are naturally dynamic, highly responsive to environmental conditions, and subject to wide fluctuations in abundance and distribution. Management measures may have to be modified in the future to accommodate changes in the status of endangered species (e.g. brown pelican and least tern) or other predators. The fishery is currently in a state of flux, and it is difficult to predict what the characteristics of the fleet and fishery will be in the future. The CPS fishery is a multispecies fishery with bycatch. Changes in abundance of CPS will result in bycatch, geographic allocation, and other issues that will have to be addressed.

The FMP establishes the fishery management program for CPS and the process and procedures the Council will follow in making adjustments to that program. It also sets the limits of management authority of the Council and the Secretary when acting under the FMP. Management measures implementing the FMP, which directly control fishing activities, must be consistent with the goals and objectives of the FMP, the Magnuson Fishery Conservation and Management Act (MFCMA), and other applicable law. Since the FMP provides several general framework procedures for making management decisions, not all management measures authorized by the FMP will be implemented at any given time. Management decisions made under the framework procedures outlined in the FMP are intended to be implemented without the need to amend the FMP.

The FMP establishes two framework procedures through which the Council is able to recommend the establishment and adjustment of specific management measures for the CPS fishery. The "points of concern" framework allows the Council to develop management measures in response to resource conservation issues. The "socioeconomic" framework allows the Council to develop management measures in response to social, economic, and ecological issues that affect the fishing community. Associated with each framework is a set of criteria that forms the basis for Council recommendations and with which Council recommendations will be consistent.

This FMP also establishes a general process for developing and implementing management measures that normally will occur over the span of at least two Council meetings, with an exception that provides for more timely Council action under certain specific conditions.

The FMP presumes the Secretary will publish management measures recommended by the Council in the Federal Register as either "notices" or "regulations." Generally, management measures of broad applicability and permanent effectiveness are intended to be published as "regulations." Measures more narrow in their applicability, meant to be effective during the current fishing year only, and that might require frequent adjustment are intended to be published as "notices."

The National Marine Fisheries Service (NMFS) Regional Director will review the Council's recommendation, supporting rationale, public comments, and other relevant information. If the recommendation is approved, the Regional Director will undertake the appropriate method of implementation. Rejection of the recommendation will be explained in writing.

Framework management does not affect the authority of the Secretary to take emergency regulatory action as provided for in Section 305(e) of the MFCMA if an emergency exists. Nor does framework management affect the Secretary's authority to take other regulatory action as may be necessary under Section 305(g) of the MFCMA.

2.1 List of Management Measures

Fishing mortality is the only factor affecting fish abundance that can be effectively controlled in the ocean. The principal measures used to control fishing mortality in the CPS fishery include but are not limited to: harvest guidelines, quotas, landing limits, trip frequency limits, allocation, mesh size, bycatch restrictions,

time/area closures, prohibited species, bag and size limits, fishing effort control (license limitation and individual transferable quotas), reporting requirements, other types of controls on fishing gear, and on board observers. These measures may be used to address socioeconomic issues in the CPS fishery as well. This section of the FMP describes these measures and their general application for management of the CPS fisheries in the Washington, Oregon, and California region.

The FMP authorizes the promulgation of regulations necessary to enforce the provisions of the FMP and its implementing regulations through the appropriate rule making procedures. This document discusses in detail certain management measures, but other types of management measures may have valid applicability and are intended to be available to the Council providing they are consistent with the criteria and general procedures contained in this FMP.

2.1.1 Harvest Guidelines

A harvest guideline is a numerical harvest objective which differs from a quota in that closure of a fishery (prohibition of retention, possession or landing) is not automatically required when the guideline is reached. A harvest guideline may be a range or a point estimate. Bycatch may be allowed after a harvest guideline is reached although some allowance for bycatch is usually made when the harvest guideline is set.

2.1.2 Quotas

Quotas are specified harvest limits, the attainment of which causes closure of the fishery for that species, gear type, or geographic area. Quotas may be established for intentional allocation purposes, to terminate harvest at a specified point, or for other purposes. They may be specified for a particular area, gear type, time period, species, or species group.

2.1.3 Bycatch

Bycatch of CPS is expected in the CPS fishery because different species school together. Regulation of bycatch is necessary to limit or prohibit the take of a species that occurs incidentally in the catch of another CPS. Species may be regulated under bycatch regulations because the incidental CPS is overfished, to include some harvests beyond a quota or harvest guideline, or for other reasons. Management measures to regulate bycatch include but are not limited to bycatch allowances or overall incidental reserves that are subtracted from the total harvest guideline.

2.1.4 Time/Area Closures

Time/area closures (seasons and closed areas) have traditionally been used to regulate fisheries when harvest limits were reached. In addition, they have also been used to restrict fishing when fish condition (oil and/or fat content) made fish undesirable. Time/area closures may also be used to reduce conflict between user groups or for other uses.

2.1.5 Landing Limits and Trip Frequency Limits

A trip or landing limit is the amount of CPS that may be taken and retained, possessed, or landed from a single fishing trip or during a specified period of time. A trip frequency limit is a limit on the number of trips during a specified period of time. Trips may be defined in various ways depending on circumstances. Trip landing limits and trip frequency limits are used to delay achievement of a quota or harvest guideline and avoid premature closure of a fishery or for other reasons. They can be utilized to minimize targeting on a species while allowing landings of some level of incidental catch. Trip landing and frequency limits may also be used to discourage waste by limiting landings to amounts that can be utilized by available markets and/or processing capabilities. Trip landing and frequency limits are most effective in fisheries where the fisher can control what is caught. Prohibited species (species that may not be retained or landed) are an extreme example of landing limits.

2.1.6 Allocation

Allocation is the apportionment of harvest to a particular person or group of persons. Allocation is commonly a numerical quota or harvest guideline for a specific gear, fishery sector, geographic area, use, or vessel category but may arise from any other type of management measure. Most fishery management measures allocate fishery resources to some degree because they differentially affect access to the resource by different fishery sectors. Allocation impacts that are not intentional are considered to be indirect, or unintentional, allocations. Direct allocation occurs when numerical quotas, harvest guidelines, or other management measures are established with the specific intent of affecting a particular group's access to the fishery resource.

Fishery resources may be allocated to accomplish a single biological, social or economic objective, or a combination of such objectives. The entire resource, or a portion, may be allocated to a particular group, although the MFCMA requires that allocation among user groups be determined in such a way that no group, person, or entity receives an undue share of the resource. The socioeconomic framework provides criteria for direct allocation. Allocation impacts of all proposed management measures should be analyzed and discussed in the Council's decision making process.

This FMP authorizes allocations including, but not limited to, those specified in this section as well as any inseason adjustments to such allocations that the Council determines necessary.

2.1.7 Size Limits

Size limits are used to prevent the harvest of small or large fish. Small fish are often immature fish or have not reached their full reproductive capacity. Large fish may be important in reproduction. Size limits can be applied to all fisheries, but are generally used where fish are handled individually or in small groups such as by hook and line or by anglers. Size limits may lose their utility in cases where the survival of the fish returned to the sea is low.

2.1.8 Mesh Size

Restrictions on the minimum size of mesh used in nets is a common management measure that may be used for CPS. By increasing or decreasing mesh size, it is possible to increase or decrease the size of fish retained in the net to a limited degree. Control over the size of fish taken by the fishery can ensure that sufficient numbers of immature or mature fish pass through the net to protect the long-term productivity of the resource. Mesh size also can be adjusted to maximize yield.

A single mesh size is unlikely to provide the desired size or age harvested for all species. In a multispecies fishery, a single mesh size will tend to over harvest some species while overprotecting others. Ideally, the selected mesh size should tend to maximize the economic yield to the fishery over the long term.

2.1.9 Bag Limits

Methods for controlling recreational fishing include, but are not limited to, bag limits. The intended effect of bag limits is to reduce the overall catch, to spread the available catch over a large number of anglers and to avoid waste.

2.1.10 Other Forms of Effort Control

Effort limitation in its most general interpretation includes almost all measures that restrict fishing activities. Of particular interest, however, are limited entry programs such as limitation on the number of fishing licenses or vessels (license limitations) and individual transferable quotas.

2.1.11 Other Controls on Fishing Gear

Other forms of controls include but are not limited to restrictions on the number of units of gear or restrictions on the size of nets, the number of hooks or pots, the size of vessels, or escape panels and ports.

2.1.12 Reporting and Observer Programs

Data reporting and on board observer programs are used to collect detailed and accurate data required under some circumstances.

2.2 Species Managed

This FMP will be used at the outset to manage Pacific sardine, northern anchovy, Pacific mackerel and jack mackerel. It is appropriate, however, for managing any species that is pelagic or associated with the CPS fishery. Species that could be managed under this FMP include, but are not limited to:

Pacific saury	*Cololabis saira*
Northern anchovy	*Engraulis mordax*
Market squid	*Loligo opalescence*
Pacific bonito	*Sarda chiliensis*
Pacific herring	*clupea harengus*
Pacific sardine	*Sardinops sagax*
Pacific (chub or blue) mackerel	*Scomber japonicus*
Jack (Spanish) mackerel	*Trachurus symmetricus*

Market squid is one of the most important species in the CPS fishery but would not be managed by Council at the outset of this FMP because: (1) no situation requiring immediate management attention exists in the squid fishery; (2) there is no industry support for Council management of squid at this time; (3) there is too little information available about biology, stock status and productivity; and (4) there is no way at present to track trends in abundance. It will be possible, however, for Council to commence management of squid in the future without amending this FMP if it becomes desirable or necessary.

2.3 Experimental and Exploratory Fishing

The objectives of this FMP include full utilization and promotion of efficiency and profitability. In order to accomplish these objectives, it is necessary to permit domestic experimental and exploratory fishing (recreational or commercial) for CPS. "Experimental fishing" and "exploratory fishing" are used synonymously in this FMP and defined to be fishing practices that are new to the fishery or not allowed under the FMP. In practice, exploratory fishing is usually a type of experimental fishing undertaken to locate concentrations of fish.

2.4 Procedure for Reviewing State Regulations

There are and will continue to be state regulations affecting CPS fisheries off the West Coast which are in addition to federal regulations. This potential extends to waters off all three West Coast states, to all gear types, and to both commercial and recreational fisheries. In some cases, it may be desirable to ensure consistency between state and federal regulations by implementing federal regulations that complement state regulations. In other cases, Council may determine that federal regulations are not necessary to complement state regulations, but wish to assure a state that its regulations are consistent with the FMP insofar as they are applied to vessels registered in that state when fishing in the exclusive economic zone. The CPS FMP establishes a framework review process by which any state may petition the Council to initiate a review of its regulations, determine consistency with the FMP, and if appropriate, recommend the implementation of complementary federal regulations.

3.0 LIMITED ENTRY IN THE COASTAL PELAGIC SPECIES (CPS) FISHERY

3.1 Background

Seven fishery segments currently harvest CPS or squid: (1) the directed roundhaul fishery for CPS; (2) the live bait fishery for CPS; (3) the dead bait fishery for CPS; (4) the incidental fishery for CPS; (5) the small boat fishery for CPS; (6) the directed fishery for squid, and (7) the recreational fishery. Three fishery segments potentially, but do not now, harvest significant quantities of CPS: (1) California gill and trammel net fishers affected by the California Marine Resources Protection Act (MRPA, also know as Proposition 132); (2) the factory trawler fleet; and (3) the offshore trawl fleet. Although each segment is well known and recognized, there is a great deal of overlap (e.g., among the gill and trammel net, small boat and incidental segments). The directed roundhaul fisheries for CPS and squid are particularly similar and tend to overlap. As shown below, each of these segments can be assigned to three categories: present participants, historical participants, and potential participants.

3.1.1 Present Participants

Since the late 1970s, about 40 California round haulers based in San Pedro (and to a lesser extent Port Hueneme and Monterey) have accounted for well over 90 percent of total statewide landings of mackerel and anchovy. These vessels have also been major participants in the sardine fishery since the lifting of the moratorium on directed harvest in 1987. Historically the fleet's CPS landings have been 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, many of these vessels also target market squid, Pacific bonito, bluefin tuna, and Pacific herring.

Other vessels target CPS in small quantities and usually sell their landings to specialty markets for relatively high prices. These include:

a. about eighteen live bait boats in southern California and two boats in Oregon and Washington that take about 5,000 mt per year of CPS (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. round haul vessels that take a maximum of 1,000-3,000 mt of anchovy per year that are sold as dead bait to recreational anglers; and

c. round haul and other mostly small vessels that target CPS (particularly mackerel and, to an increasing extent during recent years, sardine) for sale in local fresh fish markets or canneries.

Many other vessels land CPS incidentally on a routine basis while targeting other species.

3.1.2 Historical Participants

Approximately 200 boats participated in the sardine fishery during its heyday in the 1940s and 1950s. Many round haulers previously described as present participants in the CPS fishery are remnants of the sardine fleet. Other remnants of the fleet can be found among round haulers that target squid but land zero or very small amounts of CPS (primarily near Monterey, California). Although vessels in this segment may not have fished CPS during the Council's window period, many of them participated (or are the successors of boats that participated) in the historical sardine fishery, use the same type of gear used in the directed CPS fishery, and would likely be interested in resuming fishing for mackerel and sardine when fish become more available in northern areas such as Monterey.

3.1.3 Potential Participants

The largely unexploited population of jack mackerel has stimulated new interest in CPS fishing by factory trawlers and offshore trawl boats. Interest to date has focussed on underutilized jack mackerel although small amounts (hundreds of tons per year) of Pacific mackerel are often taken as bycatch north of 39° latitude in the offshore trawl fishery for Pacific whiting, particularly when waters are warm due to El Niño. Available evidence indicates that there will be significant bycatch of Pacific mackerel and sardine in any offshore fishery for jack mackerel. Allocation of jack mackerel, Pacific mackerel and sardines among factory or offshore trawlers and present participants will, therefore, probably be required if an offshore fishery develops.

3.2 Window Period and Fishery Performance

In November of 1991, the Council established a window period from January 1, 1986 to November 13, 1991 (inclusive) for defining present participants in the CPS fishery and for use in establishing a limited entry management system. The analysis and options that follow consider landings and trips during the window period. Landings of CPS only and combined CPS and squid are considered because squid is an important component of the CPS fishery (although squid would not be actively managed at the outset of this fishery management plan (FMP)), and because of options (described below) for basing initial allocation of permits on CPS plus squid landings.

Total CPS landings and numbers of CPS trips were fairly constant during 1986 to 1991 (see below). A large fraction of trips (40 percent) during 1986 to 1991 resulted in harvests of less than 1 mt of CPS per trip and a minuscule fraction (less 0.3 percent of the total) of total CPS harvested. A modest fraction of total CPS landings (6 percent) was taken during trips of intermediate size (1 to 10 mt). About 94 percent of all CPS harvested were taken during trips that landed more than 10 mt (Tables 3.2-1 and 3.2-2).

Year	Total CPS Landings	Total CPS Trips
1986	54,710 mt	3,500
1987	56,630 mt	3,571
1988	58,536 mt	2,978
1989	61,726 mt	3,502
1990	48,030 mt	3,696
1991	45,386 mt	3,031
Average	54,169 mt	3,380

Ten mt of CPS per trip is a useful criterion for distinguishing between "small" boats that harvest small amounts of CPS using a variety of gear (gill nets, hook-and-line, seines, dipnets, etc.) for sale to fresh fish and other specialty markets and "large" boats that harvest larger amounts of CPS primarily by purse seine for sale to canneries and reduction facilities. The 10 mt per trip criterion for distinguishing between small and large vessels is supported by industry proposals in letters to the Council and discussions with industry representatives. The proposals and discussions all indicate that small boats delivering to specialty markets seldom make CPS landings in excess of 5 to 10 mt per trip. Thus, available information and common knowledge indicate that 10 mt per trip is a good estimate of the upper limit on landings by small boats. Large purse seiners in the directed fishery for CPS have large holds and usually land more than 10 mt of CPS per trip.

On the basis of the available data and information, incidental landings are defined as 1 mt of CPS or less per trip, small boat landings are defined as more than 1 mt but no more than 10 mt of CPS per trip and large boat landings are defined as landings larger than 10 mt of CPS per trip. The significance of these

definitions lies in their relationship to total landings during the window period of CPS and CPS plus squid (Tables 3.2-1 and 3.2-2). Boats that landed less than 20 mt of CPS and squid or CPS only during the window period typically landed less than 1 mt of CPS per trip on average. Boats that landed at least 20 mt but less than 400 mt of CPS and squid, or of CPS only, typically landed more than 1 mt of CPS per trip but less than 10 mt per trip on average. Boats that landed 400-800 mt or more of CPS plus squid or CPS alone, typically landed more than 10 mt of CPS per trip on average. Thus, there is good correspondence between total landings per vessel during the window period, average landings of CPS per trip, and the definitions for incidental, small boat and large boat landings.

In Table 3.2-3, principal gear is defined as the gear that accounted for a plurality (largest share) of the vessel's total landings (all species) during the window period. Two things should be noted about the principal gear designation:

1. "Net" gear not specifically identified as gillnet, trawl net, etc. on the fish ticket is included under the same Pacific Coast Fisheries Information Network (PacFIN) gear code as roundhaul gear. For this reason, the "Roundhaul/Other Net" gear category likely includes some vessels whose principal gear is a net gear other than roundhaul.

2. "Other/Unspecified" gear includes vessels whose principal gear is (a) a reported gear other than roundhaul/other net, line, pot/trap, dipnet, trawl (e.g., gillnet, dredge), or (b) unspecified on fish tickets. Some boats with unspecified gear may be roundhaulers.

Principal county is defined in Table 3.2-4 as the county in which a vessel landed a plurality of its catch (all species) during the window period.

According to Table 3.2-3, 833 boats made at least one CPS landing and 975 boats made at least one CPS and/or squid landing during the window period. Using a minimum landings criterion of 400 mt of CPS (no squid) during the window period as the definition of large boats and 20 mt of CPS (no squid) as the definition of small boats, there are 56 small boats and 56 large boats. Using 400 mt of CPS and squid as the minimum landings criterion, the number of small boats increases to 66 and the number of large boats increases to 83. Most of the small and large boats are classified as roundhaul vessels.

Using a minimum landings criterion of 800 mt of CPS (no squid) during the window period to define large boats and a minimum landings criterion of 20 mt of CPS (no squid) to define small boats, there are 61 small boats and 51 large boats. Using 800 mt of CPS and squid as the landings criterion, the number of small boats increases to 77 and the number of large boats increases to 72. The 800 mt criteria shift boats from the large to small boat category but leave unchanged the total number of small and large boats.

Inclusion of squid in the definitions of small and large boats causes a shift in their geographic distribution (Table 3.2-4). The geographic distribution of vessels in the incidental fishery is not significantly affected by inclusion of squid in landings criteria.

The length distribution of vessels differs significantly among the three landings categories (Table 3.2-5). Median lengths are 30-40 feet for vessels in the incidental fishery, 40-50 feet for small boats and 50-60 feet for large boats. The length distribution within each landings category is not significantly affected by the inclusion of squid in landings criteria. Although the median size of boats in each category and amount of landings agree in a predictable way, the largest fishing vessels (110 feet) that took CPS and squid during the window period landed less than 20 mt and are therefore classified as "small boats" in terms of CPS landings.

According to Tables 3.2-6 and 3.2-7, CPS comprised a modest proportion of trips, landings and revenues for incidental boats with less than 20 mt of window period landings. Small and large boats relied on CPS to a greater extent (as evidenced by the higher proportion of trips, landings and revenues for CPS). Large boats had the highest level of coastal pelagic trips, landings and revenues per vessel year.

Large and small boats frequently target traditional "wetfish" species, i.e., market squid, Pacific herring, Pacific bonito, bluefin tuna, other tunas and CPS (Tables 3.2-8 and 3.2-9). In contrast, traditional wetfish species accounted for a smaller amount of landings and revenues by incidental boats (less than 20 mt of landings during the window period). Incidental boats obtained the bulk of their landings and revenues from groundfish, flatfish, crustaceans and shark/swordfish. When landings criteria are based on CPS and squid landings (Table 3.2-9), traditional wetfish species accounted for 4 percent of landings and 3 percent of revenues for incidental boats, 83 percent of landings and 69 percent of revenues for small, and 99 percent of landings and 97 percent of revenues for large boats (more than 400 mt of CPS and squid).

Table 3.2-10 describes total coast wide landings of northern anchovy, Pacific and jack mackerel, Pacific sardine and market squid during the window period and the proportion of these landings accounted for by vessels in each landings category. The 56 large boats (defined by more than 400 mt of CPS) accounted for 97 percent of CPS and 73 percent of market squid landed coast wide during the window period. Including squid, 83 large boats accounted for 99 percent of CPS and 97 percent of squid landings during the window period. Potential small boat permit holders accounted for very modest amounts landed and vessels in the incidental fishery accounted for only trace amounts of coast wide CPS and squid landings during the window period.

Although small boats have historically accounted for modest amounts of CPS landings, they are numerous and potentially have the capacity to harvest a significant amount of CPS. Thus, it may be important to control the number and capacity of small as well as large boats in the CPS fishery.

3.2.1 Post Window Period Fishery Performance

The total number of vessels participating in the CPS fishery declined by 3-5 percent after the window period (January 1, 1986 to November 13, 1991). For example, the number of boats with at least 20 mt of CPS landed was 112 during the window period but only 106 during 1990-1994, the most recent five year period for which data are available (Table 3.2.1-1).

After the window period, the percentage of small boats in the CPS fishery increased. Small boats (with at least 20 mt but less than 800 mt of CPS) were 54 percent of the total fleet during the window period but increased to 71 percent of the total fleet during 1990-1994 (Table 3.2.1-1). Closure of a major cannery in Los Angeles County, California during 1993 likely contributed to the increased percentage of vessels acting as small boats.

A number of boats active in the CPS fishery during the window period changed their mode of operation during recent years. These changes are not reflected in Table 3.2.1-1 because only total numbers of boats are presented. For example, 61 vessels landed between 20 mt and 800 mt of CPS during the window period (Table 3.2.1-1). During 1990-1994, however, 32 (52 percent) of these vessels landed less than 20 mt of CPS while one (2 percent) landed more than 800 mt of CPS. Similarly, 51 vessels landed more than 800 mt of CPS during the window period (Table 3.2.1-1). During 1990-1994, however, ten (20 percent) of these vessels landed between 20-800 mt of CPS while 12 (24 percent) landed less than 20 mt of CPS.

3.3 Fleet Capacity

Vessels defined as present participants in the CPS fishery have the capacity to harvest more CPS than is available under current low biomass conditions. Available information indicates that present participants could harvest at least as much CPS as would be available under conditions of greater availability. Present participants include 66 low-volume (defined by at least 20 mt of CPS plus squid during the window period) and 83 high-volume producers (at least 400 mt of CPS plus squid during the window period). Low-volume producers could probably average about 5 mt per trip. Assuming five trips a week and a six-month season, these boats could land 5 mt/trip x 5 trips/week x 26 weeks/year = 650 mt of CPS 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 boats could land 50 x 5 x 26 = 6,500 mt per boat per year. On this basis, 66

low-volume and 83 high-volume producers could land about 42,900 + 539,500 = 582,400 mt of CPS per year. Thus, current capacity may be as much as 45 percent greater than the combined maximum sustainable yield (MSY) for anchovy, Pacific mackerel and sardine (about 400,000 mt per year). These crude estimates of excess capacity are exaggerated to some extent because many present participants catch species other than CPS, 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 capacity in the fleet that might otherwise be excess.

3.4 Approaches to Managing Fishing Effort

There are three basic approaches to managing fishing effort: open access management, license limitation and individual transferable quotas (ITQ's). The Council, CPS Plan Development Team, CPS Advisory Subpanel, and other industry representatives discussed all three approaches to managing fishing effort 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 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 pursuing too few fish). Overcapitalization may be due to too many boats in a fishery or to too much investment in equipment used on individual boats. As a fishery becomes overcapitalized, economic efficiency is reduced and pressure to over harvest stocks increases (Wilen 1988; Townsend 1990). Other problems (short seasons, wastage, dangerous fishing practices) are typical of open access conditions and exacerbated by overcapitalization. Management of fishing effort plays an important role, therefore, in conservation and efficient exploitation of fishery resources.

License limitation programs restrict the number of vessels having access to the fishery. Licenses are usually transferable, and economic efficiency is promoted to the extent that more efficient fishers purchase permits from less efficient ones. However, license limitation programs are not completely effective at managing fishing effort and capitalization (Rettig and Ginter 1978; Townsend 1990) because vessel fishing power 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 license limitation program is difficult because participants who would be excluded under the program 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). ITQ's theoretically eliminate overcapitalization, inefficiency and dangerous fishing practices associated with the "race for the fish" but also engender practical problems with monitoring and enforcement.

Early in the plan development process, Council decided to develop options for license limitation and open access only, because of difficulties associated with applying ITQ's to a multispecies fishery like CPS, extra costs and lack of industry support. As indicated by Copes (1986), whenever separate quotas are set for different species in a multispecies fishery, an individual fisher is not likely to fill all quotas simultaneously. In attempting to use up its quota for one species, the fisher will repeatedly take bycatch for which there is no remaining quota. Rather than trying to obtain (by purchase, lease or other means) sufficient quota to cover bycatch, fishers may discard or illegally retain the excess catch. Thus, the potential for extra costs to fishers or managers who adjust quotas, quota busting, and discarding is greater in a multispecies fishery (like CPS) than in a single species one.

ITQ's are also generally acknowledged to be more costly to monitor and enforce than license limitation programs. For example, recurring costs for a proposed ITQ program for fixed gear sablefish were estimated at $1,133,000-$2,174,000 per year (PFMC 1993) or 15 percent to 29 percent of the exvessel value of the CPS fishery in 1992 ($7,500,000, according to Thomson et al. 1993).

3.5 Option for Open Access Management (Status Quo)

This option would maintain open access management (status quo) in the CPS fishery. The advantages of this option are that regulations and costs of limited entry are avoided and that operations of individual boats and firms are not restricted by regulations.

If the status quo is adopted, an opportunity to implement a limited entry system in the CPS 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- and long-term management costs (to develop and implement trip limits and other regulatory measures) associated with overcapitalized fisheries and depleted stocks. The collapse of the sardine fishery in the 1940s and 1950s and problems in the Pacific mackerel fishery during periods of poor recruitment suggest that problems linked with overcapitalization may 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 boats increased from 150 in the 1930-1931 season to 200 in 1933-1934 to over 300 in 1936-1937, as landings increasing from 200,000 tons to 400,000 tons to 700,000 tons. Fleet size peaked at 380 boats in 1937-1938 as landings began to decline. The maximum allowable catch (MAXCAT) for sardine and anchovy recommended under the FMP is 600,000 mt per year of which about 400,000 mt per year 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 to 400,000 mt. Based on historical data, however, a fleet size of 175-250 boats seems plausible, particularly since the fleet would take species other than anchovy and sardine (e.g., mackerels, squid, bonito and tuna).

3.6 Option for License Limitation

This option would establish limited entry in the CPS fishery by license limitation. A number of different suboptions for implementing a license limitation program were developed (see below). All of the suboptions are designed to maintain the capacity of the CPS fishery at current levels and accommodate current participants and fishery patterns. No reductions to current capacity are proposed. All suboptions presume that:

1. Permits will be permanent subject to legal, performance or other renewal requirements.
2. Permits will be assigned for use on one vessel at a time.
3. 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.
4. Only entities (persons, corporations, etc.) qualified to own a U.S. fishing vessel may hold (by ownership, lease or otherwise) a permit.
5. 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.
6. CPS may not be landed (other than as incidental catch or other category explicitly excluded from license limitation requirements) by any boat without a permit.
7. CPS may not be purchased (other than as incidental catch or other category explicitly excluded from license limitation requirements) from any boat without a permit.
8. Application, renewal and other fees may be charged by NMFS to cover administrative costs.
9. Permits will be issued initially to owners of boats that apply and qualify for permits based on landings during the window period or other criteria; in the event that a boat was sold after the window period but before permits were issued, the permit will be issued to the new owner.

3.6.1 Benefit-Cost Analysis

The benefit-cost analysis in this section demonstrates that measurable economic benefits would accrue from a license limitation system that maintains capacity in the CPS fishery at current 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.

There are about 112-149 participants in the current CPS fishery, depending on how they are defined (Table 3.2.3). In contrast, an open access CPS fishery might grow to a maximum size of about 175-250 boats under conditions of higher resource abundance (Section 3.5). Thus, a license limitation program that limits the number of boats to current levels may prevent a significant number of new boats from entering the fishery at some future time.

Estimates of fixed costs under two scenarios were used to demonstrate potential benefits from a license limitation system in the CPS fishery that would prevent increases in the number of large boats. Annual average fixed costs ($38,440 per boat per year, Table 3.6.1-1) for a large CPS vessel were estimated from data for a representative wetfish vessel provided by the Fishermen's Cooperative Association (San Pedro, California). Scenario 1 was the license limitation case in which the number of large boats (56-83 depending on the definition, Table 3.2.2) in the fishery remained constant. Scenario 2 was the open access case in which the number of high-volume boats increased to 100-150. No more than 150 boats were assumed under open access because many boats entering the fishery would probably be small boats.

Under Scenario 1 (license limitation), maximum total fixed costs incurred by the 83 large boats are $3,190,520 (83 x $38,440). Maximum fixed costs incurred by the 100-150 large boats under Scenario 2 (open access) range from $3,840,000 (100 x $38,400) to $5,760,000 (150 x $38,400). Thus the benefits of license limitation that limits capacity to current levels, as measured by the avoidance of unnecessary fixed costs, are estimated to range from $649,480 ($3,840,000-$3,190,520) to $2,569,480 ($5,760,000-$3,190,520) per year.

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 small boat sector of the CPS 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 (a) decreased revenue per boat, as an increasing number of boats compete for a fixed allowable harvest, and (b) 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.

3.6.2 Summary of Advantages for License Limitation

The main advantage in license limitation for the CPS fishery is that potential for overcapitalization in the fishery and the resulting tendency for overexploitation are reduced. Capacity in the CPS fishery is currently low relative to historical levels but more than sufficient to handle current and likely future harvest levels. Under open access conditions, additional boats will probably enter the fishery as abundance of sardine, or other CPS, increases. A license limitation program for the CPS fishery that maintains capacity at current levels will reduce economic inefficiency due to additional capacity as CPS harvest levels increase.

All of the proposed license limitation systems for CPS are relatively simple and inexpensive (Appendix C) to administer. Benefit-cost analysis demonstrates that the potential benefits of license limitation are considerable.

Industry supports the license limitation option for CPS at the present time but may not in the future as conditions in the fishery change. Capacity of the CPS fishery has fallen somewhat during recent decades due to low availability of fish and poor market conditions. There is relatively little interest in entering the fishery by potential participants. Thus, difficult decisions about whether to issue permits to large numbers of recent and potential entrants are not necessary at present and these sources of overcapitalization are avoided. A license limitation system could be converted to an ITQ-type limited entry program if future conditions warrant.

A license limitation program in the CPS fishery would contribute to all of the goals and objectives listed in the FMP. In particular, it would promote efficiency and profitability by reducing tendencies for overcapitalization, promote year-round fishing opportunities by limiting the number of participants, maintain exiting CPS fishery segments and U.S. fishery investment by accommodating present participants, and it would provide a mechanism for managing fishing effort.

A potential disadvantage in implementing a limited entry program for CPS at this time is that the capacity of the fleet may, following trends over the last decade, continue to decline. This possibility seems unlikely, however, due to the current increasing trend in sardine abundance.

3.7 Options for a License Limitation Program

EXCLUDE INCIDENTAL CATCHES OF CPS (1 MT OR LESS) FROM LICENSE LIMITATION REQUIREMENTS

This option would make a license limitation permit unnecessary when landing less than 1 mt of CPS. The principal advantage of this option is that it will discourage discard of CPS taken incidentally in small quantities outside the license limitation fleet. Although a great many trips result in CPS landings of 1 mt or less, the total amount of CPS landed incidentally is minuscule (less 0.3 percent of the total). Thus, no effort would be wasted in managing catches of negligible size and importance. About 595 boats took incidental quantities of CPS and squid during the window period (Table 3.2-1) and about 539 took incidental quantities of CPS only (Table 3.2-2). No serious disadvantages are thought to exist for this option.

This option is recommended by the CPS Advisory Subpanel and CPS Plan Development Team. It contributes to most of the goals and objectives listed in the FMP. In particular, it maintains existing fishery segments, helps avoid discard, and efficiently uses management resources.

EXCLUDE HARVEST OF CPS AS LIVE BAIT USED IN RECREATIONAL FISHERIES FROM LICENSE LIMITATION REQUIREMENTS

This option would make a license limitation permit unnecessary for the capture and sale of CPS as live bait. CPS 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 (mostly anchovy) are harvested annually by about eighteen boats based in southern California and two boats based off Oregon and Washington. 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 expected.

The advantage of this option is that no resources would be expended to manage fishing effort 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). Although not restricted by license limitation requirements, live bait harvest could be potentially managed by quota, allocation, mesh size regulations, or any other potential management measure. No serious disadvantages are thought to exist for this option.

This option is recommended by the CPS Advisory Subpanel and CPS Plan Development Team. It contributes to most of the goals and objectives listed in the FMP. In particular, it maintains existing fishery segment, helps avoid discard, and uses resources spent on management of CPS efficiently.

EXCLUDE RECREATIONAL HARVEST OF CPS FROM LIMITED ENTRY REQUIREMENTS

This option excludes recreational harvest of CPS from limited entry requirements although recreational harvest could still be restricted by quotas, area closures, or any other type of management measure. Pacific mackerel are the only CPS often taken by anglers although they are seldom taken as a target species. During the period from 1980 to 1989, the recreational catch of Pacific mackerel averaged 1,462 tons per year.

The advantage of this option is that no resources would be expended to manage fishing effort in the recreational fishery where the total catch of CPS is trivial. No serious disadvantages are thought to exist for this option.

This option is recommended by the CPS Advisory Subpanel and CPS Plan Development Team. It contributes to most of the goals and objectives listed in the FMP. In particular, it maintains existing fishery segments, helps avoid discard, and efficiently uses management resources.

EXCLUDE FISHING FOR CPS NORTH OF 39° N LATITUDE FROM LICENSE LIMITATION REQUIREMENTS

This option would establish a northern boundary to the license limitation fishery for CPS. Fishing north of 39° latitude (approximately Pt. Arena, California) would not be affected by license limitation requirements while fishing south of 39° latitude would require license limitation permits. This option would provide 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. A boundary at 39° latitude would coincide approximately with the current boundary at 42° latitude in the groundfish FMP for U.S. at-sea processors.

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 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 distribution of jack mackerel depends on abundance.

Most CPS experience dramatic changes in abundance, even in the absence of a commercial fishery, and availability of CPS north of Pt. Arena is expected to vary considerably over time. When abundance is high or El Niño conditions exist, 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."

Present participants in the CPS fishery operate almost exclusively south of Pt. Arena. About 99 percent of total CPS taken during the window period by present participants were taken south of Pt. Arena. Thus, the northern boundary at 39° latitude includes the grounds utilized by present participants.

Almost all (100 percent) of sardines landed in California during 1915-1946, including the heyday of the U.S. sardine fishery, were taken south of Pt. Arena, although as much as 40,000 mt per year were taken in Oregon and Washington and 89,000 mt in British Columbia during some years. Thus, the northern

boundary at 39° latitude is north of fishing grounds utilized by the historical California fishery when sardine biomass was relatively high. A large fraction of the fishing opportunities that may arise due to increased sardine biomass will, therefore, probably be available to the license limitation fishery although opportunities in northern California, Oregon, and Washington areas are also likely to develop.

The principal advantage of this option is that it is a simple and inexpensive approach to taking advantage of fishing opportunities in northern fishing grounds that are distant from current participants. Fishing on northern grounds during periods of high abundance would be accommodated without increasing the number of license limitation permits and without increasing the size of the fleet fishing for CPS during periods of low abundance. In the geographic area of the license limitation fishery, increased biomass levels would probably result in redistribution of fishing effort to the north so that excess capacity centered around Los Angeles County and southern California would be utilized. Permit holders might also be able to take advantage of fishing opportunities north of 39° latitude so that existing capacity would be further utilized.

Council considered issuing temporary permits to boats wishing to fish in the north but found all proposals to be too complex given uncertainty about northern fisheries developing and the nature of any fisheries that might arise. If a significant and sustained fishery for CPS develops north of 39° N latitude, then it may be possible to extend the limited entry system for CPS fishing in southern areas to include fishing to the north.

The principal disadvantage of this option is the possibility of overcapitalization in northern areas resulting from increased fishing opportunities for sardine or jack mackerel. If northern fisheries develop quickly, then it may be difficult to implement an effective limited entry system for northern grounds. Another important disadvantage is that allocation of overall quota between the northern fishery and southern limited entry fishery may be required.

This option is recommended by the CPS Advisory Subpanel and CPS Plan Development Team. It contributes to most of the goals and objectives listed in the FMP. In particular, it promotes full utilization, helps avoid discard in northern areas, manages CPS throughout their range, manages fishing effort, and efficiently uses management resources.

INCLUDE SQUID LANDINGS IN CRITERIA USED TO ALLOCATE INITIAL PERMITS

This option would allow fishers to obtain license limitation permits for CPS on the basis of CPS and squid landings during the window period instead of CPS landings only.

Assuming the two-tiered permit system least restrictive option for allocating limited entry permits (Section 3.8), ten additional small boat permits and 27 additional large boat permits would be included in the license limitation system for CPS if this option is adopted. These increases correspond to 18 percent for small boat permits and 48 percent for large boat permits. The total number of boats given permits would increase from 112 to 149, an increase of 33 percent (Table 3.2-3).

Assuming the two-tiered permit system most restrictive option for allocating limited entry permits (Section 3.8), 16 additional small boats and 21 additional large boats would be included in the license limitation system for CPS if this option is adopted. These increases correspond to 26 percent for small boat permits and 41 percent for large boat permits. As in the least restrictive option for allocating limited entry permits, the total number of boats given permits would increase from by 33 percent from 112 to 149 (Table 3.2-3).

Inclusion of squid in the criteria for small and large boat permits causes a shift in their geographic distribution (Table 3.2-4). For example, if large boat permits are issued to vessels with 400 mt of landings during the window period, then the share of small boat permits in Orange-Los Angeles counties would increase from 43 percent (24 permits) without squid to 48 percent (32 permit) with squid, while the Monterey-Santa Cruz share would decline from 20 percent (11 permits) to 8 percent (5 permits). Declines in the number of small boats in areas such as Monterey-Santa Cruz would be due to boats classified as small boats using CPS only being shifted to the large boat category when landings of both CPS and squid are considered. The total number of boats in the small and large permit categories in an area always

increases when CPS and squid landings are considered. The distribution of large boat permits shifts in the opposite direction, with the Orange-Los Angeles share declining from 66 percent (37 permits) without squid to 51 percent (42 permits) with squid and the Monterey-Santa Cruz share increasing from 13 percent (7 permits) to 27 percent (22 permits).

The primary advantage of this option is that it has broad industry support and is a requirement for industry acceptance of limited entry for the CPS fishery. Sardine are increasing in abundance and have only recently become abundant off Monterey where squid fishing occurs and where processing capabilities for sardine have recently been expanded. If squid were excluded from the criteria used to allocate license limitation permits, then there might be insufficient boats in the Monterey area to deliver fish required by processors. Furthermore, (1) squid is an important and integral component of the CPS fishery that could be managed under this FMP even though Council does not intend to manage it at this time, (2) squid are taken by roundhaul gear that is similar in design and deployment to gear used to harvest CPS, (3) many squid boats participated historically in the sardine fishery, (4) boats that targeted squid would have taken CPS also (particularly sardine and Pacific mackerel) if they had been available in the Monterey area during the window period, (5) boats harvesting squid but not CPS during recent years are socially and culturally part of the same fishery that harvests CPS, and (6) squid have been economically the most important species in the CPS fishery during recent years (Thomson et al. 1994), and 7) all segments of the current fishery for CPS (including squid) would be treated similarly.

The primary disadvantage of this option is that it further increases capacity in the CPS fishery, particularly in the form of large boats. The significance of this problem will be reduced, however, if the most restrictive option for allocating large boat permits is adopted (Section 3.8). Another potential problem is that permits issued to boats used primarily for squid might be sold to new boats while the original vessels continue to fish for squid. This would, in effect, further increase capacity in the fishery as a whole. This problem is unlikely, however, because the squid fishery is seasonal and the same type of boats are used to harvest squid, sardine, anchovy, and mackerels. Thus, there would be little incentive to buy boats to fish for anchovy, sardine, and mackerel while the vessels originally issued permits fish for squid.

This option is recommended by the CPS Advisory Subpanel and CPS Plan Development Team. It contributes to most of the goals and objectives listed in the FMP. In particular, it maintains existing fishery segments, and manages fishing effort.

RESTRICT TRANSFER OF PERMITS TO BOATS SMALLER THAN 150 FEET IN LENGTH

This option would limit sale and transfer of CPS license limitation permits to boats smaller than 150 feet (length overall). The intent of this option is to prevent sale of permits to very large vessels (e.g., factory trawlers) that would substantially increase capacity in the CPS fishery. It is not intended as a primary or fine-scale means of controlling fishing effort. The largest boat in the current fishery is 110 feet so this option would not affect current participants or the owners of a few boats in the 110-150 foot range who might wish to sell their vessels to license limitation permit holders or to purchase license limitation permits.

The principal advantage of this option (alone or in combination with the 100 mt trip limit option described in Section 3.9) is that it is easy to implement, easy to enforce, and will help prevent large and immediate increases in capacity that might occur if permits were sold for use with very large vessels such as factory trawlers.

The disadvantages of this option are that it may be redundant and unnecessary if the 100 mt trip limit for large boats in a limited entry system is adopted (Section 3.9). Length limits tend to be ineffective at reducing overcapitalization because characteristics other than length (i.e., electronics, winches, refrigeration equipment, hold space, etc.) can be modified to increase capacity. As pointed out above, however, this measure is not intended as a primary or fine-scale means of controlling capacity. In addition, length limits tend to increase inefficiency because constraints placed on size might make fishing more difficult or expensive.

This option is not recommended by the CPS Advisory Subpanel and CPS Plan Development Team unless the 100 mt trip limit for large boat permit holders is rejected.

3.8 Options for allocating permits

Numbers of boats involved in each of the options can be determined from data in Tables 3.2-1 and 3.2-2. Additional detailed data are available in Tables 3.2-3 to 3.2-10.

TWO-TIERED PERMIT SYSTEM FOR SMALL AND LARGE BOATS (LEAST RESTRICTIVE OPTION)

This option would issue small boat permits to boats with window period landings of at least 20 mt of CPS and squid or CPS only but less than 400 mt of CPS plus squid or CPS only. Boats with small boat permits would be limited to no more than 10 mt of CPS per trip. Either 66 (CPS and squid) or 56 (CPS only) boats would qualify for small boat permits under this option.

Large boat permits would be issued to boats with at least 400 mt of CPS plus squid or CPS only during the window period. Either 83 (CPS and squid) or 56 (CPS only) boats would qualify for large boat permits under this option.

The principal advantage of such a two-tiered system is that diversity in the present fishery (small boats supplying low volume/high value markets and large boats supplying high volume/low value markets) would be accommodated without the possibility of greatly expanded fishing capacity through transfer of permits from small boats to large boats. By specifying a 10 mt trip limit for small boats, this option reduces the need to develop additional restrictions (e.g., based on boat size) on the sale of permits issued to small boats. As described in Section 3.2, criteria for issuing permits under this option correspond with amounts of CPS typically landed per trip in the fishery and the definitions of the two types of vessels (less than 10 mt per trip for small boats and more than 10 mt per trip for large boats). Thus, this option protects the interests of all present participants with minimal disruptions to current fishing patterns.

The principal disadvantage of this option is that the number of vessels issued permits, particularly large boat permits and if squid are included in qualifying criteria, would be larger than required to take CPS at present and likely future abundance levels (Section 3.3). In addition, the 400 mt landings criteria may result in large boat permits being issued to some vessels that typically land less than 10 mt per trip and operate as small boats (Tables 3.2-1 and 3.2-2), further increasing excess capacity.

TWO-TIERED PERMIT SYSTEM FOR SMALL AND LARGE BOATS (MOST RESTRICTIVE OPTION)

This option would issue small boat permits to boats with window period landings of more than 20 mt of CPS and squid or CPS only but less than 800 mt of CPS plus squid or CPS only. As with the least restrictive option, boats with small boat permits would be limited to no more than 10 mt of CPS per trip. Either 77 (CPS and squid) or 61 (CPS only) boats would qualify for small boat permits under this option. The number of small boat permits is greater than under the least restrictive option because the most restrictive option shifts 11 (CPS plus squid) or 5 (CPS only) boats from the large to the small boat permit category.

Large boat permits would be issued to boats with at least 800 mt of CPS plus squid or CPS only during the window period. Either 72 (CPS and squid) or 51 (CPS only) boats would qualify for large boat permits under this option. This option would result in the same total number of license limitation permits as the least restrictive option. The number of large boat permits is decreased by either 11 (13 percent) for qualifying criteria based on CPS plus squid or 5 (9 percent) for criteria based on CPS only.

Advantages of this option are similar to those of the least restrictive option except that capacity is capped at a lower level which should result in increased economic efficiency and a more effective limited entry system. These benefits are achieved at the cost of a small disruption to status-quo fishery patterns. According to Tables 3.2-1 and 3.2-2, the 11 (CPS plus squid) or 5 (CPS) additional boats issued small boat permits under this option made 528 (CPS plus squid) or 3 percent of total CPS trips and 463 (CPS only) or 2 percent of total CPS trips during the window period. Some of these trips resulted in more than 10 mt of CPS and would have been affected by the 10 mt trip limit applied to vessels with small boat permits.

This option is recommended by the CPS Plan Development Team and CPS Advisory Subpanel. It contributes to most of the goals and objectives listed in the FMP. In particular, it promotes efficiency and profitability, maintains existing fishery segments, and manages fishing effort.

3.9 Other Options

100 MT TRIP LIMIT FOR LARGE BOATS IN A TWO-TIERED PERMIT SYSTEM OR FOR ALL BOATS IN THE ABSENCE OF LIMITED ENTRY

If a two-tiered license limitation system is adopted, then this option would limit the amount of CPS carried, landed, transported, or delivered by any boat with a large boat license limitation permit to 100 mt (round weight equivalent) or less. If a two-tiered license limitation system is adopted, this option applies to large boat permit holders only because small boat permit holders will already be limited to 10 mt per trip. If a license limitation system is not adopted, then this option would apply to all boats involved in catching CPS.

For purposes of this option, a trip is defined to mean any activity (e.g., catching, landing, transporting, or delivering) by a boat with a license limitation permit for CPS (i.e. a boat with a limited entry permit and legally capable of landing CPS in excess of 1 mt). The trip limit is defined in round weight equivalent units so that, for example, a boat could not carry CPS products weighing less than 100 mt if they were derived from more than 100 mt of CPS in a fresh, round weight condition. Under this definition and for the purposes of this option, there are no further restrictions on the nature of a trip. In particular, 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. The limit of 100 mt was chosen because it is larger than the hold capacity of all but the largest vessels currently in the fishery, as well as larger than the size of individual deliveries that can be processed by current markets. During 1981-1991, more than 99 percent of all CPS deliveries were less than 100 mt. The advantage of this option is reduced probability of large increases in fleet capacity due to transfer of permits to boats with very large holds or physical modifications to boats with permits. The approach based on a trip limit is, however, preferable to vessel size limits because the control on catch is direct and fishers are free to choose vessels of the optimum size for handling legal catches. The trip limit approach does not generate incentives for owners to increase the capacity of boats by indirect means beyond the level that provides for efficient operations. This option is not expected to impact activities in the current fishery.

This option is recommended by the CPS Advisory Subpanel and CPS Plan Development Team. This option contributes to most of the goals and objectives listed in the FMP. In particular, it promotes efficiency and profitability, maintains existing fishery segments, and manages fishing effort.

ALLOW CONVERSION OF LARGE BOAT PERMITS TO SMALL BOAT PERMITS

If a two-tiered permit system is adopted, then this option would allow fishers to obtain a small boat permit instead of a large boat permit. A fisher who qualified for a large boat permit at the outset of the license limitation program for CPS could elect (within a period of one year and subject to other regulations) to receive a small boat permit instead. The choice would be permanent; small boat permits obtained in this fashion could not be reconverted to large boat permits. This option is irrelevant if an option for a low-volume reserve is not adopted.

The rationale for this option is based on (1) the possibility that some small boat operators who landed CPS consistently during the window period may qualify for large boat permits, and (2) the option for a low-volume reserve (described in Section 5). The low-volume reserve is an allocation option that allocates part of the U.S. harvest to small boats who serve low-volume/high value specialty markets (e.g. fresh fish markets, dead bait). Specialty markets served by small boats require a consistent and year round supply of CPS. The small boat provides a measure of protection to small boat operations and markets against premature fishery closures due to high catch rates in the large boat component of the fishery where consistent supply is less important.

The advantage of this option is that a small boat fisher who qualifies for a large boat permit could elect to receive a small boat permit instead in order to benefit from the low-volume reserve. This option will tend to adjust the number of small and large boat permits issued to better match the number of small and large boat operators in the fishery. The capacity of the fleet would be unaffected or would decrease under this option.

The disadvantage of this option is that a fisher might elect to receive a small boat permit in anticipation of a low volume reserve that could be eliminated at a future date. The Council might be obliged to maintain the low volume reserve in future or reconvert some small boat permits if this option for conversion to small boat permits is adopted.

This option is recommended by the CPS Advisory Subpanel and CPS Plan Development Team. This option contributes to most of the goals and objectives listed in the FMP. In particular, it promotes efficiency and profitability, maintains existing fishery segments, and manages fishing effort.

3.10 California Marine Resources Protection Act (Proposition 132)

The California Marine Resources Protection Act (MRPA, also known as Proposition 132) was passed by the California electorate on November 7, 1990. One of the purposes of the MRPA was to prohibit the use of gill and trammel nets after January 1, 1994 in a zone that includes:

1. ocean waters from 0-3 miles from the mainland shore (State waters) between Point Arguello (Santa Barbara County) and the U.S.-Mexico border;

2. waters less than 35 fathoms deep between Point Fermin (Los Angeles County) and the south jetty at Newport Beach (Orange County); and

3. waters less than 70 fathoms deep, or within one mile, whichever is less, of the Channel Islands.

Under MRPA, the state of California paid compensation from a special fund to eligible fishers who declared their intention to seek compensation prior to November 21, 1991. The California Department of Fish and Game received a total of 135 applications on or before the deadline. Each applicant was required to meet several additional eligibility criteria, and compensation was actually paid to the operators/owners of 81 gillnet boats (Barnes, 1995). The amount of compensation was based on the average annual exvessel value of each fisher's landings from the affected zone during 1983 to 1987. Not all participants in the 1993 fishery met the criteria to receive compensation, and so the number of permit holders is somewhat larger than the number of persons who applied for compensation.

An important feature of the MRPA was an escalating system of fees for permits required to use gill and trammel nets in the affected zone:

Calendar Year	Fee
1991	$250
1992	$500
1993	$1000

After 1993 gillnet fishing in the affected zone was prohibited, and MRPA gill and trammel net permits were no longer issued.

The best available criteria for defining the population of gill and trammel net fishers affected by the MRPA is a list of 107 persons (97 boats) for which gill and trammel net permits were purchased (at a cost of $1,000) to fish during calendar year 1993. The number of boats in the fishery is fewer than the number of permittees because some boats were jointly operated by more than one permittee. The geographic

distribution of persons with 1993 MRPA permits is given in Table 3.10-1. Approximately five boats with gill and trammel net permits would receive small boat license limitation permits on the basis of 20 mt of CPS or CPS plus squid during the window period as described in Section 3.8.

It is difficult to determine how many gill and trammel net fishers would have a serious interest in catching CPS. Sources in the fishery affected by the MRPA indicate that the number of gill and trammel net fishers interested in entering the CPS fishery would likely be small (at least two boats but no more than 10) due to conversion costs and limited market demand for CPS. The CPS Plan Development Team was unable to estimate the number of displaced gillnet boats that might potentially enter the CPS fishery as viable participants. The CPS Advisory Subpanel and industry representatives voiced concerns that some gill and trammel net fishers might obtain permanent CPS permits for speculative purposes. The end result of speculative interest in permits would be additional boats and capacity in the fishery and decreased value of limited entry permits. Additional capacity would probably be modest unless the permits were sold or used on other vessels, since most converted gill net vessels would probably carry less than 5 tons of fish at a time.

The eventual cost of buying a permit for CPS is unknown so it is impossible to estimate how much it would cost gill net fishers to enter the CPS fishery if they were not granted small boat permits at the outset. Amounts of money paid to gillnet and trammel net fishers under terms of the MRPA (equal to average exvessel value of fish harvested from the affected area during 1983 to 1985) ranged from $56,616 to $0.00 and averaged $13,993.

The size of boats with MRPA permits (see below) is potentially important since small boats might not be suitable for the CPS fishery. Locations of boats with MRPA permits is similar to the distribution of permit owners described in Table 3.10-1.

Boats owned by individuals with MRPA Permits
for 1993 by size class

Size	Number
< 20 feet	2
20-29 feet	19
30-39 feet	56
40-49 feet	13
> 49 feet	7
Total	97

One study indicates that gill net boats 25 feet and longer could be converted to fishing for CPS while one industry source indicates that boats less than 40 feet would probably be unsuitable for conversion. The same study indicates that the cost of converting a 37-foot gillnet vessel to lampara gear suitable for catching CPS is $16,000 ($31,000 if sonar equipment is added) and that a converted gill net boat could earn $1,500 to $2,000 per week in gross revenues.

3.10.1 Options for Boats Affected by the MRPA

The following points, in addition to those in Section 3.6, apply to all of the options listed below:

1. Only boat owners with 1993 MRPA permits and boats identified in 1993 MRPA permits are eligible.

2. Restrictions on eligibility or transferability for permits may be waived due to hardship under appeal procedures specified in the FMP.

The alternative to these options is not to issue any CPS limited entry permits to fishers affected by the MRPA, except for those fishers and boats that meet other qualifying criteria. Approximately five boats with gill and trammel net permits would receive small boat license limitation permits on the basis of 20 mt of CPS or CPS plus squid during the window period as described in Section 3.8. All options listed in this section will be irrelevant if MRPA is declared null and void by legal challenge or other means.

SMALL BOAT PERMITS BASED ON LANDINGS DURING 1994

Under this option, small boat limited entry permits would be issued to boat owners affected by the MRPA who landed at least 10 mt of CPS and made at least 10 landings of CPS during January 1, 1994 to December 31, 1995. Landings data for 1994 indicate that approximately two vessels would receive small boat limited entry permits under this option.

The advantage of this option is that the maximum number of additional small boat permits (about two) is small and predictable. Large increases in capacity would not occur. Speculative interest in obtaining CPS limited entry permits would be minimized.

The disadvantage of this option is that some fishers may have begun conversion from gillnet gear to roundhaul gear in 1994 but without completing the conversion in time to meet landings criteria for 1994. Some fishers displaced by the MRPA were not paid by the state of California under the terms of the MRPA until late in 1994. It is possible that they delayed conversion of their vessels until after they were paid and thus did not have an opportunity to meet landings criteria. Industry sources report that many gillnetters displaced by the MRPA were unaware of the potential for license limitation in the CPS fishery or assumed that license limitation would no longer be considered after the Council temporarily stopped developing the CPS FMP in November of 1993. Lack of information and uncertainty about plans to develop a license limitation system for CPS may have reduced incentives to land enough CPS during 1994 to meet criteria for a small boat permit.

CONDITIONAL PERMITS FOR TWO YEARS (1995-1996)

Under this option, nontransferable conditional permits would be required for two years (January 1, 1995 to December 31, 1996). Permanent permits would be issued to conditional permit holders who had landed at least 10 mt of CPS during each year and made at least 10 landings of CPS in each year during the proving-up period. Conditional permits would be valid until terminated or converted to permanent CPS permits by NMFS. No more than one conditional CPS permit would be issued per vessel; vessels used by two or more MRPA permittees would receive a single conditional CPS permit that could be issued in the name of the two (or more) fishers.

The advantage of this option is that fishers who spent money to convert their boats to gear for catching CPS but who delayed fishing in 1994 would be potentially eligible to obtain a license limitation permit for CPS. The two year landings criteria would help discourage fishers from obtaining a CPS permit for speculative purposes. The disadvantage is uncertainty about the number of additional boats that would eventually qualify for permits. Industry sources suggest, however, that the number of permits issued would likely be small (2-10 boats).

This option is similar to one endorsed by the Council (conditional permits for 1994-1995) at its September meeting. It is recommended by the CPS Advisory Subpanel. The CPS Plan Development Team makes no recommendation.

> 50 mt	130	845	50 to 100 mt	14	703	760	0.92
>100 mt	116	859	100 to 200 mt	21	1,571	347	4.53
>200 mt	95	880	200 to 300 mt	7	389	104	3.74
>300 mt	88	887	300 to 400 mt	5	553	204	2.71
>400 mt	83	892	400 to 410 mt	0	0	0	0.00
>410 mt	83	892	410 to 420 mt	1	300	21	14.30
>420 mt	82	893	420 to 430 mt	2	417	318	1.31
>430 mt	80	895	430 to 440 mt	0	0	0	0.00
>440 mt	80	895	440 to 450 mt	0	0	0	0.00
>450 mt	80	895	450 to 460 mt	0	0	0	0.00
>460 mt	80	895	460 to 460 mt	1	242	10	24.17
>470 mt	79	896	470 to 480 mt	1	1	0	0.00
>480 mt	78	897	480 to 490 mt	0	0	0	0.00
>490 mt	78	897	490 to 500 mt	0	0	0	0.00
>500 mt	78	897	500 to 510 mt	1	246	99	2.48
>510 mt	77	898	510 to 520 mt	0	0	0	0.00
>520 mt	77	898	520 to 530 mt	0	0	0	0.00
>530 mt	77	898	530 to 540 mt	0	0	0	0.00
>540 mt	77	898	540 to 550 mt	0	0	0	0.00
>550 mt	77	898	550 to 560 mt	0	0	0	0.00
>560 mt	77	898	560 to 570 mt	0	0	0	0.00
>570 mt	77	898	570 to 580 mt	0	0	0	0.00
>580 mt	77	898	580 to 590 mt	0	0	0	0.00
>590 mt	77	898	590 to 600 mt	1	592	20	29.59
>600 mt	76	899	600 to 700 mt	2	111	13	8.57
>700 mt	74	901	700 to 800 mt	2	193	47	4.11
>800 mt	72	903	800 to 900 mt	2	884	37	23.88
>900 mt	70	905	900 to 1,000 mt	3	1,271	197	6.45
>1000 mt	67	908	1,000 to 2,000 mt	15	6,163	763	8.08

>2000	52	923
>3000 mt	47	928
>4000 mt	39	936
>5000 mt	35	940
>6000 mt	31	944
>7000 mt	26	949
>8000 mt	26	949
>9000 mt	24	951
>10,000 mt	21	954
>20,000 mt	2	973
>30,000 mt	1	974

2,000 to 3,000 mt	5	7,162	248	28.88
3,000 to 4,000 mt	8	15,231	1,162	13.11
4,000 to 5,000 mt	4	7,197	374	19.24
5,000 to 6,000 mt	4	6,551	276	23.74
6,000 to 7,000 mt	5	13,889	719	19.32
7,000 to 8,000 mt	0	0	0	0.00
8,000 to 9000 mt	2	14,433	597	24.18
9,000 to 10,000 mt	3	23,244	770	30.19
10,000 to 20,000 mt	19	172,126	4,752	36.22
20,000 to 30,000 mt	1	13,922	482	28.88
> 30,000 mt	1	32,053	599	53.51
Totals	975	320,439	19,524	16.41

Table 3.2-2 Left side: Number of boats that would and would not qualify for permits based on CPS (anchovy, mackerel and sardine but no squid) landings during the window period (January 1, 1986 to November 13, 1991).
Right side: number of boats in corresponding landings categories, their CPS (no squid) landings, number of trips with CPS landings and average CPS (no squid) landed per CPS trip during the window period.

Minimum Window Per. Landings	Total Boats Included	Total Boats Excluded	Landings Group	N Boats	CPS-Landings (No Squid)	CPS Trips	CPS/Trip
>0 mt	833	0	0 to 0.5 mt	539	69	1,929	0.04
>0.5 mt	294	539	0.5 to 1 mt	59	43	704	0.06
>1 mt	235	598	1 to 5 mt	83	198	1,689	0.12
>5 mt	152	681	5 to 10 mt	21	149	1,053	0.14
>10 mt	131	702	10 to 11 mt	1	10	144	0.07
>11 mt	130	703	11 to 12 mt	0	0	0	0.00
>12 mt	130	703	12 to 13 mt	0	0	0	0.00
>13 mt	130	703	13 to 14 mt	5	67	88	0.77
>14 mt	125	708	14 to 15 mt	2	28	227	0.12
>15 mt	123	710	15 to 16 mt	3	47	165	0.28
>16 mt	120	713	16 to 17 mt	1	16	100	0.16
>17 mt	119	714	17 to 18 mt	4	69	356	0.19
>18 mt	115	718	18 to 19 mt	1	19	2	9.40
>19 mt	114	719	19 to 20 mt	2	38	170	0.23
>20 mt	112	721	20 to 21 mt	0	0	0	0.00
>21 mt	112	721	21 to 22 mt	0	0	0	0.00
>22 mt	112	721	22 to 23 mt	0	0	0	0.00
>23 mt	112	721	23 to 24 mt	2	47	43	1.10
>24 mt	110	723	24 to 25 mt	1	25	11	2.25
>25 mt	109	724	25 to 50 mt	13	503	119	4.22

> 50 mt	96	737	50 to 100 mt	12	923	721	1.28
>100 mt	84	749	100 to 200 mt	16	2,262	418	5.41
>200 mt	68	765	200 to 300 mt	5	1,197	230	5.20
>300 mt	63	770	300 to 400 mt	7	2,379	350	6.80
>400 mt	56	777	400 to 410 mt	0	0	0	0.00
>410 mt	56	777	410 to 420 mt	1	416	318	1.31
>420 mt	55	778	420 to 430 mt	0	0	0	0.00
>430 mt	55	778	430 to 440 mt	1	435	15	28.98
>440 mt	54	779	440 to 450 mt	0	0	0	0.00
>450 mt	54	779	450 to 460 mt	0	0	0	0.00
>460 mt	54	779	460 to 460 mt	0	0	0	0.00
>470 mt	54	779	470 to 480 mt	0	0	0	0.00
>480 mt	54	779	480 to 490 mt	0	0	0	0.00
>490 mt	54	779	490 to 500 mt	0	0	0	0.00
>500 mt	54	779	500 to 510 mt	0	0	0	0.00
>510 mt	54	779	510 to 520 mt	1	515	25	20.59
>520 mt	53	780	520 to 530 mt	0	0	0	0.00
>530 mt	53	780	530 to 540 mt	0	0	0	0.00
>540 mt	53	780	540 to 550 mt	0	0	0	0.00
>550 mt	53	780	550 to 560 mt	0	0	0	0.00
>560 mt	53	780	560 to 570 mt	0	0	0	0.00
>570 mt	53	780	570 to 580 mt	0	0	0	0.00
>580 mt	53	780	580 to 590 mt	0	0	0	0.00
>590 mt	53	780	590 to 600 mt	1	592	20	29.59
>600 mt	52	781	600 to 700 mt	1	668	85	7.86
>700 mt	51	782	700 to 800 mt	0	0	0	0.00
>800 mt	51	782	800 to 900 mt	2	1,670	195	8.56
>900 mt	49	784	900 to 1,000 mt	2	1,960	366	5.36
>1000 mt	47	786	1,000 to 2,000 mt	10	14,697	544	27.02

>2000	37	796	2,000 to 3,000 mt	8	19,586	889	22.03
>3000 mt	29	804	3,000 to 4,000 mt	2	6,422	643	9.99
>4000 mt	27	806	4,000 to 5,000 mt	3	13,254	711	18.64
>5000 mt	24	809	5,000 to 6,000 mt	2	11,667	435	26.82
>6000 mt	22	811	6,000 to 7,000 mt	1	6,097	353	17.27
>7000 mt	21	812	7,000 to 8,000 mt	3	22,885	810	28.25
>8000 mt	18	815	8,000 to 9000 mt	3	25,889	817	31.69
>9000 mt	15	818	9,000 to 10,000 mt	4	37,012	1,105	33.49
>10,000 mt	11	822	10,000 to 20,000 mt	10	116,533	3,075	37.90
>20,000 mt	1	832	20,000 to 30,000 mt	0	0	0	0.00
>30,000 mt	1	832	> 30,000 mt	1	32,053	599	53.51
			Totals	833	320,439	19,524	16.41

Table 3.2-1. Left side: Number of boats that would and would not qualify for permits based on CPS (anchovy, mackerel and sardine) plus squid landings during the window period (January 1, 1986 to November 13, 1991)
Right side number of boats in corresponding landings categories, their CPS (no squid) landings, number of trips with CPS landings and average CPS (no squid) landed per CPS trip during the window period

Minimum Window Per. Landings	Total Boats Included	Total Boats Excluded
>0 mt	975	0
>0.5 mt	381	594
>1 mt	310	665
>5 mt	203	772
>10 mt	172	803
>11 mt	168	807
>12 mt	167	808
>13 mt	167	808
>14 mt	164	811
>15 mt	163	812
>16 mt	160	815
>17 mt	159	816
>18 mt	152	823
>19 mt	150	825
>20 mt	149	826
>21 mt	148	827
>22 mt	147	828
>23 mt	146	829
>24 mt	145	830
>25 mt	143	832

Landings Group	N Boats	CPS-Landings (No Squid)	CPS Trips	CPS/Trip
0 to 0.5 mt	594	67	1,903	0.04
0.5 to 1 mt	71	40	698	0.06
1 to 5 mt	107	172	1,633	0.11
5 to 10 mt	31	143	1,122	0.13
10 to 11 mt	4	11	145	0.07
11 to 12 mt	1	0	0	0.00
12 to 13 mt	0	0	0	0.00
13 to 14 mt	3	41	84	0.49
14 to 15 mt	1	14	167	0.08
15 to 16 mt	3	47	165	0.28
16 to 17 mt	1	16	100	0.16
17 to 18 mt	7	70	357	0.20
18 to 19 mt	2	19	2	9.50
19 to 20 mt	1	19	169	0.11
20 to 21 mt	1	0	0	0.00
21 to 22 mt	1	3	1	3.30
22 to 23 mt	1	0	0	0.00
23 to 24 mt	1	24	12	1.99
24 to 25 mt	2	25	11	2.25
25 to 50 mt	13	285	36	7.91

TABLE 3.2-3. Number of vessels in selected Coastal Pelagics Species (CPS) and CPS+squid landings categories, by principal gear.[a]/ Only boats that landed CPS (833 boats) or CPS+squid (975 boats) during the window period are included. Figures for CPS+squid landings are given in parentheses. For example, 186 boats used roundhaul or other net gear to take more than zero but less than 1 mt of CPS during the window period and 188 boats used roundhaul or other net gear to take more than zero but less than 1 mt of CPS+squid.

CPS(+Squid) Landings During Window Period	Roundhaul/ Other Net	Line	Pot/Trap	Dipnet	Trawl	Other/ Unspecified	All Gears
Trace-0.9 mt	186 (188)	308 (316)	37 (40)	1 (5)	24 (58)	42 (58)	598 (665)
1-19.9 mt	76 (76)	20 (23)	8 (11)	1 (4)	8 (13)	10 (34)	123 (161)
20-399.9 mt	45 (47)	1 (2)	0 (0)	0 (3)	1 (3)	9 (11)	56 (66)
400-799.9 mt	5 (7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (4)	5 (11)
>800 mt	51 (71)	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	51 (72)
Total Boats	363 (389)	329 (342)	45 (51)	2 (12)	33 (74)	61 (107)	833 (975)
Less restrictive option for large boat permits:							
No. Small Permits (20-399.9 mt)	45 (47)	1 (2)	0 (0)	0 (3)	1 (3)	9 (11)	56 (66)
No. Large Permits (>400 mt)	56 (78)	0 (1)	0 (0)	0 (0)	0 (0)	0 (4)	56 (83)
Most restrictive option for large boat permits:							
No. Small Permits (20-799.9 mt)	50 (54)	1 (2)	0 (0)	0 (3)	1 (3)	9 (15)	61 (77)
No. Large Permits (>800 mt)	51 (71)	0 (1)	0 (0)	0 (0)	0 (0)	0 (0)	51 (72)
Total Permits:	101 (125)	1 (3)	0 (0)	0 (3)	1 (3)	9 (15)	112 (149)

a/ CPS include northern anchovy, Pacific and jack mackerel and Pacific sardine. Principal gear is the gear which accounted for a plurality (largest share) of a vessel's total landings (all species) during the window period.

TABLE 3.2-4. Number of vessels in selected coastal pelagic species (CPS) and CPS+squid landings categories, by principal county.[a]/ Only boats that landed CPS (833 boats) or CPS+squid (975 boats) during the window period are included. Figures for CPS+squid landings are given in parentheses. For example, 82 boats based in San Diego county took more than zero but less than 1 mt of CPS during the window period and 84 boats based in San Diego county took more than zero but less than 1 mt of CPS+squid.

CPS+Squid Landings During Window Period	Principal County								
	San Diego	Orange/L.A	Ventura/Santa Barbara	SLuis Obispo	Monterey/ Santa Cruz	San Francisco	Other California	OR/WA/JV	Total
Trace-0.9 mt	82 (84)	102 (109)	54 (65)	26 (31)	90 (90)	122 (130)	8 (16)	114 (140)	598 (665)
1-19.9 MT	12 (14)	64 (81)	11 (14)	0 (0)	17 (22)	14 (14)	1 (6)	4 (10)	123 (161)
20-399.9 mt	5 (5)	24 (32)	11 (15)	1 (9)	11 (5)	0 (2)	0 (0)	4 (6)	56 (66)
400-799.9 mt	0 (0)	1 (5)	2 (2)	0 (0)	2 (4)	0 (0)	0 (0)	0 (0)	5 (11)
>800 mt	0 (0)	36 (37)	9 (15)	0 (0)	5 (18)	1 (2)	0 (0)	0 (0)	51 (72)
Total Boats	99 (103)	227 (264)	87 (111)	27 (32)	125 (139)	137 (148)	9 (22)	122 (156)	833 (975)
Least restrictive option for large boat permits:									
Number Small permits (20-399.9 mt)	5 (5)	24 (32)	11 (15)	1 (1)	11 (5)	0 (2)	0 (0)	4 (6)	56 (66)
Number Large permits (>400 mt)	0 (0)	37 (42)	11 (17)	0 (0)	7 (22)	1 (2)	0 (0)	0 (0)	56 (83)
Most restrictive option for large boat permits:									
Number Small Permits (20-899.9 mt)	5 (5)	25 (37)	13 (17)	1 (1)	13 (9)	0 (2)	0 (0)	4 (6)	61 (77)
Number Large Permits (>800 mt)	0 (0)	36 (37)	9 (15)	0 (0)	5 (18)	1 (2)	0 (0)	0 (0)	51 (72)
Total Permits	5 (5)	61 (74)	22 (32)	1 (1)	18 (27)	1 (4)	0 (0)	4 (6)	112 (149)

a/ CPS include northern anchovy, Pacific and jack mackerel and Pacific sardine. Principal county is the county in which a vessel landed a plurality of its catch all species) during the window period.

TABLE 3.2-5. Number of vessels in selected coastal pelagic species (CPS) and CPS+squid landings categories, by boat length.[a]/ Only boats that landed CPS 833 boats) or CPS+squid (975 boats) during the window period are included. Figures for CPS+squid landings are given in parentheses. For example, 294 boats less than 30' took more than zero but less than 1 mt of CPS during the window period and 314 boats less than 30' took more than zero but less than 1 mt of CPS+squid.

CPS+Squid Landings During Window Period	Boat Length <30'	30–39.9'	40–49.9'	50–59.9	60–60.9'	70–79.9'	>80'	Total
Trace–0.9 mt	294 (314)	204 (212)	67 (88)	19 (25)	9 (15)	5 (10)	0 (1)	598 (665)
1–19.9 mt	53 (73)	49 (56)	10 (16)	4 (6)	4 (6)	3 (3)	0 (1)	123 (161)
20–399.9 mt	8 (12)	10 (14)	16 (18)	16 (14)	3 (4)	1 (2)	2 (2)	56 (66)
400–799.9 mt	1 (1)	1 (2)	2 (3)	1 (5)	0 (0)	0 (0)	0 (0)	5 (11)
>800 mt	1 (1)	1 (4)	13 (24)	11 (16)	12 (14)	12 (12)	1 (1)	51 (72)
Total Boats	357 (401)	265 (288)	108 (149)	51 (66)	28 (39)	21 (27)	3 (5)	833 (975)
Least restrictive option for large boat permits:								
Number Small Permits (20–399.9 mt)	8 (12)	10 (14)	16 (18)	16 (14)	3 (4)	1 (2)	2 (2)	56 (66)
Number Large Permits (>400 mt)	2 (2)	2 (60	15 (27)	12 (21)	12 (14)	12 (12)	1 (1)	56 (83)
Most restrictive option for large boat permits:								
Number Small Permits (20–799.9 mt)	9 (13)	11 (16)	18 (21)	17 (19)	9 (4)	1 (2)	2 (2)	61 (77)
Number Large permits (>800 mt)	1 (1)	1 (4)	13 (24)	11 (16)	12 (14)	12 (12)	1 (1)	51 (72)
Total Permits:	10 (14)	12 (20)	31 (45)	28 (35)	15 (18)	13 (14)	3 (3)	112 (149)

a/ CPS include northern anchovy, Pacific and jack mackerel and Pacific sardine.

TABLE 3.2-6. Coastal pelagic trips, landings (mt) and revenues ($1,000's, Base Year=1989) during the window period as an average per vessel year and as a percent of total (all species) trips/landings/revenues, by vessels in selected coastal pelagic species (CPS) landings categories.[a]/ For example, boats that took more than zero but less than one mt of CPS during the window period made, on average, less than one (0.9) trip per year that produced CPS. CPS landings for this group average 0.04 mt worth $200 per year. In addition, 7 percent of all trips taken produced some CPS and landings and revenues were an inconsequential (0%) part of total landings and revenues for the group.

CPS Landings During Window Period	Trips	Landings	Revenues
Trace-0.9 mt	0.90 (7 percent)	0.04 (0 percent)	$0.02 (0 percent)
1-19.9 mt	6.67 (19 percent)	1.07 (2 percent)	$0.65 (3 percent)
20-399.9 mt	6.94 (28 percent)	26.92 (20 percent)	$10.22 (20 percent)
400-799.9 mt	19.03 (33 percent)	107.93 (20 percent)	$24.31 (20 percent)
>800 mt	42.49 (63 percent)	1,248.21 (68 percent)	$235.00 (52 percent)
All	4.82 (23 percent)	79.06 (58 percent)	$15.33 (37 percent)
Least restrictive option for large boat permits:			
>400	40.39 (60 percent)	1146.40 (67 percent)	$216.19 (52 percent)
Most restrictive option for large boat permits:			
>800	42.49 (63 percent)	1248.21 (68 percent)	$235.00 (52 percent)

a/ CPS include northern anchovy, Pacific and jack mackerel and Pacific sardine. A coastal pelagic trip is a trip on which a vessel landed any CPS.

TABLE 3.2-7. Coastal pelagic species (CPS) trips, landings (mt) and revenues ($1000's, Base Year=1989) during the window period as an average per vessel year and as a percent of total (all species) trips/landings/revenues per vessel year, by vessels in selected CPS+squid landings categories.[a]/ For example, boats that took more than zero but less than one mt of CPS+squid during the window period made, on average, less than one (0.8) trip per year that produced CPS. CPS landings for this group averaged 0.03 mt worth $200 per year. In addition, 6 percent of all trips taken produced some CPS and landings and revenues were inconsequential (0%) parts of total landings and revenues for the group.

CPS+Squid Landings During Window Period	Trips		Landings		Revenues	
Trace-0.9 mt	0.80	(6 percent)	0.03	(0 percent)	$0.02	(0 percent)
1-19.9 mt	5.03	(16 percent)	0.70	(3 percent)	$0.33	(2 percent)
20-399.9 mt	4.59	(37 percent)	11.06	(30 percent)	$6.44	(22 percent)
400-799.9 mt	9.87	(34 percent)	39.27	(30 percent)	$10.01	(21 percent)
>800 mt	31.33	(48 percent)	896.71	(62 percent)	$169.04	(47 percent)
All	4.12	(21 percent)	67.55	(56 percent)	$13.10	(34 percent)
Least restrictive option for large boat permits:						
>400	28.49	(47 percent)	783.08	(61 percent)	$147.96	(46 percent)
Most restrictive option for large boat permits:						
>800	31.33	(48 percent)	896.71	(62 percent)	$169.04	(47 percent)

a/ CPS include northern anchovy, Pacific and jack mackerel and Pacific sardine. A coastal pelagic trip is a trip on which a vessel landed any CPS.

TABLE 3.2-8. Breakdown by species of total landings (mt) and exvessel revenues ($1000's, Base Year=1989) during window period by vessels in selected Coastal Pelagic Species (no squid) landings categories.

	Window Period Coastal Pelagic Species (no squid) Landings Categories (mt)					
Species	Tr-0.9	1-19.9	20-399.9	400-799.9	>400	.800
LANDINGS						
Anchovy	0%	0%	7%	9%	3%	2%
Mackerel	0%	2%	12%	10%	62%	64%
Sardine	0%	0%	1%	1%	2%	2%
Squid	5%	44%	65%	74%	27%	26%
Herring	4%	3%	8%	5%	1%	1%
Bonito	0%	1%	0%	0%	3%	3%
Tuna	0%	0%	3%	0%	2%	2%
Shark/Swd	4%	2%	0%	0%	0%	0%
Flatfish	12%	4%	2%	0%	0%	0%
Salmon	3%	0%	0%	1%	0%	0%
Groundfish	59%	35%	2%	0%	0%	0%
Mollusks	1%	0%	0%	0%	0%	0%
Crustaceans	7%	2%	0%	0%	0%	0%
Other	5%	6%	0%	0%	0%	0%
Total	**22,859**	**26,916**	**37,219**	**12,994**	**465,237**	**452,243**
REVENUES						
Anchovy	0%	0%	6%	8%	2%	2%
Mackerel	0%	2%	12%	10%	48%	49%
Sardine	0%	0%	2%	1%	1%	1%
Squid	1%	23%	36%	63%	21%	20%
Herring	2%	4%	10%	10%	1%	1%
Bonito	0%	1%	0%	0%	6%	6%
Tuna	1%	1%	19%	0%	19%	19%
Shark/Swd	14%	10%	3%	0%	0%	0%
Flatfish	18%	13%	3%	0%	0%	0%
Salmon	14%	2%	1%	5%	0%	0%
Groundfish	26%	19%	4%	0%	0%	0%
Mollusks	1%	1%	1%	0%	0%	0%
Crustaceans	16%	10%	1%	0%	0%	0%
Other	5%	15%	1%	2%	1%	1%
Total	**$23,011**	**$14,717**	**$13,978**	**$3,013**	**$114,128**	**$111,116**

TABLE 3.2-9. Breakdown by species of total landings (mt) and exvessel revenues ($1000) (Base Year=1989) during window period by vessels in selected coastal pelagic species (CPS) and squid landings categories.

	Window Period CPS+Squid Landings Categories (mt)					
Species	Tr-0.9	1-19.9	20-399.9	400-799.9	>400	>800
LANDINGS						
Anchovy	0%	0%	13%	6%	2%	2%
Mackerel	0%	3%	16%	21%	57%	57%
Sardine	0%	0%	0%	2%	2%	2%
Squid	0%	1%	39%	56%	33%	32%
Herring	1%	1%	3%	8%	1%	1%
Bonito	0%	1%	1%	0%	3%	3%
Tuna	0%	1%	9%	0%	2%	2%
Shark/Swd	5%	6%	1%	1%	0%	0%
Flatfish	18%	9%	6%	0%	0%	0%
Salmon	3%	0%	1%	1%	0%	0%
Groundfish	54%	52%	4%	3%	0%	0%
Mollusks	2%	8%	2%	0%	0%	0%
Crustaceans	9%	4%	4%	0%	0%	0%
Other	7%	13%	1%	1%	0%	0%
Total	**29,949**	**18,516**	**11,730**	**6,986**	**515,642**	**508,655**
REVENUES:						
Anchovy	0%	0%	8%	5%	2%	2%
Mackerel	0%	2%	14%	12%	43%	43%
Sardine	0%	0%	0%	5%	1%	1%
Squid	0%	1%	15%	34%	26%	26%
Herring	1%	1%	2%	16%	3%	2%
Bonito	0%	1%	1%	0%	5%	5%
Tuna	1%	2%	27%	0%	17%	17%
Shark/Swd	11%	13%	8%	12%	0%	0%
Flatfish	20%	18%	6%	1%	0%	0%
Salmon	13%	2%	3%	4%	1%	0%
Groundfish	27%	22%	5%	7%	0%	0%
Mollusks	3%	8%	2%	0%	0%	0%
Crustaceans	18%	12%	8%	1%	0%	0%
Other	6%	19%	1%	2%	1%	1%
Total	**$29,533**	**$13,380**	**$9,196**	**$2,526**	**$128,609**	**$126,083**

TABLE 3.2-10. Percent of total coastwide coastal pelagic species (CPS) and squid landings during the window period that were taken by vessels in selected CPS and CPS+squid limited entry categories.[a]/

Landings During Window Period	Number of Boats	Anchovy	Mackerel	Sardine	All CPS	Squid
CPS (no squid):						
<0.9	598	0%	0%	0%	0%	6%
1-19.9	123	0%	0%	0%	0%	7%
20-399.9	56	18%	1%	3%	2%	14%
400-399.9	5	8%	0%	1%	1%	6%
>800	51	73%	98%	96%	97%	68%
Total	**833**	**100%**	**100%**	**100%**	**100%**	**100%**
Least restrictive option for large boat permits:						
>400	56	81%	98%	97%	98%	74%
Most restrictive option for large boat permits:						
>800	51	73%	98%	96%	97%	68%
CPS and Squid:						
<0.9	665	0%	0%	0%	0%	0%
1-19.9	161	0%	0%	0%	0%	0%
20-399.9	66	11%	1%	0%	1%	3%
400-799.9	11	3%	1%	1%	1%	2%
>800	72	86%	99%	98%	98%	95%
Total	**833**	**100%**	**100%**	**100%**	**100%**	**100%**
Least restrictive option for large boat permits:						
>400	83	89%	99%	99%	99%	97%
Most restrictive option for large boat permits:						
>800	72	86%	99%	98%	98%	95%

a/ CPS include northern anchovy, Pacific and jack mackerel and Pacific sardine.

TABLE 3.2.1-1. Numbers of boats that landed various amounts of coastal pelagic species (CPS) and CPS+squid during the window period (January 1, 1986 to November 13, 1991) and during the most recent five year period (January 1, 1990 to December 31, 1994).

	Window Period		Recent Period	
	Number of Boats	Percentage of Boats	Number of Boats	Percentage of Boats
CPS only				
20–399.9 mt	56	50 percent	69	65 percent
≥ 400 mt	56	50 percent	37	35 percent
Total	112	100 percent	106	100 percent
20–799.9 mt	61	54 percent	75	71 percent
≥ 800 mt	51	46 percent	31	29 percent
Total	112	100 percent	106	100 percent
CPS + squid				
20–399.9 mt	66	44 percent	82	57 percent
≥ 400 mt	83	56 percent	62	43 percent
Total	149	100 percent	144	100 percent
20–799.9 mt	77	52 percent	86	60 percent
≥ 800 mt	72	48 percent	58	40 percent
Total	149	100 percent	144	100 percent

TABLE 3.6.1-1. Fixed costs for a representative purse seine vessel in the coastal pelagics species fleet.

Item	Annual Cost
Accounting fees	$ 4,044
Auto expense	$ 1,331
Bank charges	$ 47
Contributions	$ 166
Maintenance	$ 2,389
Dues & subsciptions	$ 1,352
Employee benefits	$ 998
Entertainment	$ 1,304
License & permits	$ 770
Miscellanceous	$ 272
Moorage & storage	$ 2,691
Netting expense	$ 190
Outside services	$ 3,563
Parts & repairs	$ 6,561
Supplies	$11,166
Truck Expense	$ 1,596
Total	**$38,440**

TABLE 3.10-1. Locations of gill and trammel net fishers who received Marine Resource Protection Act permits to fish with gillnets in California waters during 1993.

County/Area	Number	Percent
Los Angeles	1	1 percent
San Pedro	33	30 percent
Monterey	1	1 percent
Orange	5	5 percent
San Diego	24	22 percent
San Luis Obispo	4	4 percent
Santa Barbara	21	20 percent
Ventura	16	15 percent
Other	2	2 percent
Total	107	100 percent

4.0 OPTIMUM YIELD, HARVEST FORMULAS AND OVERFISHING DEFINITIONS FOR THE COASTAL PELAGIC SPECIES FISHERY

This section analyzes options for Optimum Yield (OY), approaches for specifying harvest levels, and overfishing definitions in the Coastal Pelagic Species (CPS) fishery.

4.0.1 Optimum Yield

As defined in the Magnuson Fishery Conservation and Management Act (MFCMA), OY is the harvest level that provides greatest net benefits (including social and economic benefits) to the nation. Determination of OY involves consideration of biological, economic and social factors.

This fishery management plan (FMP) defines OY for the CPS fishery as the quantity of fish that can be taken under the regulations, specifications and management measures authorized by the FMP and promulgated by the Secretary. Policies and formulas for setting harvest limits (harvest guidelines or quotas, see below), and other management measures in the CPS fishery (e.g., size limits, gear restrictions, etc.) are based on biological and socioeconomic factors as described in the FMP. Future modifications to management policies and measures under the framework process will also be based on biological and socioeconomic factors. Thus, regulations, specifications and management measures established under the FMP and its framework management process provide the best means of specifying and achieving OY.

This approach to specifying OY in the CPS fishery provides the Pacific Fishery Management Council (Council) with flexibility for managing stocks under all possible situations. OY for well studied, overfished, or fully utilized stocks such as northern anchovy and Pacific sardine will be numeric, based on formulas involving current biomass estimates, and updated regularly. In contrast, OY for poorly known, unfished stocks such as Pacific saury (not actively managed at the outset of this FMP) could be non-numeric. OY for stocks such as jack mackerel, with high biomass, low fishing mortality and intermediate data availability, could be a numeric value updated only if conditions change or new data become available.

4.1 General Approach to Setting Harvest Levels

The general approach to setting harvest levels (as either harvest guidelines or quotas, see below) in the CPS fishery is different than that used by the Council for groundfish and in many other fisheries. A two step procedure is used in the groundfish fishery. First, the biological status of the resource is determined and a formula is used to estimate a harvest level that seems prudent on biological grounds called the allowable biological catch (ABC) or a range of harvest levels that can be justified on biological grounds. For most species in the groundfish fishery, ABC is equal to the biomass estimate times the target fishing mortality rate (usually $F_{35\%}$, the fishing mortality rate that results in spawning biomass per recruit equal to 35 percent of the level in a stock with no fishery). The second step in the groundfish fishery is adjustment of the ABC level or selection from a range of levels based on socioeconomic considerations (Council 1993).

The approach to setting harvest levels in the CPS fishery involves a single formula with no subsequent adjustment, rather than a formula for ABC followed by a subsequent adjustment based on socioeconomic factors. The difference in approach is due to an orientation towards long term benefits, limited management resources, relatively high resource variability, and imprecise management advice.

4.1.1 Analysis

The main advantage of a formula for setting harvest levels is that harvest levels can be set in a completely predetermined fashion quickly, easily and at minimum expense once the general formula has been agreed upon. To the extent that ABC and harvest levels are identical (as they tend to be in well managed fisheries), the approach recommended for CPS is better than a two-step process, because equivalent results are obtained more easily.

The one-step formula approach is less likely to result in overfishing or an overfished stock than a two-step process because it is not possible to set harvest levels higher than could be recommended on biological grounds or at levels that endanger high long term biological benefits. Long-term catch and biomass are likely to be relatively high while the frequency of low biomass levels is expected to be relatively low. Thus, impacts on endangered species that use CPS for forage and other CPS predators are minimal.

If harvest level formulas are well chosen, then relatively simple definitions of overfishing that complement the overall harvest policy can be prudently used (see below). The definitions can be simpler because the harvest formula itself prevents harvest guidelines or quotas that are larger than justifiable on biological grounds, for example, the harvest formula prevents overfishing.

One-step harvest level formulas are appropriate when management advice is imprecise, as in the case of CPS. Biomass estimates for CPS used to set quotas and harvest guidelines are imprecise and have coefficients of variation (a measure of precision) that range 30-50 percent. Thus, information about stock biomass provided to managers has a 95 percent confidence interval that is usually at least ±60 percent and sometimes ±100 percent. In the face of this uncertainty, and particularly when biomass is thought to be low, there is little information about the status of a stock to justify harvest rates beyond ABC.

The main disadvantage in using a one-step formula for setting harvest levels is less flexibility. There may be short term costs in not being able to set harvest levels greater than ABC during some years in order to accommodate short term socioeconomic problems in the fishery.

The performance of harvest formulas for CPS must be evaluated on the basis of biological, economic and social factors. In contrast, performance of ABC formulas need to be evaluated on the basis of biological factors only. Thus, the effort required to develop a harvest formula for CPS may be greater than the effort required to develop an ABC formula.

4.1.2 Harvest Formula

The general formula for harvest levels in the CPS fishery is:

$$H_{t+1} = (BIOMASS_t - CUTOFF) \times FRACTION$$

where H_{t+1} is the total harvest target level (for the entire stock throughout its range), CUTOFF is the lowest level of estimated biomass at which harvest is allowed and FRACTION is the fraction of the biomass above CUTOFF that can be taken by the fishery. $BIOMASS_t$ is generally the estimated biomass of fish age 1+ at the beginning of season t (not the spawning biomass during the peak spawning season as in the FMP for northern anchovy). 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. The formula uses the estimated biomass for the whole stock in one year ($BIOMASS_t$) to set harvest for the whole stock in the following year (H_{t+1}). 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.

An important characteristic of the harvest formula for CPS is that the overall harvest rate ($H_{t+1}/BIOMASS_t$) declines as biomass becomes low. By the time $BIOMASS_t$ falls as low as CUTOFF, the overall harvest rate is reduced to zero.

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.

4.1.2.1 Analysis

The general formula 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 mackerel (MacCall et al. 1985) and sardine and 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.

4.1.3 General Approach to Defining Overfishing

The definition of overfishing, as described in the National Standards, is a purely biological definition designed to protect the long term reproductive capacity of a fish stock. The general approach to setting harvest levels in the CPS fishery leads to natural and practical definitions of overfishing.

Overfishing in the FMP for CPS is defined as any fishing (except as allowed by bycatch restrictions) that occurs when biomass falls below a prespecified biomass level which is equal to or less than CUTOFF. For some stocks (like Pacific mackerel), it may be desirable to make CUTOFF and the definition of overfishing equal so that some harvest is allowed at biomass levels approaching the level of an overfished stock. For stocks where very conservative management is desired (like northern anchovy), it may be better to use a relatively high CUTOFF and a lower definition of overfishing so that most fishing is eliminated well before the stock becomes overfished.

4.1.3.1 Analysis

This approach to defining overfishing is consistent with one already used for anchovy (Council 1989) and regulations used by California to manage Pacific mackerel and sardine (which close the Pacific mackerel and sardine fisheries when biomass drops below prespecified levels).

Another advantage of the approach taken for CPS is that a rehabilitation program for overfished stocks is defined implicitly. Harvests of any kind (except as allowed under bycatch restrictions) are not allowed until the stock increases above the overfishing level and directed harvests are not allowed until the stock increases to at least the CUTOFF level. In addition, the harvest formula approach used for CPS reduces fishing mortality for stocks near the definition of overfishing or CUTOFF.

Taken together, the one-step harvest formula and definition of overfishing approach used for CPS prevent overfishing (too much harvest), minimize the chances of an overfished stock (low biomass conditions), and define rehabilitation programs if stocks become overfished so that the long term reproductive capacity of CPS stocks are protected.

4.1.3.2 National Marine Fisheries Service (NMFS) Review of Overfishing Definitions

NMFS reviewed overfishing definitions used in all FMP regulated fisheries (Rosenberg et al. 1994). For simplicity, the review by NMFS focused on overfishing definitions without reference to the policies or formulas used to determine OY or set catch limits. Discussion of the harvest formula approach for CPS is included here, because the harvest formulas and definitions of overfishing for CPS are designed to work together in preventing overfishing.

The NMFS review assumes a two step process in which (1) the ABC is estimated based on biological and fishery data, and (2) the ABC is modified, if necessary, on the basis of socioeconomic information to determine OY. The review recommends, therefore, that overfishing definitions be designed to prevent situations where OY is set too far above the ABC. This is usually accomplished by specifying separate fishing mortality rates for setting catch limits (a "target" level fishing mortality) and defining overfishing (a "threshold" level of fishing mortality).

The approach proposed for determining harvest levels for CPS is different than assumed in the NMFS review since harvest levels are set directly using a formula like the one used for ABC in other fisheries. Thus, if a formula is well chosen, OY cannot be set higher than justifiable on biological grounds and there is little or no opportunity for overfishing to occur. Of course, overfishing might still occur if actual catch exceeds target levels because of harvest in Mexican waters or lack of compliance in U.S. waters (the latter has seldom been a problem). The decision to use a formula for setting harvest levels, rather than a formula for ABC followed by subsequent adjustment, makes definitions of overfishing based on a threshold level of fishing mortality less useful and less important.

NMFS recommends that overfishing definitions should be measurable, operationally unambiguous, based in sound theory and biologically sensible. The options for setting harvest levels and defining overfishing proposed for CPS are based on estimated biomass levels and therefore measurable and operationally unambiguous. The options are based on sound theory because the definition of overfishing and harvest policy reduce the maximum fishing mortality rate as biomass or abundance levels decline. They are biologically sensible because they are designed to work well given the high level of natural variability in CPS, and other biological characteristics of the stocks.

NMFS recommends that an overfishing definition should set a limiting threshold for management of the stock that is distinct from a fishing target. Thresholds should be set at higher fishing mortality rates and lower biomass levels than targets. Options proposed for CPS use a threshold biomass level in the definition of overfishing that is generally not the same as a management target. The harvest formula approach (which is essentially an exploitation or fishing mortality rate criterion) is designed to ensure that biomass levels remain higher than the biomass threshold that defines overfishing. An additional exploitation rate or fishing mortality rate criterion could be specified in the definition of overfishing for CPS but, as explained above, would be redundant.

NMFS recommends that an overfishing definition should prevent recruitment overfishing. To define overfishing conceptually, NMFS used the stock size or level of fishing that would result in expected recruitment falling below one-half of the expected maximum recruitment. The recommended threshold biomass levels for defining overfishing in the anchovy and sardine fisheries are 75,000 metric tons (mt) and 50,000 mt, respectively. Spawner-recruit data for northern anchovy in the review and Pacific sardine in Jacobson and MacCall (1995) indicate that expected recruitment at the proposed thresholds is less than 50 percent of the expected maximum. The recommended harvest level formulas for CPS are designed, however, to minimize the occurrence of biomass levels as low as the overfishing threshold and the NMFS criteria may not be suitable for fish like CPS with highly variable recruitment.

NMFS recommends that overfishing definitions and threshold harvest control laws have at least two components: a maximum fishing mortality rate, and a precautionary biomass level below which the maximum fishing mortality rate is reduced. Further, NMFS recommends that additional protection be afforded by inclusion of an absolute minimum biomass (usually set at a low level) below which the fishery is closed. The recommended definition of overfishing and harvest level formulas for CPS include a maximum fishing mortality rate (the FRACTION parameter) which is continuously reduced as biomass decreases (because the harvest rate is H/BIOMASS = [1-CUTOFF/BIOMASS] x FRACTION). The definition of overfishing is, itself, a low biomass level below which CPS fisheries are closed.

NMFS recommends that an overfishing definition should be conservative but not overly restrictive. Extensive modeling indicates that the recommended definitions of overfishing and harvest formulas for CPS have a low probability of producing an overfished stock or restricting a fishery unnecessarily.

NMFS recommends that additional life history characteristics should be incorporated into overfishing definitions where appropriate. Where sufficient information is available (i.e., anchovy and sardine), recommended definitions of overfishing and harvest formulas for CPS are analyzed using species specific simulation models that incorporate as many biological details as possible. For example, the simulation model for Pacific sardine includes temperature related effects on recruitment and regimes of favorable and unfavorable environmental conditions.

NMFS recommends that an analysis of uncertainty is needed to evaluate the status of a stock with respect to its overfishing definition. When biomass levels are low, the recommended threshold biomass definitions for CPS can be readily compared to the statistical distributions that measure uncertainty in biomass estimates which are routinely provided in stock assessments for CPS (Jacobson et al. 1994) to estimate the probability that a stock is overfished.

NMFS recommends that the overfishing definition should be explicitly linked to management actions and rebuilding programs should be agreed upon while the stock is healthy. The recommended definitions of overfishing and harvest formulas for CPS include rebuilding programs (no fishing from an overfished stock and reduced exploitation rates while stock biomass is low) that will be established when the FMP is implemented.

NMFS recommends that the process for updating overfishing definitions when new information becomes available should be explicit. Overfishing definitions for CPS for which analyses are incomplete (i.e., Pacific mackerel and jack mackerel) should be updated as soon as adequate data and stock assessments are available. Overfishing definitions for all CPS will be updated whenever significant new information becomes available.

4.1.4 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. and Mexico on the basis of common policy. Effective management of CPS may be impossible 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 will be established.

In the absence of a cooperative management agreement, this 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. 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.

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 percent, the current total biomass is 200,000 mt and the portion of the stock in U.S. waters is 35 percent, 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.

4.1.4.1 Analysis

The advantages of prorating the total target harvest level to obtain harvest guidelines or quotas for U.S. fisheries are practical. The primary advantage is that U.S. fisheries can be managed unilaterally in a responsible manner that is consistent with the MFCMA. 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 potential 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. If problems with exchange of data were to arise, it is possible that surveys could be conducted in U.S. waters to estimate the biomass actually occurring there.

The most serious disadvantage is that the portion of each stock in U.S. waters must 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).

It is likely that estimates of the portion of CPS stocks in U.S. waters will be controversial. Managers may decide to choose, as a matter of policy, 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 possibly 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 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 although 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.

4.1.4.2 Portion in U.S. Waters and Available Data

Estimates of the portion in U.S. waters 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). 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 1951–1985. 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 Point Conception.

Estimates of the distribution of CPS larvae[1/] between the U.S. and Mexico based on CalCOFI larval data for 1951–1985 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 Mackerel	55 percent	45 percent
Jack Mackerel	54 percent	46 percent
Pacific Sardine	31 percent	69 percent
Northern Anchovy	65 percent	35 percent

1// Portion is U.S. waters could also be estimated using CalCOFI egg data, which might better reflect the distribution of adults at the time of spawning for some species.

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.

Estimates of the portion of CPS stocks in U.S. waters from CalCOFI data are probably reliable for northern anchovy and Pacific 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.

Estimates of the average distribution of CPS between the U.S. and Mexico based fish spotter data for 1964-1992 are given below. Fish spotters seldom enter Mexican waters during the winter and spring when CPS are most abundant in southern areas. Portions in the table are, therefore, best thought of as summer-fall estimates.

Fish Spotter (Summer-Fall) Distribution

Species	United States	Mexico
Pacific Mackerel	84 percent	16 percent
Jack Mackerel	75 percent	25 percent
Pacific Sardine	87 percent	13 percent
Northern Anchovy	98 percent	02 percent

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 (Figure 4.1.4.2-1).

Following the notation and approach in Lo et al. (1992), average relative abundance in region r (I_r) is:

$$I_r = d_r \, P_r \, A_r$$

where I_r is relative abundance in region r, d_r is the density in positive flights, P_r is the proportion of positive flights and A_r is the area searched. The terms for density (d_r) and proportion positive (P_r) 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 (A_r) 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:

$$US\% = \frac{\sum_{n=1}^{3} I_n}{\sum_{j=1}^{6} I_j}.$$

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 for CPS in U.S. waters during the whole year are probably averages of the CalCOFI estimates for winter-spring and the fish spotter estimates for summer-winter (see below). It is not possible at the present time to estimate the portion of any CPS in U.S. waters on an annual basis.

Best Estimates of Average Distribution

Species	United States	Mexico
Pacific Mackerel	70 percent	30 percent
Jack Mackerel	65 percent	35 percent
Pacific Sardine	59 percent	41 percent
Northern Anchovy	82 percent	18 percent

The best estimate for northern anchovy based on CalCOFI and fish spotter data (82 percent) is larger than the 70 percent 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 and the best estimate for jack mackerel should be reevaluated if a significant fishery develops.

4.1.5 Analysis by Simulation

Harvest formula options were analyzed using simulation models for species with sufficient data and recent stock assessments (Pacific sardine and northern anchovy). The general approach was to simulate a stock and its fishery over a long period of time and for a large number of CUTOFF, FRACTION and MAXCAT levels. The largest values of MAXCAT give essentially the same results as if MAXCAT were infinite or not used in the formula. Measures of performance for the harvest formula parameters used in each simulation (see below) were plotted so that results from the simulations could be readily interpreted. The purpose of the simulations was not to find the combination of CUTOFF, FRACTION, and MAXCAT that was optimal for all measures of performance (Ruppert et al. 1984). Instead, the results are used to find combinations of CUTOFF, FRACTION and MAXCAT that gave good results for most measures of performance (MacCall et al. 1985). In practice, the simulations proved very useful for choosing FRACTION but less useful for choosing CUTOFF and MAXCAT levels. This was largely because FRACTION was the most important parameter in the long term for simulated stocks that were well managed and unlikely to be overfished. Although the long term importance of CUTOFF is lower than FRACTION, CUTOFF levels become very important in the short term when stock biomass is low and harvests may be reduced or eliminated.

The simulation models for each species (described in detail below) were designed to be as realistic as possible. Each model was based on results and parameter estimates from recent stock assessments and included a realistic degree of density dependence and year to year variability in production or recruitment. Total harvest for each year in each simulation was based on a biomass estimate for fish age one and older at the beginning of the previous season. Simulated biomass estimates included realistic amounts of measurement error. Current conditions in the fishery were used to initialize simulations. Each simulation was run for a long period of time (1,000 simulated years) so initial conditions did not strongly affect results.

Simulation models assumed that the entire target harvest was taken in each year. Harvests greater than the total target harvest level due to lack of a cooperative management agreement with Mexico were not modeled or analyzed.

4.1.5.1 Measures of Performance

Six or seven measures of performance were used in simulation analysis of harvest formula options (see below). The value of each performance measure was computed for each combination of CUTOFF, FRACTION and MAXCAT.

Performance Measure

1. Average catch
2. Catch variance
3. Average midyear biomass
4. Percent of years with no catch
5. Average log catch
6. Average log midyear biomass
7. Net national benefits (for anchovy only)

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 is a measure of expected variability in annual landings over many years (Hall et al. 1988). Average midyear biomass was 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 zero because biomass was below the CUTOFF.

Average log catch and average log midyear biomass are downward curving or "convex" (Figure 4.1.5.1-1) measures of fishery performance. 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). Average log catch and average log midyear biomass were used to evaluate harvest parameter options for CPS because they are good measures of fishery performance over both the long and short term. Logarithms fall off rapidly as catch or biomass declines (Figure 4.1.5.1-1) so low levels of catch and biomass get a very low performance score. Thus, a harvest policy that gets a high average log catch or average log biomass score must result in relatively high catch levels that are fairly constant over the long term. Over the short term, convex 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.

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). Risk aversion as a policy is not an important part of the harvest formula analysis for CPS. The important point is that mean log catch and mean log biomass are highest for harvest formula parameters that give relatively high levels of catch or biomass with relatively low year to year variability.

Net benefits were calculated as a performance measure in the simulation model for northern anchovy only. Net benefits were not calculated for other species because of lack of data on relationships between catch rates and stock biomass. Comparing net benefits for different harvest formula options provides managers with a feeling for the economic tradeoffs involved in choosing a harvest formula option. Economic tradeoffs are due to choosing between harvest formula options that give high catches but low abundance versus harvest formula options that give lower catches but high abundance. High harvest levels tend to increase exvessel revenue but also increase operating costs because of low abundance and low catch rates. Low catches tend to decrease revenue but also decrease operating costs because of high abundance and high catch rates.

4.1.6 Recommended Harvest Formula and Definition of Overfishing for Each Species

Harvest formula parameters and the definition of overfishing recommended by the CPS Plan Development Team and CPS Advisory Subpanel for each species are given in Table 4.1.6-1. Recommendations and the full range of options considered for each species are described in detail below.

4.2 Pacific Sardine

Pacific sardine have recently increased in abundance 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 indices of relative abundance and catch at age data from fisheries in the U.S. and Mexico (Barnes et al. 1992; Deriso 1983). As a result, credible stock assessment models and biomass estimates are available although the precision of biomass estimates for the most recent year tends to be low with coefficient of variation's (CV's) of about 50 percent.

4.2.1 Current management

Pacific sardine are managed exclusively 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 spawning biomass exceeds 18,200 mt (20,000 short tons). In years when directed fishing is authorized, the bait fishery is allocated a minimum of 318 mt (350 short tons) and 227 mt (250 short tons) are allocated for dead bait. A reserve, based on the expected level of sardine bycatch in mackerel fisheries, is

subtracted from the overall quota and, if bycatch levels remain low, released to the directed fisheries late in the season. The overall quota in recent years has been set by CDFG on the basis of scientific advice and industry input. No formula for setting the U.S. quota was used prior to the 1994 season; quotas were according to informal policies regarding desired recovery rates, Mexican catches, etc. U.S. sardine quotas have been adjusted either directly or indirectly for expected catches in Mexico. Since 1994, sardine quotas set by CDFG have used a 15 percent FRACTION and CUTOFF at 20,000 mt (for U.S. fisheries only). One third of each U.S. directed quota is reserved for boats operating north of San Simeon Point (San Luis Obispo County, California). Tolerance limits for sardine are used to manage bycatch and may be, by law, 15-45 percent by weight in each delivery. The current tolerance limit is 35 percent. Incidental landings (less than 35 percent) and directed landings (more than 35 percent) are counted against the directed quota while it is available. When the directed quota has been reached, incidental landings are counted against the reserve.

4.2.1.1 Special Issues in Sardine Management

The sardine stock has increased since the early 1980's 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. Sardine are probably important as forage to brown pelicans (an endangered species) although few data are available because of scarcity of sardine until recently. Decisions about harvest formula options and the definition of overfishing for sardine must, therefore, consider sardine as forage.

4.2.2 Simulation Model

The simulation model for sardine used a Ricker recruitment model based on 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 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 percent. Recent sardine biomass estimates for 1992 had an arithmetic scale CV of 50 percent (Deriso 1993). Slightly larger CV's (60 percent) were used in the simulation because the estimate of measurement error in stock assessments was probably too small.

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 model was tested by comparing simulated biomass levels to actual biomass estimates for 1935-1990. Actual landings, growth rate and temperature data were used in the historical simulations. Historical biomass estimates and simulated biomass trajectories were similar.

4.2.3 Simulation Model Results

Simulations were run for FRACTION ranging from 0.001 to 1 with CUTOFF ranging from zero to 400,000 mt and MAXCAT ranging from 200,000 mt to 1,000,000 mt. FRACTION was the most important parameter and CUTOFF was the least important parameter for most performance measures. Figures 4.2.3-1 to 4.2.3-6 give performance measures over the range of FRACTION and CUTOFF levels for MAXCAT equal to 200,000 mt, 600,000 mt, and 1,000,000 mt.

Simulation results for MAXCAT in the range of 200,000 to 1,000,000 mt indicate that FRACTION for sardine should be about 20 percent (Figures 4.2.3-1 to 4.2.3-6). Higher levels of FRACTION lead to more fishing mortality than is optimal and relatively low biomass levels; lower levels result in too much foregone yield. Mean catch (Figure 4.2.3-1) is near maximum at FRACTION values of about 20 percent. This result is consistent with estimates of a 20 percent harvest rate for maximum sustainable yield (MSY) in sardine. Catch variance is maximum for FRACTION values greater than 35 percent (Figure 4.2.3-2) and only about half of maximum values for FRACTION values near 20 percent. Average midyear biomass declines steadily as FRACTION increases (Figure 4.2.3-3) and is about half the virgin level at FRACTION values near 20 percent. Mean log catch is maximum for FRACTION levels around 20 percent (Figure 4.2.3-4). Mean log midyear biomass declines as FRACTION increases but is near maximum levels at FRACTION equal 20 percent (Figure 4.2.3-5). Percent of years with no harvest (Figure 4.2.3-6) is quite low (less than 2 percent) for FRACTION levels up to about 30 percent.

Simulation results for runs with FRACTION equal to 20 percent indicate that MAXCAT levels of 400,000 to 600,000 mt are reasonable for sardine (Figures 4.2.3-7 to 4.2.3-12). Higher levels of MAXCAT give higher average catch levels (Figure 4.2.3-7) but also higher catch variance (Figure 4.2.3-8), lower biomass (Figure 4.2.3-9, and lower log biomass (Figure 4.2.3-11) levels. Lower log biomass levels at high MAXCAT levels were due to both lower average biomass and more year to year variation. Log catch (Figure 4.2.3-10) was maximum at MAXCAT levels around 600,000 mt and CUTOFF less than 50,000 mt. Percent of years with no harvest was low for all MAXCAT levels (Figure 4.2.3-12) as long as CUTOFF was low.

Simulation results indicate that the CUTOFF level is not critical in the long term for sardine if MAXCAT and, particularly, FRACTION are set at appropriate levels. Only two performance measures were affected by CUTOFF levels in simulations with FRACTION at 20 percent. Mean log catch of sardine with FRACTION at 20 percent was highest (Figure 4.2.3-10) and percent of years with no harvest was lowest (Figure 4.2.3-12) for CUTOFF less than 50,000 mt. These results indicate that a CUTOFF of about 50,000 mt is appropriate for sardine and that a fishery will not increase the frequency of low biomass periods if the stock is managed as assumed in the simulation with FRACTION equal to 20 percent.

The long term importance of the CUTOFF parameter for sardine may be low, as indicated by the simulation analysis, but 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 will occur even in the absence of a fishery; (2) sardine biomass is currently low; and (3) the simulation analysis assumed that the <u>whole</u> stock is managed according to the harvest formula (i.e. harvests in U.S. and Mexican waters do not exceed the total target harvest level as calculated using the harvest formula). 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 results in over harvest and increased frequency of low sardine biomass levels.

4.2.4 Options

Six options for the sardine harvest formula and definition of overfishing were developed. All options use FRACTION equal to 20 percent because simulation results and other analyses (MacCall 1979) indicate that FRACTION is the most important parameter for sardine and that the best choice is around 20 percent. Two values of MAXCAT (400,000 mt and 600,000 mt) and three values of CUTOFF (20,000, 50,000, and

100,000 mt) were used in options for sardine. A CUTOFF of 20,000 mt is roughly equivalent to the status quo for sardine since California regulations allow a directed fishery only when the spawning biomass exceeds 18,200 mt.

The definition of overfishing for sardine in each option was equal to CUTOFF except for options with CUTOFF equal to 100,000 mt. For options with CUTOFF equal 100,000 mt, a definition of overfishing of 50,000 mt was used. Considerable bycatch of sardine with Pacific mackerel occurs when sardine biomass levels are 50,000 to 100,000 mt (Wolf 1992) which would result in discard if the definition of overfishing was 100,000 mt. Recent experience indicates that modest levels of catch can be accommodated at biomass levels between 50,000 and 100,000 mt while still allowing the stock to increase (Barnes et al. 1992). Fifty thousand mt is near the minimum biomass level that can be objectively measured (Wolf and Smith 1986).

All harvest formula options for sardine are summarized in the table below. For example, under option 3, total harvest for sardine would be 20 percent of the total biomass over 50,000 mt (up to a maximum of 400,000 mt) and overfishing would be defined as any landings (except as allowed under bycatch restrictions) when the estimated biomass during the preceding season was less than 50,000 mt. Total harvest, U.S. harvest, and annual exploitation rates over a range of biomass levels under each option for sardine are given in Table 4.2.4-1. Performance measures for each option are given in Table 4.2.4-2.

Harvest formula and definition of overfishing options for Pacific sardine. All CUTOFF, MAXCAT, and definition of overfishing options are in mt. Options 1 and 2 are similar to the status quo. Option 3 is recommended by the CPS Plan Development Team and CPS Advisory Subpanel.

	FRACTION	CUTOFF	MAXCAT	OVERFISHING
Option 1	20 percent	20,000	400,000	20,000
Option 2	20 percent	20,000	600,000	20,000
Option 3	20 percent	50,000	400,000	50,000
Option 4	20 percent	50,000	600,000	50,000
Option 5	20 percent	100,000	400,000	50,000
Option 6	20 percent	100,000	600,000	50,000

4.2.5 Recommended Option for Sardine

The CPS Plan Development Team and CPS Advisory Subpanel recommend Option 3 for sardine. Under the recommended option, total harvest for sardine would be 20 percent of the total biomass above 50,000 mt up to a maximum of 400,000 mt. Overfishing would be defined as fishing of any kind (except as allowed under bycatch restrictions) when the biomass drops below 50,000 mt.

The choice of a CUTOFF for sardine (50,000 mt) requires that short and long term benefits be balanced. Performance of CUTOFF values was similar over a wide range for most performance measures (Table 4.2.4-2) although, as mentioned above, CUTOFF levels may be more important than indicated by simulation analyses. A CUTOFF of 50,000 mt for sardine is relatively low considering that sardine biomass levels have been as high as 3,500,000 mt. From a long term perspective, therefore, the more conservative Option 5 with a 100,000 mt CUTOFF might be preferred. From a short term perspective, Option 3 with a 50,000 mt CUTOFF is better because sardine biomass has recently been less than 100,000 mt (Deriso 1993) and Option 5 with a 100,000 mt CUTOFF would have eliminated the existing U.S. sardine fishery at least temporarily. In addition, the probability of realizing long term benefits from Option 5 are reduced by high catch levels in the Mexican fishery which is unregulated.

The recommended MAXCAT level (400,000 mt) is larger than historical landings except for landings during the 1934-1935 to 1944-1945 seasons when the stock was being overfished (Barnes et al. 1992). The recommended MAXCAT is close to the largest long term mean catch in simulations (Figure 4.2.3-7). These facts indicate that a MAXCAT level of 400,000 mt would not severely limit the fishery during periods when sardine biomass and productivity were high and would protect the stock against harvest levels set too high because of stock assessment errors. Overcapitalization is less of a potential problem under the preferred option than under an option with a higher MAXCAT.

The recommended definition of overfishing (50,000 mt) is a level measurable even when fishery data are not available (Wolf and Smith 1986; Barnes et al 1992). Mexican catches have historically been very low at biomass levels as low as 50,000 mt so it is likely Mexican catches would fall to zero at least as soon as U.S. catches if CUTOFF was set at 50,000 mt.

Compared to the status quo, the recommended option uses a higher definition of overfishing and CUTOFF and is more conservative. Option 3 is consistent with the goals and objectives listed in the FMP. In particular, it provides adequate forage for dependent species, 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.

4.3 Northern Anchovy

The three principal segments of the fishery for northern anchovy in the U.S. are the reduction, live bait and nonreduction commercial segments. Total catch of northern anchovy in the U.S. has been less than 10,000 mt per year since 1983 and reduction quotas were zero for U.S. fishers during 1992 and 1994. In contrast, landings in Mexico were greater than 79,000 mt per year after 1983 until the fishery collapsed in 1991 and catches fell to less than 100 mt.

4.3.1 Current Management

Anchovy are currently managed by Council under the Northern Anchovy FMP. Current regulations for anchovy (i.e., the 300,000 mt reduction CUTOFF) are designed to accommodate the most valuable commercial segments of the anchovy fishery as well as meet forage requirements of commercial and recreational fish species, marine mammals and birds, including several endangered species. Each year, the reduction quota is set equal to (1) zero, if the estimated spawning biomass is less than or equal to 300,000 mt, and (2) 100 percent 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. This approach corresponds to a CUTOFF of 300,000 mt, FRACTION of 100 percent and MAXCAT of 200,000 mt. There is no numeric limit on the valuable live bait catch but the fishery is market-limited and regularly takes about 5,000 mt per year. A minimum of 7,000 mt are reserved for other non-reduction uses, of which about 2,000 mt are typically taken for use as human and animal food.

In the Northern Anchovy FMP, overfishing is defined as harvests of any kind when the spawning biomass during the current <u>and</u> preceding season was less than 50,000 mt. All fisheries (reduction, live bait and other non-reduction) are closed in the second season when the spawning biomass falls below 50,000 mt for two consecutive seasons, and the closure continues in subsequent seasons until the spawning biomass equals or exceeds 50,000 mt.

4.3.1.1 Special issues in anchovy management

Management of northern anchovy has historically been more complex than management of other CPS because anchovy are important as forage for birds (including the endangered brown pelican and least tern), marine mammals and game fish (Anderson et al. 1980; Anderson et al. 1982). In the Northern Anchovy FMP, OY and harvest levels are set conservatively using a high CUTOFF level (300,000 mt) to ensure sufficient forage for endangered species and other predators. Consistent with previous policy and discussions with parties involved, recommended options for the CPS FMP use relatively high CUTOFF levels to maintain high anchovy biomass levels for use as forage.

Use of anchovy for bait is another factor that makes anchovy management complex. Anchovy fisheries for live and dead bait are small and market-limited but important to valuable recreational fisheries for gamefish, rockfish and salmon. In the Northern Anchovy FMP (Council 1983; 1989), the definition of overfishing (50,000 mt for two season in a row) is set much lower than the CUTOFF (300,000 mt) in order to allow operation of the fishery segments that provide live and dead bait. The live bait fishery, which takes about 5,000 mt per year and is strictly market-limited, is not restricted in the northern anchovy FMP until the stock becomes overfished. In addition, a 4,900 mt quota is allowed in the northern anchovy FMP for the U.S. fishery that supplies dead bait (called the "nonreduction" quota) as long as the stock is not overfished.

Consistent with previous policy and discussions with parties involved, options for the CPS FMP use a definition of overfishing that is lower than the CUTOFF and make special accommodations for fisheries that provide bait. Anticipating Council's decision in this regard, all simulation runs and analyses for anchovy harvest formula options assume that live bait catches of 5,000 mt per year are taken as long as biomass estimates are above the definition of overfishing (the model assumes a non-numeric OY for live bait). In addition, a 3,000 mt quota for the fishery that provides dead bait is assumed when estimated biomass is between the definition of overfishing and the CUTOFF.

A third issue in management of anchovy arises from revised estimates of anchovy biomass and problems with the current harvest formula. Recent estimates (Jacobson and Lo 1993) indicate that anchovy spawning biomass levels are frequently on the order of 300,000 mt which is the CUTOFF level in the Northern Anchovy FMP (PFMC 1983; 1989). Thus, the current 300,000 mt CUTOFF precludes a fishery (other than for bait and non-reduction purposes) in many years. The harvest formula in the FMP for Northern Anchovy was developed prior to 1983 using models that overestimated anchovy biomass and after a period of unusually high productivity in the late 1970's. When the formula was developed, a 300,000 mt CUTOFF was expected to allow a U.S. fishery in most years (Council 1983). In addition, analyses described below indicate that the FRACTION of 100 percent used in the FMP for northern anchovy is not optimal.

Consistent with previous policy and discussions with parties involved, options were developed for this FMP that would allow a fishery at biomass levels of 300,000 mt while maintaining adequate forage levels and accommodating other special requirements in the anchovy fishery. By decreasing both the CUTOFF and FRACTION, it was possible to find options that were at least as conservative as the status quo but would allow a modest anchovy fishery at biomass levels below 300,000 mt.

4.3.2 Simulation model

The simulation model used to analyze harvest formula options for anchovy used a surplus production model based on a Ricker recruitment equation (Jacobson and Thomson 1989). The model uses biomass on July 1 at the beginning of a season and seasonal harvest by the fishery to predict biomass at the beginning of the next season. Natural variability in the production model was included by assuming lognormally distributed random errors with standard deviation 0.37 (equal to the standard deviation of residuals from the Ricker model fit to actual data).

In comparing simulation results to current management practices, it is important to remember that harvest formula calculations in the simulations are based on the biomass of anchovy age 1+ at the beginning of the previous fishing season (July 1). For example, harvest levels for the 1993 season (July 1, 1993 to June 31, 1994) would be set in the simulation on the basis of the biomass estimate for July 1, 1992. In contrast, the current management approach for anchovy uses the spawning biomass on February 15 (late in the fishing season) to determine harvest for the next season.

The season used for biomass estimates is largely a matter of convenience. Changing the effective date of the biomass estimates changes their scale because anchovy biomass declines rapidly through the season. For example, the biomass of northern anchovy age 1+ on July 1, 1992 (the beginning of the 1992 season) was 438,000 mt but the biomass of the same group of fish on February 15, 1992 (late in the 1992

season) was only 282,000 mt (Jacobson and Lo 1993). In general, total biomass on July 1 is about 46 percent larger than spawning biomass on 15 February (i.e. spawning biomass in February x 1.46 = total biomass in the previous July) although there is some variation from year to year.

Status quo harvest policy parameters can also be converted for comparison to other options. For example, the 50,000 mt (on February 15) definition of overfishing in the FMP for northern anchovy corresponds to a 73,000 mt definition of overfishing on July 1.

Simulated biomass estimates used to set quotas in the model were realistically imprecise. Measurement errors for biomass estimates used in the simulations to set quotas were lognormally distributed with arithmetic scale CV's equal to 40 percent. Recent anchovy biomass estimates for 1993 had an arithmetic scale CV of 31 percent (Jacobson and Lo 1993). Slightly larger CV's (40 percent) were used in the simulation because the estimate of measurement error in stock assessments was probably too small.

Live bait harvests in the simulation model were assumed to be 5,000 mt per year and the quota for low volume uses was assumed to be 3,000 mt per year. As described above, harvests for live bait and other low volume uses continued when estimated biomass was below CUTOFF as long as the estimated biomass was higher than the definition of overfishing.

Producer surplus was used to measure net benefits for northern anchovy because consumer surplus (the other component of net benefits) was assumed constant. Consumer surplus was assumed constant because industry sources and analysis of fish ticket data indicated that anchovy price and consumer demand were independent of supply in the CPS fishery. The number and fishing power of boats in the simulation model used to calculate net benefits did not change over time.

Net benefits (B) in 1989 equivalent dollars was calculated as the difference between exvessel revenues (R) and variable or opportunity costs (C):

$$B = R - C.$$

Total revenue was calculated:

$$R = p\ H_{US},$$

where H_{US} is the U.S. harvest in mt and p is exvessel price in dollars/mt. The average exvessel price for anchovy during 1991 ($244 per mt in 1989 dollars) was used. Results using other prices for northern anchovy were similar.

Variable costs depend on time spent fishing. According to Jacobson and Thomson (1993), catch rate for northern anchovy is a function of biomass:

$$f = 0.38\ b^{0.39},$$

where f is the catch rate in mt/hour and b is anchovy biomass in thousand mt. The time (t in hours) required to catch the U.S. harvest is:

$$t = \frac{H_{US}}{f}.$$

Opportunity costs for fuel, phone, fish spotter payments, pension payments and labor amount to about $109 per hour at typical biomass levels of about 300,000 mt and typical fuel costs ($0.25 per liter; Jacobson and Thomson 1993). Variable costs in catching the U.S. harvest are:

$$C = 109\,t$$

and net benefits are:

$$B = H_{US}\ (p - 287\ b^{-0.39})\ .$$

Average net benefits were calculated for each combination of harvest formula parameters in the simulation analysis for northern anchovy. Net benefits for northern anchovy could be negative (revenues less than opportunity costs) if prices or catch rates (biomass) were too low. Net benefits and producer surplus in the model were positive when:

$$p > \frac{287}{b^{0.39}}$$

or

$$b > \left(\frac{287}{p}\right)^{2.56}.$$

At the assumed exvessel price ($244 per mt), net benefits in the simulation model were positive at anchovy biomass levels as low as 2,000 mt. Calculations in the simulation model for northern anchovy gave results similar to those from a more complicated model in Jacobson and Thomson (1993).

4.3.3 Simulation Model Results

Values of FRACTION ranging from 0.001 to 1, CUTOFF ranging from 50,000 to 400,000 mt and MAXCAT values of 200,000 and 600,000 mt were used in the simulations. FRACTION was the most important parameter and CUTOFF was the least important parameter in the simulations for most performance measures. Figures 4.3.3-1 to 4.3.3-7 give performance measures over the range of FRACTION and CUTOFF levels for MAXCAT equal to 200,000 mt, 400,000 mt and 600,000 mt.

Simulation results for MAXCAT in the range of 100,000 mt to 600,000 mt generally indicate that FRACTION for anchovy should be 20-30 percent. Higher levels of FRACTION in the simulation analysis gave more fishing mortality than was optimal and relatively low biomass levels. Lower FRACTION levels resulted in too much foregone yield. Mean catch (Figure 4.3.3-1) was near maximum at FRACTION values of 20-30 percent for MAXCAT equal 400,000 mt to 600,000 although higher fraction values gave good results at lower MAXCAT and high CUTOFF levels. Catch variance was only about half to three quarters of maximum values for FRACTION values of 20-30 percent (Figure 4.3.3-2). Average midyear biomass declines steadily as FRACTION increases (Figure 4.3.3-3) and is about three quarters to half the virgin level at FRACTION values of 20-30 percent. Mean log catch is maximum for low FRACTION levels of 10-20 percent because periods of very low or no catch are reduced (Figure 4.3.3-4). Mean log midyear biomass declines as FRACTION increases but is relatively high at FRACTION equal 20 percent (Figure 4.3.3-5). Percent of years with no harvest (Figure 4.3.3-6) is relatively low (less than 10 percent) for FRACTION levels up to about 20 percent. Net benefits (Figure 4.3.3-7) were similar to mean catch and generally near maximum at FRACTION values of 20-30 percent.

Simulation results for runs with FRACTION equal to 25 percent indicate that MAXCAT for anchovy should be set at about 300 mt although lower levels would give lower variance in catch and biomass, fewer years with no harvest and higher levels of biomass for use as forage (Figures 4.3.3-8 to 4.3.3-14). Mean catch

is highest at MAXCAT levels of 300,000 mt and higher (Figure 4.3.3-8). Catch variance is maximum at the highest levels of MAXCAT but only about half as large as maximum at MAXCAT equal to 300,000 mt (Figure 4.3.3-9). Average midyear biomass declines steadily as MAXCAT increases and is no less than half the virgin level at MAXCAT values near 300,000 mt (Figure 4.3.3-10). Mean log catch is maximum at MAXCAT and CUTOFF levels less than 150,000 mt (Figure 4.3.3-11). Results for mean log midyear biomass (Figure 4.3.3-12) were similar to results for average midyear biomass (Figure 4.3.3-10). Percent of years with no harvest increases with MAXCAT levels and CUTOFF and is expected to be 10-15 percent at MAXCAT levels of 300,000 mt and is lower for smaller MAXCAT levels (Figure 4.3.3-13). Net benefits (Figure 4.3.3-14)is maximum at MAXCAT levels of 400,000 mt and higher as long as CUTOFF is at least 150,000 mt.

Simulation results indicate that the CUTOFF for anchovy is not critical as long as MAXCAT and, particularly, FRACTION are set at appropriate levels. Lower CUTOFFS give slightly higher average catch and lower midyear biomass at most MAXCAT levels (Figure 4.3.3-8 and 4.3.3-10). Mean midyear biomass is at least 50 percent of the virgin level for CUTOFF in the 100,000 to 150,000 range (Figure 4.3.3-10). These results indicate that a CUTOFF of about 100,000 mt is suitable from the perspective of the anchovy fishery if the stock is managed as assumed in the simulation with FRACTION equal to 25 percent. Higher levels of CUTOFF would result in higher biomass and forage levels for anchovy predators but at the cost of yield to the fishery.

The long term significance of the CUTOFF parameter for anchovy may be low, as indicated by simulation analysis, but it is important to remember that the simulations assumed that the whole stock was managed according to the harvest formula (i.e. harvests in U.S. and Mexican waters do not exceed total harvest targets calculated using the harvest formula). The importance of CUTOFF levels to the fishery and predators in the short term may be critical when anchovy biomass is low or if lack of cooperative management with Mexico results in over harvest and increased frequency of low anchovy biomass levels.

Simulation analysis indicates that parameters used in the existing harvest formula for northern anchovy (the status quo) are far from optimal for most performance measures. The existing harvest formula for northern anchovy uses FRACTION equal to 100 percent, MAXCAT equal to 200,000 mt, and CUTOFF (spawning biomass on February 15) of 300,000 mt which is roughly equivalent to a July 1 age-1+ biomass of 300,000 x exp(0.63(M-G)) = 300,000 x exp(0.63(0.8-0.2)) = 438,000 mt. Consistent with experience in the fishery, the simulation analysis indicates that existing harvest formula parameters (especially FRACTION and MAXCAT) lead to low average catch (Figure 4.3.3-1), low net benefits (Figure 4.3.3-7), high catch variance (Figure 4.3.3-2), average biomass levels of only about 300,000 mt (i.e. equal to the cutoff, Figure 4.3.3-3), and a high proportion of years with no catch (Figure 4.3.3-6). The status quo is compared to other options below.

4.3.4 Options

Six options for the anchovy harvest formula and definition of overfishing were developed. All options use FRACTION equal to 25 percent because simulation results indicate that FRACTION is the most important parameter for anchovy and that the best values are around 20-30 percent. Two values of MAXCAT (200,000 mt and 300,000 mt) and three values of CUTOFF (100,000 mt, 200,000 mt and 300,000 mt) were used in harvest formula options for anchovy. MAXCAT of 200,000 mt was equivalent to the status quo for anchovy and, as explained above, the 300,000 mt CUTOFF for February 15 biomass estimates used in current regulations is actually equivalent to a larger July 1 CUTOFF value (about 438,000 mt) used in the simulations. Similarly, a 1 July CUTOFF of 300,000 mt is equivalent to a 15 February CUTOFF of 200,000 mt.

One level for the definition of overfishing (75,000 mt on July 1) was included in the simulation model and options for northern anchovy. The 75,000 mt definition of overfishing was chosen because it is equivalent to the definition (50,000 mt on February 15) used in the existing FMP for northern anchovy. Extensive analyses with models similar to the one used here (Jacobson and Thomson 1989) indicate that a definition of overfishing at the recommended level will protect the long term reproductive capacity of northern anchovy.

A one season criteria was used for the definition of overfishing in anchovy options instead of the two season criteria currently used in the FMP for northern anchovy. Under this approach, overfishing is defined as any fishing (except as allowed under bycatch restrictions) that occurs when the biomass estimate for the previous season falls below the overfishing level. The one season approach was used for consistency with other species and to prevent exploitation of northern anchovy at biomass levels lower than 75,000 mt. As a practical matter, anchovy biomass levels as low as 50,000 mt are expected to be rare because anchovy are less variable than sardine (Soutar and Isaacs 1974) and because anchovy are unavailable in Mexican waters when spawning biomass levels fall to 300,000 mt (Jacobson and Lo 1993). The Mexican fishery and associated mortality is effectively "turned off" when biomass begins to decline.

All harvest formula options for northern anchovy are summarized in the table below. For comparison, the status quo is included also. Total harvest, U.S. harvest, and annual exploitation rates over a range of biomass levels under each option for anchovy and the status quo are given in Table 4.3.4-1. Performance measures for each option and the status quo are given in Table 4.3.4-2.

Harvest formula and definition of overfishing options for northern anchovy. All CUTOFF, MAXCAT, and definition of overfishing options are in mt. All overfishing definitions are one season definitions except for the status quo which is a two season definition. Option 3 is recommended by the Team and Advisory Subpanel. Small live bait (about 5,000 mt per year) and low volume/high value (about 3,000 mt per year) fishery segments operate as long as biomass is greater than the definition of overfishing.

	FRACTION	CUTOFF	MAXCAT	OVERFISHING
Option 1	25 percent	100,000	200,000	75,000
Option 2	25 percent	200,000	200,000	75,000
Option 3	25 percent	300,000	200,000	75,000
Option 4	25 percent	100,000	300,000	75,000
Option 5	25 percent	200,000	300,000	75,000
Option 6	25 percent	300,000	300,000	75,000
Status Quo	100 percent	438,000*	200,000	73,000**

* a 438,000 mt CUTOFF on July 1 is equivalent to a 300,000mt CTOFF on February 15

** a 73,000 mt definition of overfishing on July 1 is equivalent to a 50,000 mt definition of overfishing on February 15

4.3.5 Recommended Option for Anchovy

The CPS Plan Development Team and CPS Advisory Subpanel recommend Option 3 for northern anchovy (FRACTION 25 percent, CUTOFF 300,000 mt, MAXCAT 200,000 mt and definition of overfishing at 75,000 mt). Under the recommended option, total harvest would be 20 percent of the total biomass above 300,000 mt up to a maximum of 200,000 mt. Overfishing would be defined as fishing of any kind (except as allowed under bycatch restrictions) when the biomass drops below 75,000 mt. In addition, and depending on the Council's decisions elsewhere, the live bait fishery (about 5,000 mt per year) may operate under a non-numeric OY (be unrestricted) at biomass levels above the definition of overfishing and a 3,000 quota for low volume uses may be allowed at biomass levels above the definition of overfishing and below the CUTOFF.

Comparisons of the status quo and Option 3 are easier when the definition of overfishing, CUTOFF, FRACTION, and MAXCAT for both are expressed in terms of total biomass and U.S. catches under both policies are plotted (Figure 4.3.5-1). Harvest levels under Option 3 are somewhat higher than the status quo at total biomass levels of 300,000-485,000 mt but Option 3 is more conservative at biomass levels above 485,000 mt.

The recommended CUTOFF (300,000 mt) for northern anchovy will provide forage for dependent species while allowing a modest U.S. fishery at lower biomass levels than currently allowed. Option 3 had the lowest level of average catch and net benefits in simulation analyses but also had low catch variance and the highest average biomass levels (Table 4.3.4-2). The percentage of years with no catch was relatively high (21 percent) for Option 3 but this was consistent with a policy that conserves anchovy for use as forage. For comparison to the status quo, the recommended 300,000 mt CUTOFF for total biomass on 1 July corresponds to about a 200,000 mt spawning biomass CUTOFF during the peak spawning season (15 February).

The recommended MAXCAT level (200,000 mt) for anchovy is larger than MSY (123,000 mt per year, Conrad 1991) and smaller than the largest actual catch (314,000 mt in 1981). These facts indicate that MAXCAT would not severely limit the fishery during periods when anchovy biomass and productivity are high and is probably not high enough to encourage overcapitalization during high biomass periods.

The recommended harvest formula option for anchovy is more conservative than the status quo because the definition of overfishing is for one season instead of two, and average midyear biomass is expected to be about 9 percent higher (Table 4.3.4-2). Although more biologically conservative, the recommended option should generate some fishery benefits at low biomass levels because a small directed fishery is allowed at biomass levels between 200,000 and 438,000 mt (equivalent to the current spawning biomass CUTOFF of 300,000 mt) and the fraction of years with no catch is expected to be 45 percent lower. Average long term catch is, however, expected to be slightly (6 percent) lower. If the Council adopts a non-numeric OY for live bait and a 3,000 mt quota for low volume uses, Option 3 will still be more conservative because the current FMP for northern anchovy uses a non-numeric OY for live bait and allows a larger quota (4,900 mt for U.S. fisheries, 7,000 mt total) for low volume uses.

Option 3 is consistent with the goals and objectives listed in the FMP. In particular, it provides adequate forage for dependent species, 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.

4.4 Pacific Mackerel

Pacific 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 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 estimates of Pacific mackerel biomass are reliable because of convergence in virtual population analysis abundance estimates (Pope 1972). Work is currently underway to develop indices of abundance for Pacific mackerel and assessment models that give credible results for recent years.

4.4.1 Current Management

Pacific 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 percent 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 mackerel is similar to a CUTOFF of 18,200 mt and FRACTION of 30 percent. Current regulations focus on U.S. harvests because they were developed when Mexican catches of Pacific 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.

4.4.2 Options

The only option for harvest formula parameters in the Pacific mackerel fishery is a modification of 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. Improvements should be possible once a satisfactory index of relative abundance and stock assessment model are developed.

4.4.3 Recommended Option

A CUTOFF and definition of overfishing at 18,200 mt and FRACTION of 30 percent are recommended for Pacific mackerel. Under this option, overfishing is defined as any fishing that occurs when the biomass falls below 18,200 mt. 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 mackerel (18,200 mt) is lower than for other species 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 the table below.

The option recommended for Pacific 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.

Summary of total harvest, U.S. harvest, and annual exploitation rates for a range of Pacific mackerel biomass levels under the recommended harvest formula and definition of overfishing option. Biomass and harvest levels are in mt. The annual exploitation rate differs from FRACTION (25 percent) because FRACTION is applied to the biomass minus the CUTOFF.

Biomass	Total Harvest	U.S. Catch*	Annual Exploitation Rate
10,000	0	0	0 percent
20,000	540	378	3 percent
30 000	3,540	2,478	12 percent
40,000	6,540	4,578	16 percent
50,000	9,540	6,678	19 percent
60,000	12,540	8,778	21 percent
70,000	15,540	10,878	22 percent
80,000	18,540	12,978	23 percent
90,000	21,540	15,078	24 percent
100,000	24,540	17,178	25 percent
200,000	54,540	38,178	27 percent
400,000	114,540	80,178	29 percent
500,000	144,540	101,178	29 percent
600,000	174,540	122,178	29 percent

* Assuming 70 percent of stock in U.S. waters

4.5 Jack Mackerel

Jack mackerel are underutilized although modest quantities have been taken off southern California in recent years (about 10,000 mt per year) and small quantities (less than 100 mt per year) are taken as bycatch in the Pacific whiting fishery off Oregon and Washington. Jack mackerel are not harvested in Mexican waters although some spawning occurs there.

Estimates of average biomass and potential yield for jack mackerel (Table 4.5-1) are educated guesses (MacCall and Stauffer 1983). It is likely that intensive work on jack mackerel biology will not be undertaken unless a significant fishery develops. At present, it is not possible to routinely monitor abundance of jack mackerel because there is almost no fishery and no surveys designed to collect information about relative abundance.

4.5.1 Current Management

Council sets an OY of 52,600 mt for jack mackerel north of 39° latitude (Council 1992) that has been assumed constant and not updated. The fishery south of 39° latitude is not subject to state or federal regulation.

4.5.2 Options

A single harvest formula and definition of overfishing option for jack mackerel was developed based on "rule of thumb" approaches because there was too little information available to construct a realistic model of the stock. A complete investigation of harvest formula parameters for jack mackerel should be undertaken as soon as adequate data are available.

The natural mortality rate of jack mackerel averaged over its lifetime is probably less than 0.25 yr^{-1}. In the absence of any information about yield or spawner biomass per recruit, FRACTION can be set equal to the natural mortality rate M=0.25 (Alverson and Pereya 1969). This approach is consistent with current policy for managing jack mackerel north of 39° latitude.

A recent study (Clark 1991) indicates that sustainable yields for groundfish will be at least 75 percent of maximum if spawning biomass is maintained in the range of 20-60 percent of the unfished level. This result can applied to jack mackerel because the natural mortality rate for jack mackerel is in the range considered by Clark (1991) for groundfish. On this basis, CUTOFF and definition of overfishing levels of 20-60 percent of virgin biomass seem reasonable. For lack of better information, and to be consistent with the Council's policy for groundfish, CUTOFF and the definition of overfishing for jack mackerel can be set at 35 percent of virgin biomass. Current best estimates of average biomass for jack mackerel range from 1.5 to 1.8 (midpoint 1.65) million mt (Table 4.5-1). Average biomass is almost the same as unexploited biomass because jack mackerel fisheries are small.

4.5.3 Recommended Option

The recommended option for jack mackerel uses FRACTION of 25 percent, and sets the CUTOFF and definition of overfishing at 35 percent of virgin biomass. No MAXCAT is specified for jack mackerel because potential yield and biomass estimates are uncertain. Biomass levels corresponding to the definition of overfishing and harvest formula parameters (assuming a biomass of 1,650,000 mt) and other data are given below.

Summary of harvest formula parameters, definition of overfishing and other data for jack mackerel	
Virgin Biomass	1,650,000 mt
CUTOFF and Definition of Overfishing (35 percent of Virgin Biomass)	578,000 mt
FRACTION	25 percent
MAXCAT	None
Total Harvest	268,000 mt
Annual Exploitation Rate	16 percent
Percent in U.S. Waters	65 percent
U.S. Harvest	174,300 mt

The recommended option for jack mackerel includes a relatively high CUTOFF level and definition of overfishing level relative to most other CPS (35 percent of virgin biomass) because of uncertainty in current estimates of biomass and productivity. In practice, this option will likely result in a constant U.S. harvest guideline of 174,200 mt until current estimates of average biomass are refined or approaches to estimating current biomass are developed. U.S. harvest at average biomass levels (174,200 mt) is large enough to allow further development of U.S. fisheries for underutilized jack mackerel. Total harvest under the recommended option is a little higher than the range of potential yield (Gulland 1970) estimates (130,000 to 260,000 mt) calculated by MacCall and Stauffer (1983) although actual catches are likely to be much lower than the total target harvest level because jack mackerel are not harvested off Mexico and U.S. catches have been small in recent years. The U.S. harvest guideline at average biomass is greater than the largest recorded catch (66,000 mt). If a fishery develops, then the recommended approach will protect the stock while additional data is collected.

The chief disadvantage of the recommended option is the uncertain information on which it is based. It is possible that a large fishery may develop in expectation of large harvest levels that cannot be sustained. Annual biomass estimates may be required if a significant fishery develops. Landings are monitored and collection of data from catches is possible but there are no indices of abundance for jack mackerel and too little information to construct an assessment model.

The option recommended for jack mackerel is consistent with the goals and objectives listed in the FMP. In particular, it provides adequate forage for dependent species, 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.

FIGURE 4.1.4.2-1. Areas used to calculate the portions of CPS stocks in U.S. waters from fish soptter data.

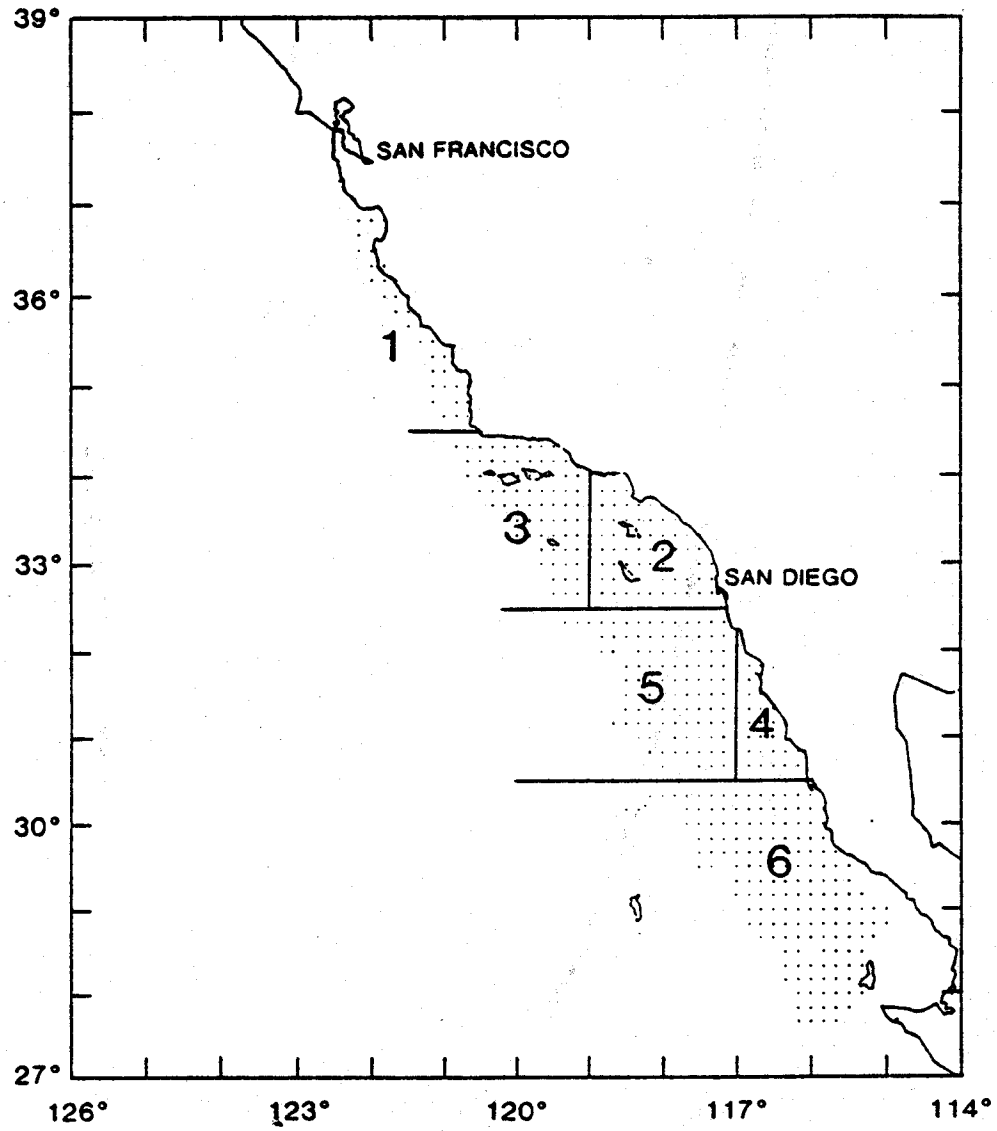

FIGURE 4.1.5.1-1. Log performance measures (y-axis) are downward curving and used to asses the performance of a harvest formula option based on catch or biomass levels (x-axis) during simulation analyses for CPS.

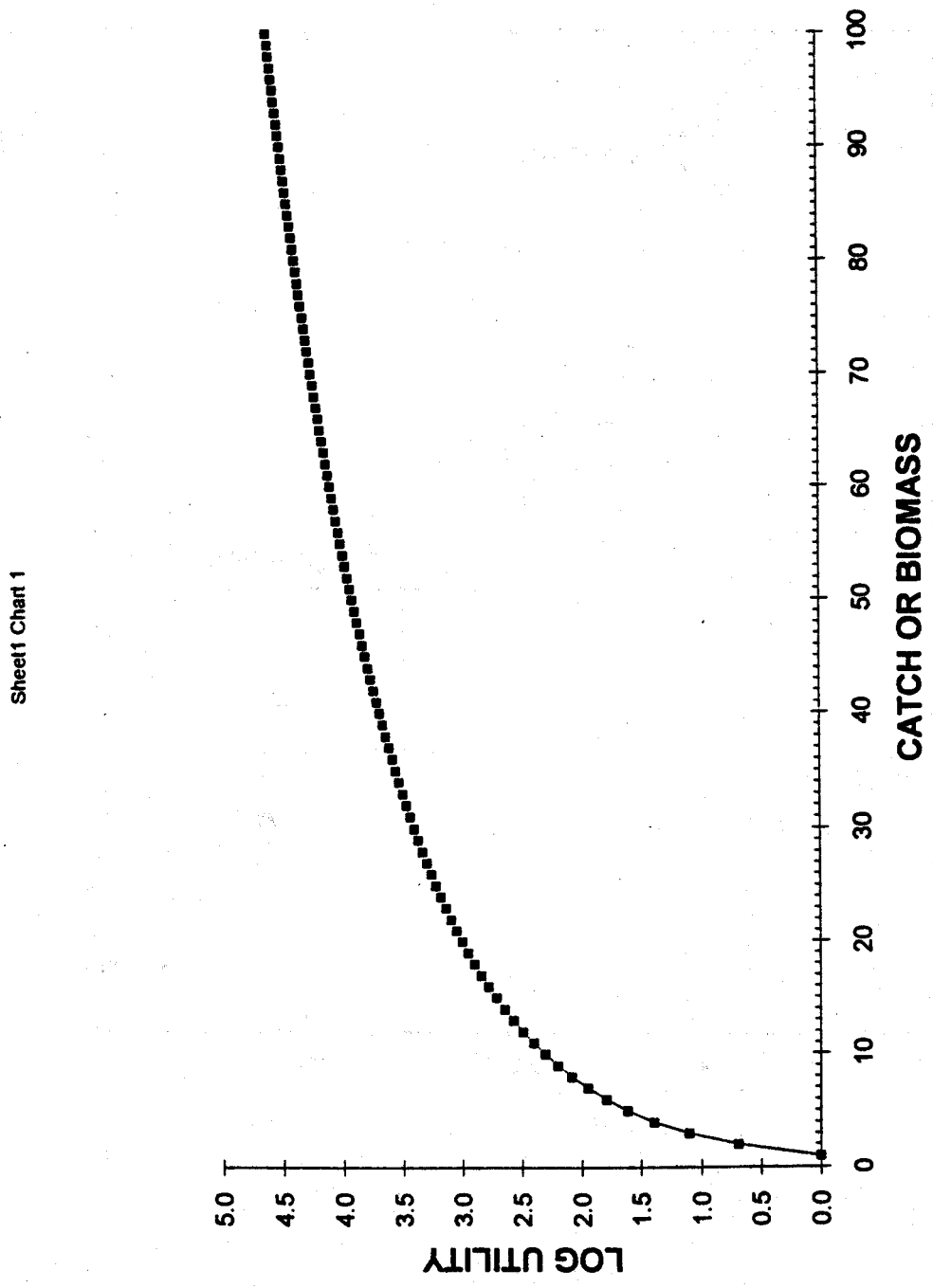

TABLE 4.1.6-1. Harvest formula and definition of overfishing options for CPS recommended by the CPS Plan Development Team and CPS Advisory Subpanel. CUTOFF, MAXCAT, and definition of overfishing options in mt.

	Pacific Sardine	Northern Anchovy	Pacific Mackerel	Jack Mackerel
FRACTION	20 percent	25 percent	30 percent	25 percent
CUTOFF	50,000	300,000	18,200	578,000*
MAXCAT	400,000	200,000	none	none
Definition of	50,000	75,000	18,200	578,000*

FIGURE 4.2.3-1.

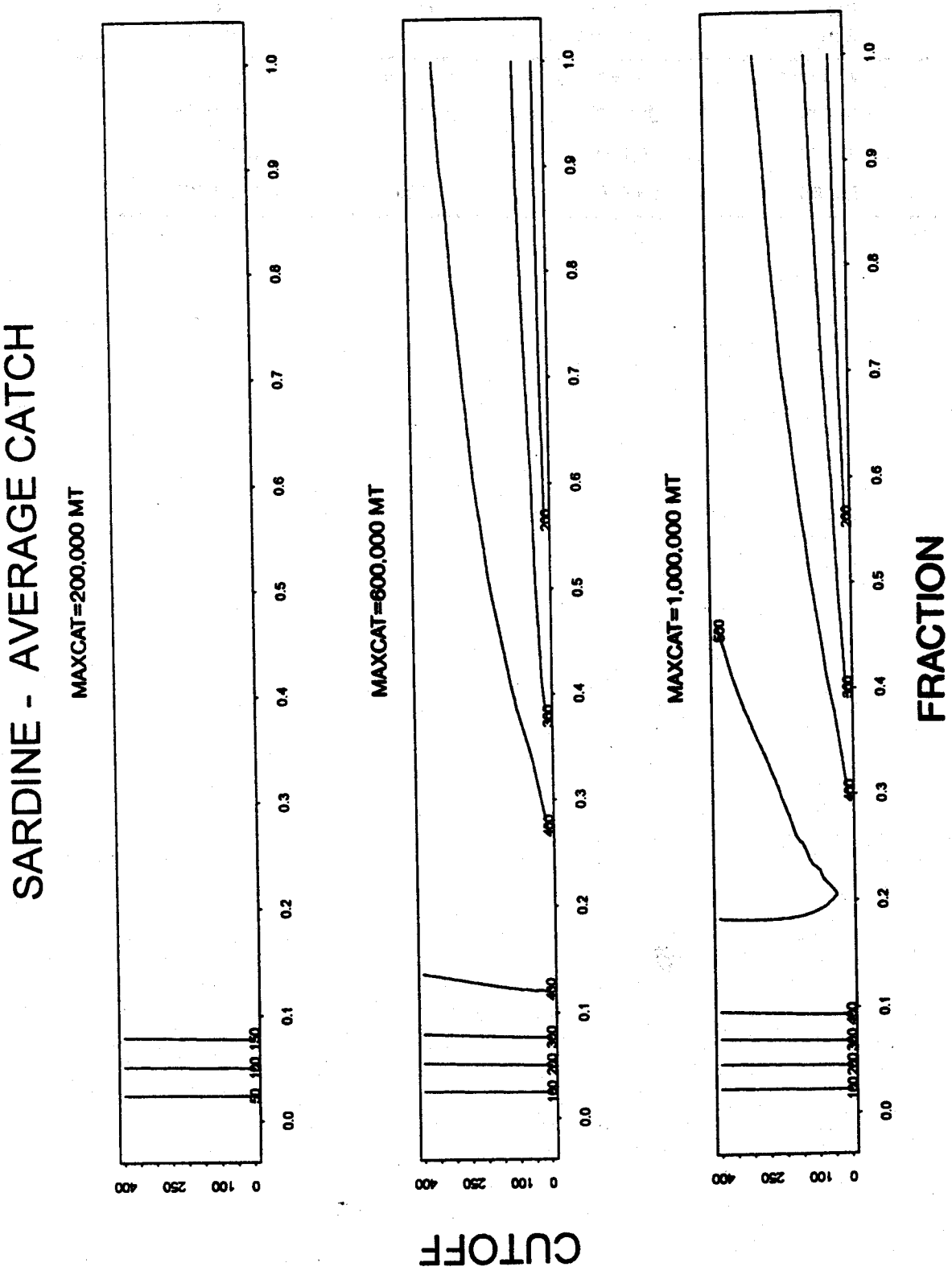
SARDINE - AVERAGE CATCH
MAXCAT=200,000 MT
MAXCAT=600,000 MT
MAXCAT=1,000,000 MT
CUTOFF
FRACTION

FIGURE 4.2.3-2.

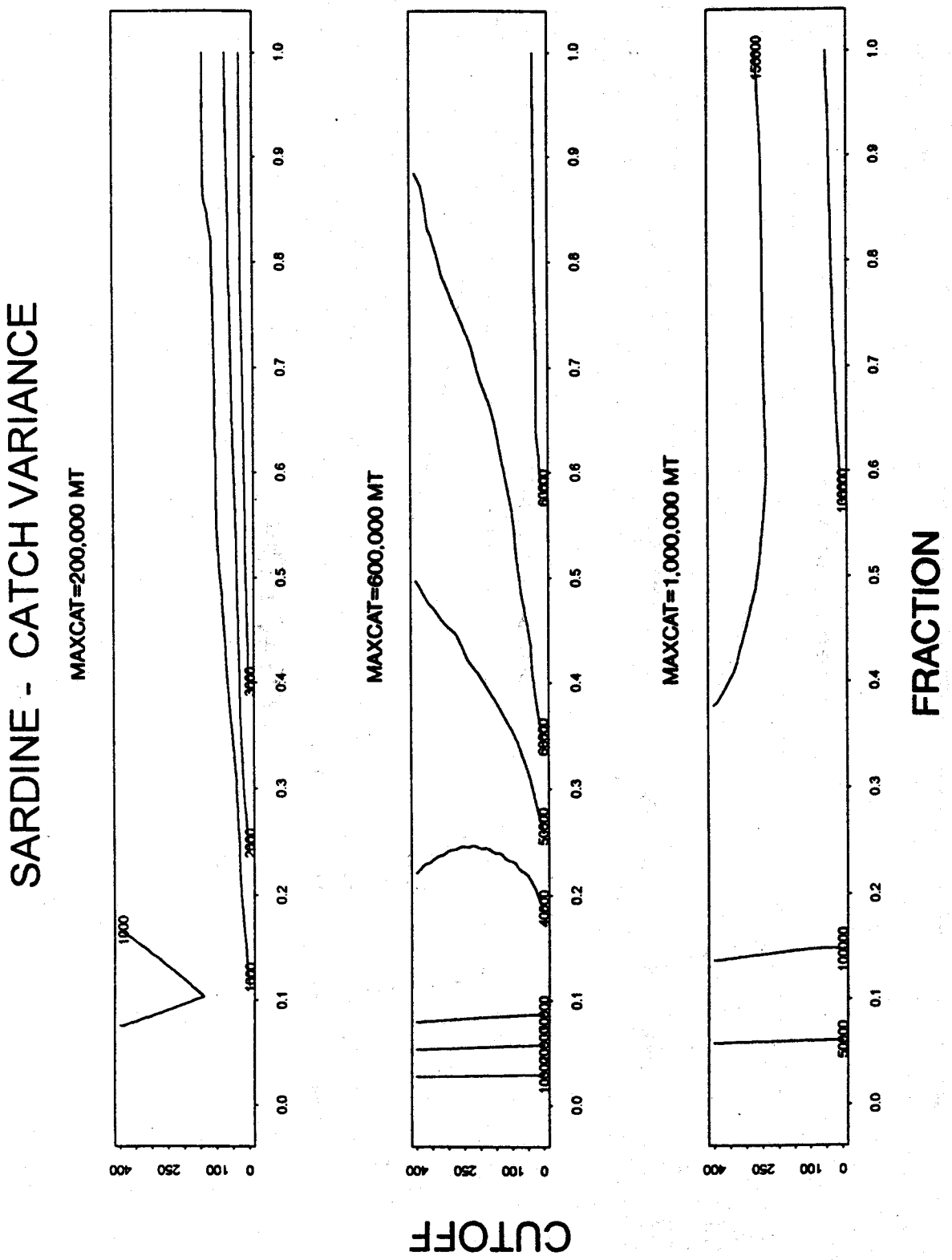
SARDINE - CATCH VARIANCE
MAXCAT=200,000 MT
MAXCAT=600,000 MT
MAXCAT=1,000,000 MT
CUTOFF
FRACTION

FIGURE 4.2.3-3.

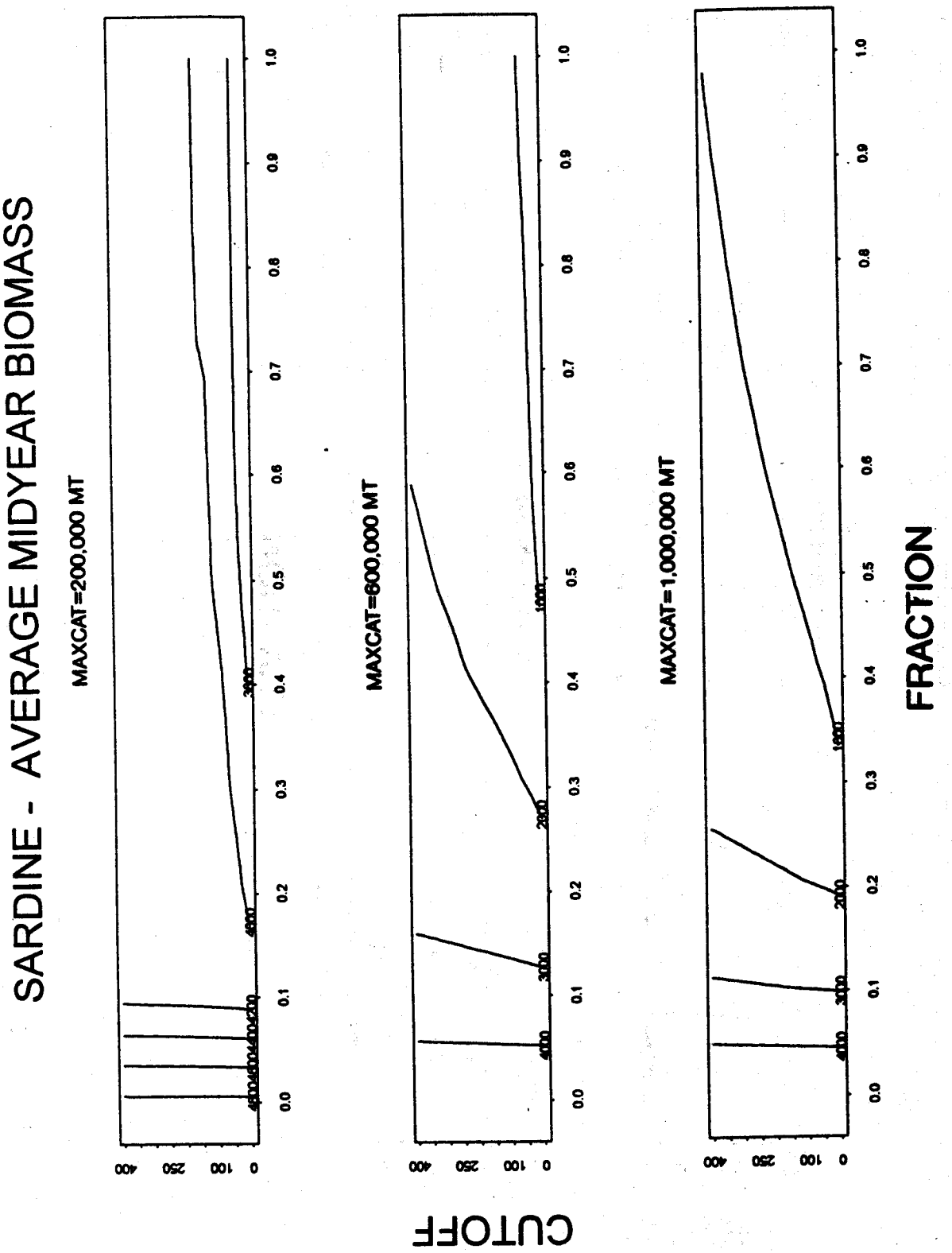
SARDINE - AVERAGE MIDYEAR BIOMASS
MAXCAT=200,000 MT
MAXCAT=600,000 MT
MAXCAT=1,000,000 MT
CUTOFF
FRACTION
0
100
250
400
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

FIGURE 4.2.3-4.

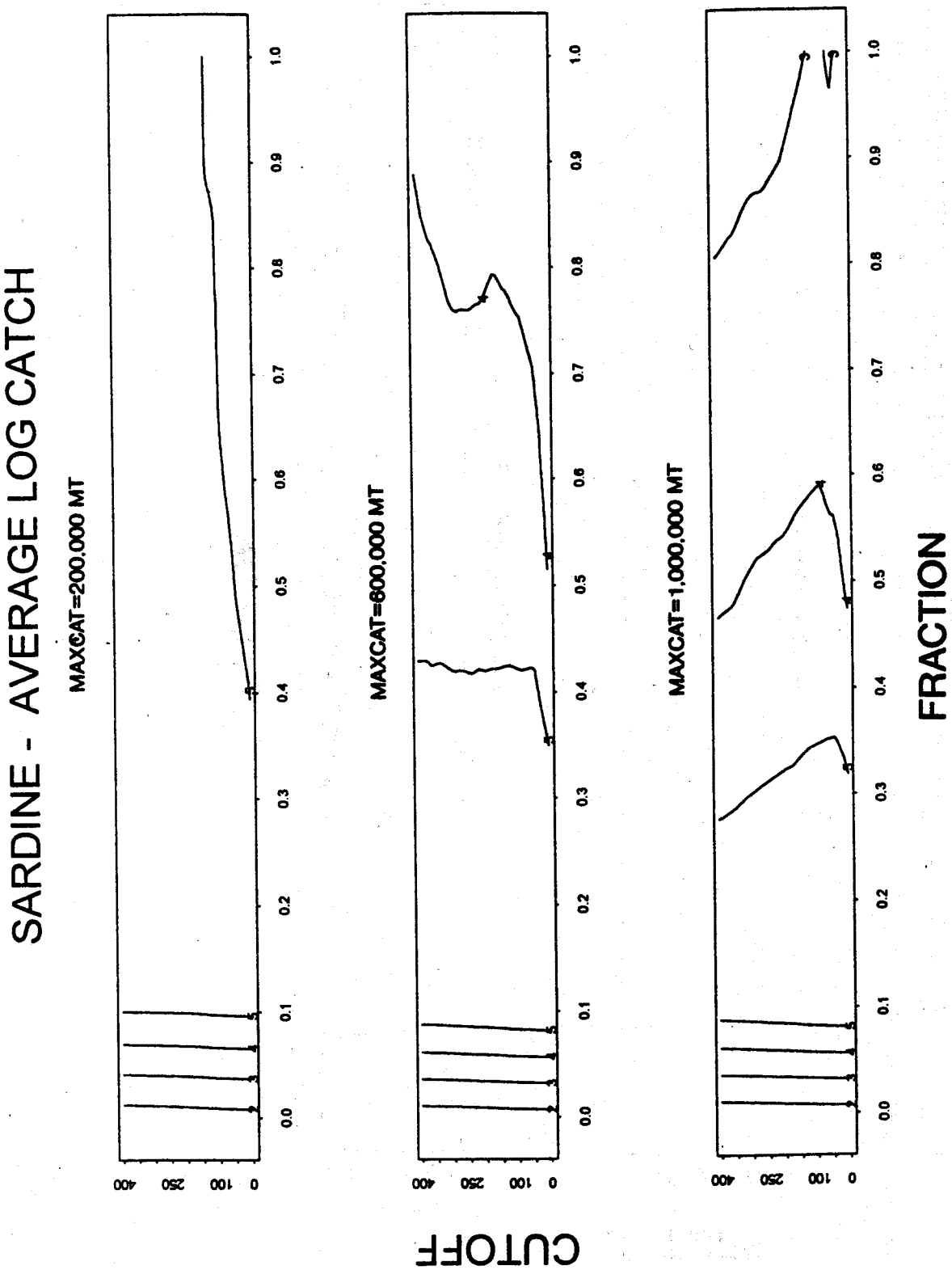
SARDINE - AVERAGE LOG CATCH
MAXCAT=200,000 MT
MAXCAT=600,000 MT
MAXCAT=1,000,000 MT
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
FRACTION
0
100
250
400
CUTOFF

FIGURE 4.2.3-5.

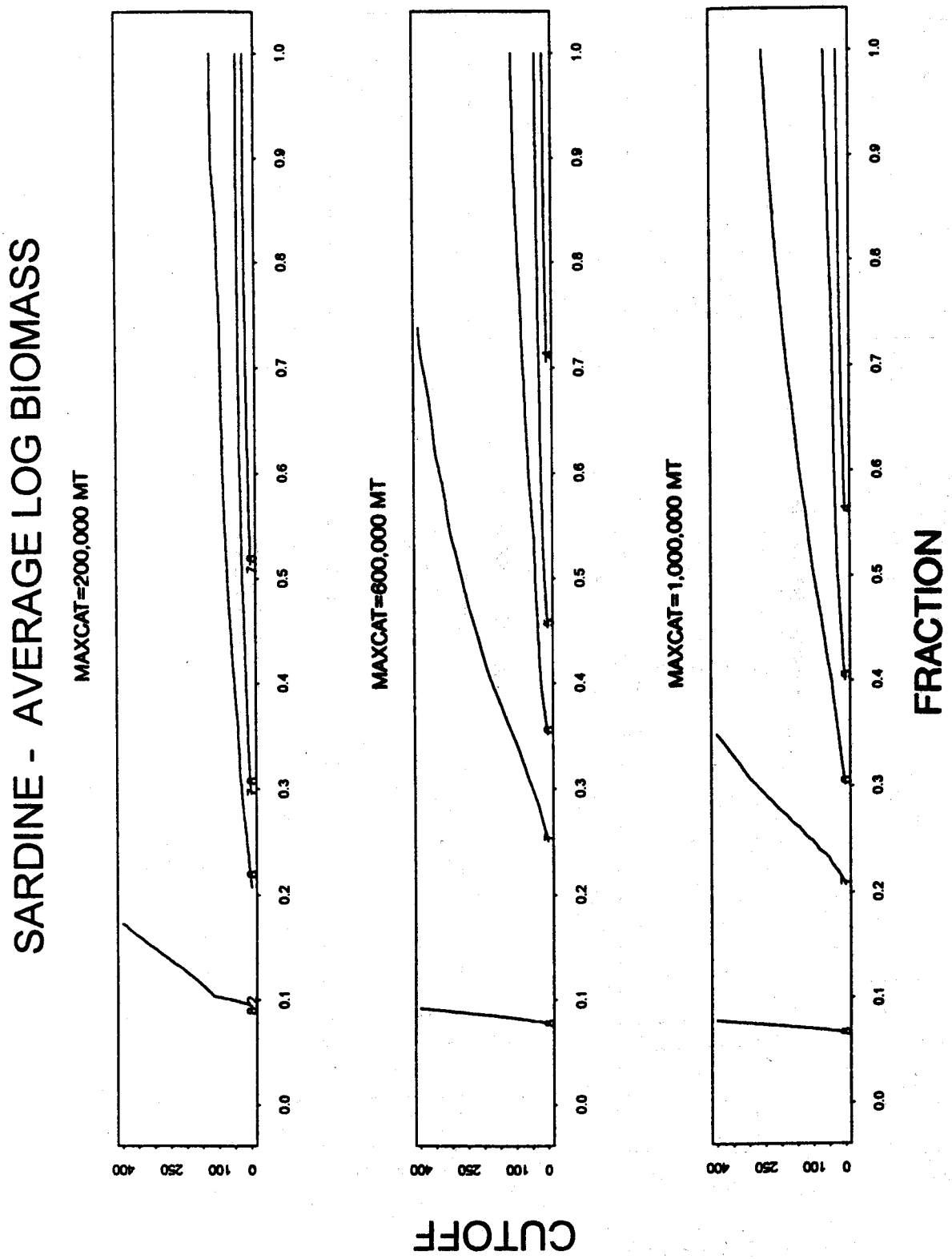
SARDINE - AVERAGE LOG BIOMASS
MAXCAT=200,000 MT
MAXCAT=600,000 MT
MAXCAT=1,000,000 MT
0
100
250
400
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
CUTOFF
FRACTION

FIGURE 4.2.3-6.

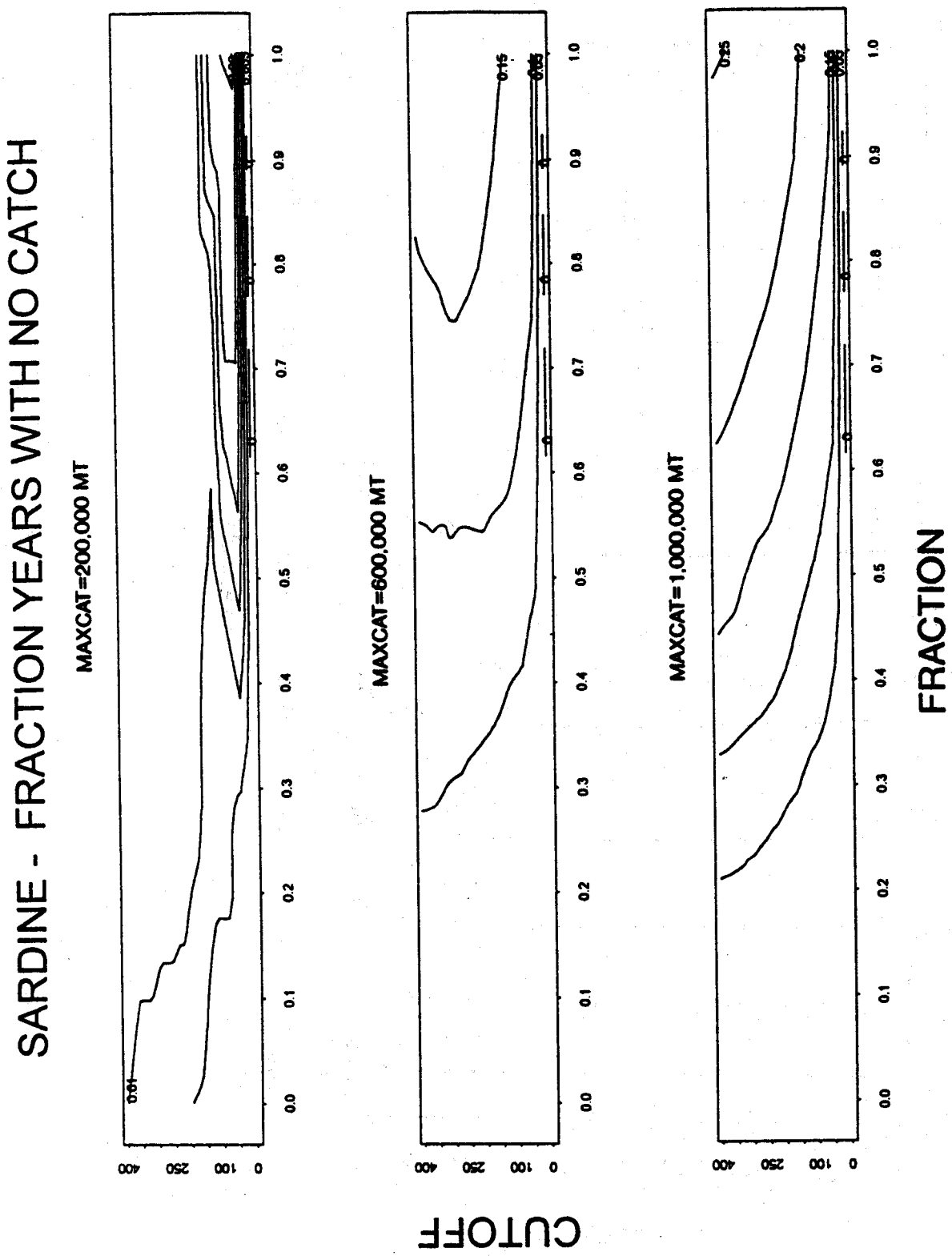
SARDINE - FRACTION YEARS WITH NO CATCH
MAXCAT=200,000 MT
MAXCAT=600,000 MT
MAXCAT=1,000,000 MT
0.01
0.15
0.25
0.2
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
0
100
250
400
CUTOFF
FRACTION

FIGURE 4.2.3-7.

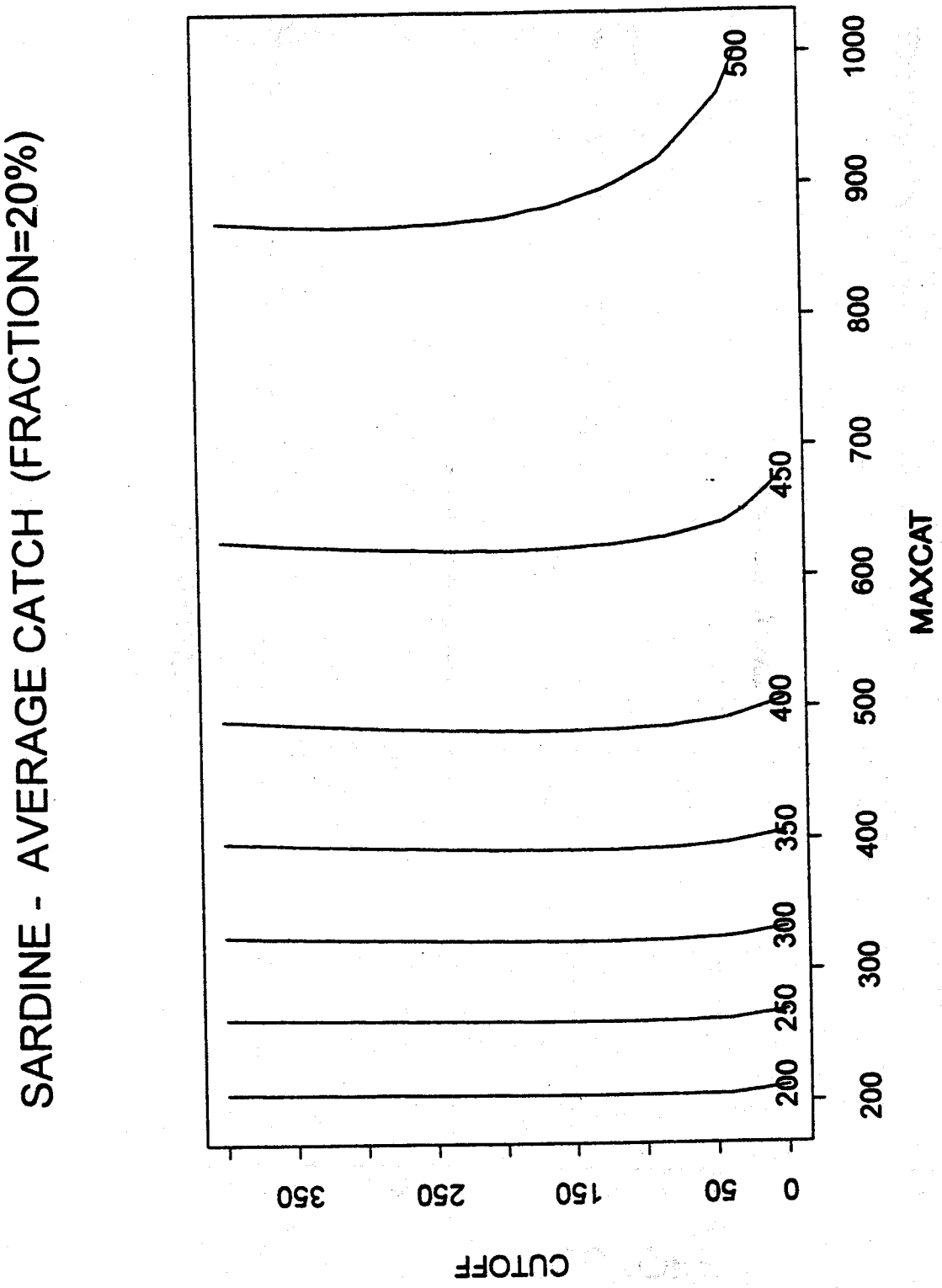
SARDINE - AVERAGE CATCH (FRACTION=20%)
CUTOFF
0
50
150
250
350
MAXCAT
200
300
400
500
600
700
800
900
1000
200
250
300
350
400
450
500

FIGURE 4.2.3-8.

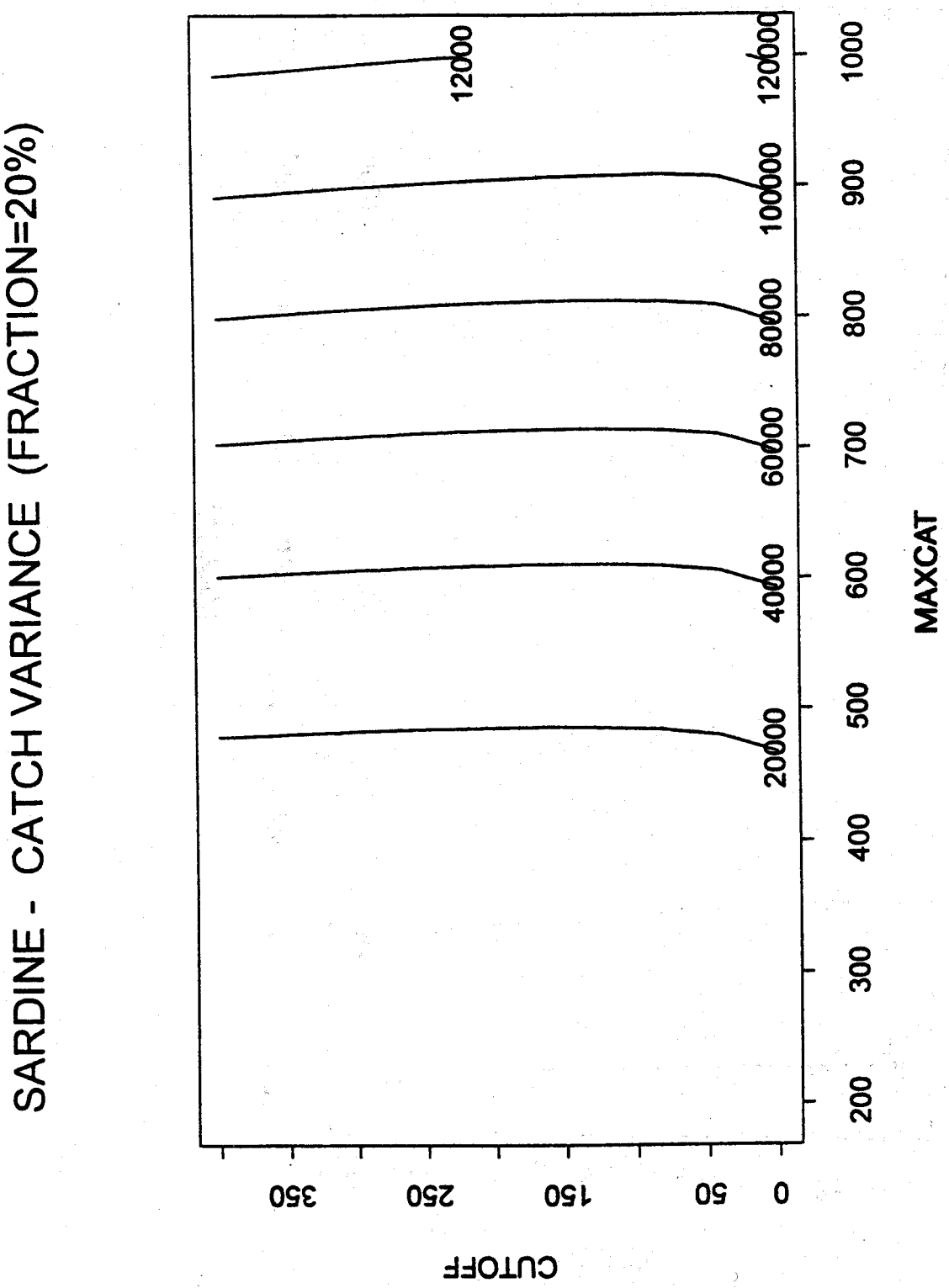
SARDINE - CATCH VARIANCE (FRACTION=20%)
CUTOFF
0
50
150
250
350
MAXCAT
200
300
400
500
600
700
800
900
1000
20000
40000
60000
80000
100000
120000
12000

FIGURE 4.2.3-9.

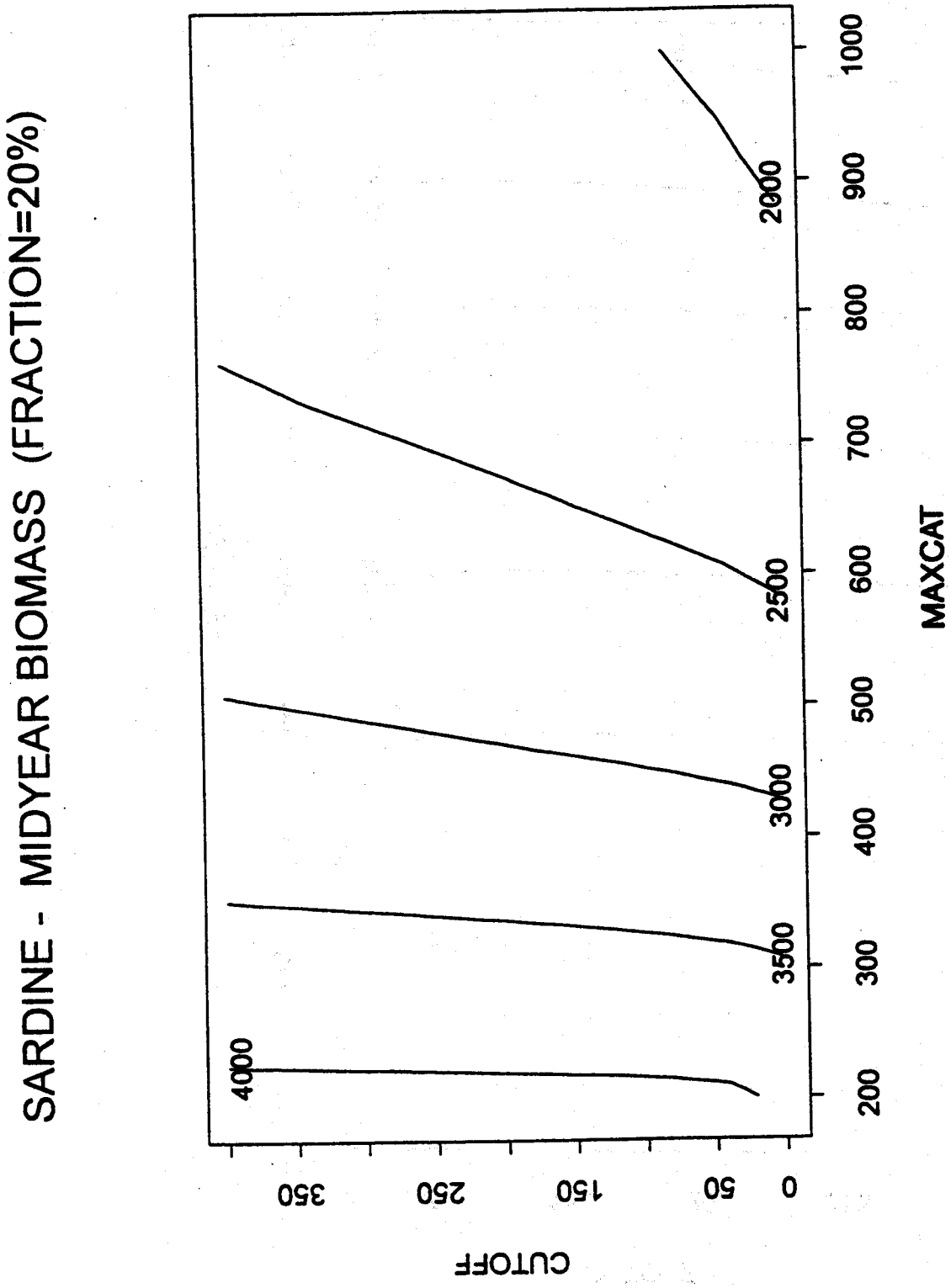
SARDINE - MIDYEAR BIOMASS (FRACTION=20%)
CUTOFF
0
50
150
250
350
MAXCAT
200
300
400
500
600
700
800
900
1000
4000
3500
3000
2500
2000

FIGURE 4.2.3-10.

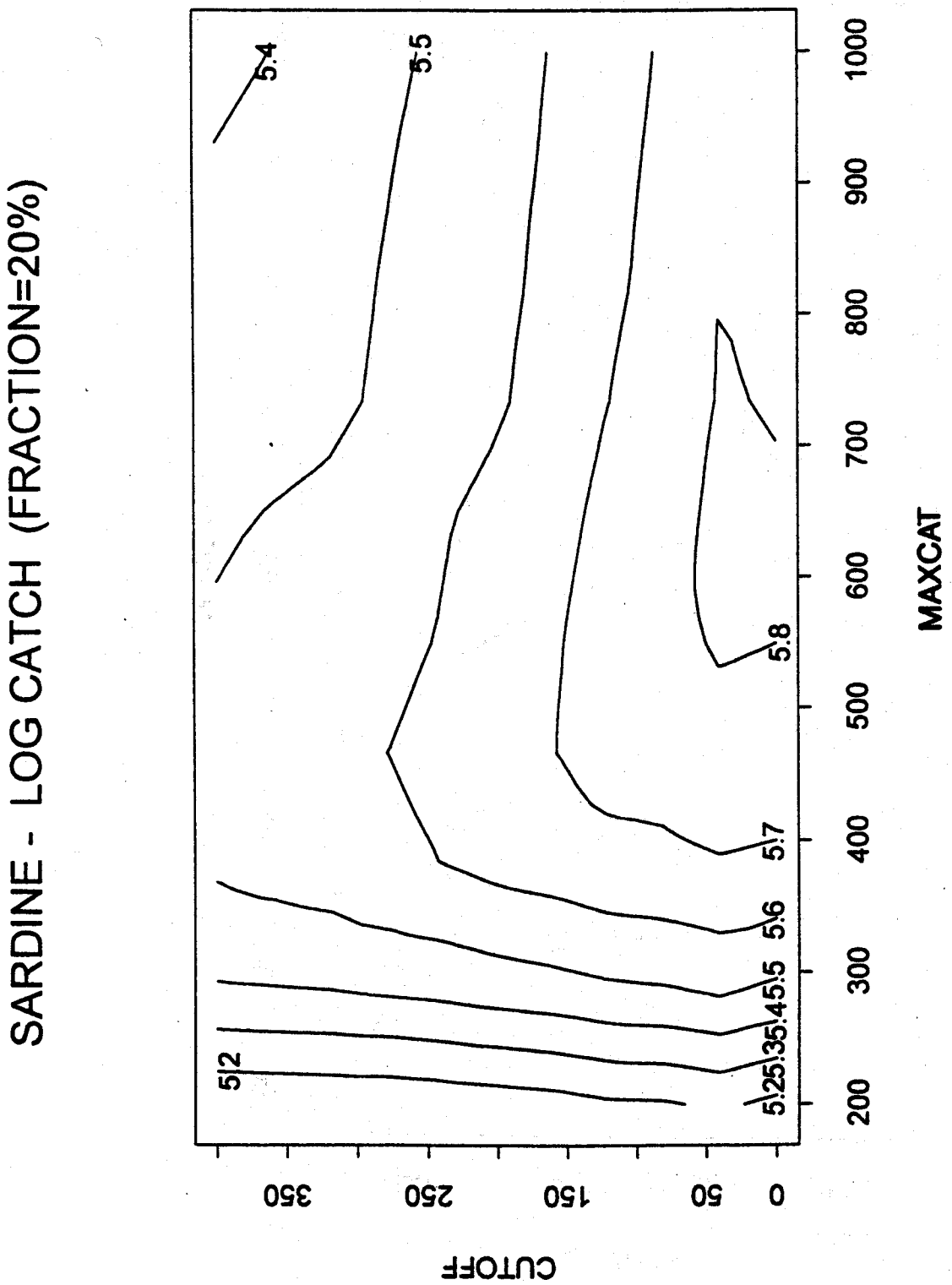

FIGURE 4.2.3-11.

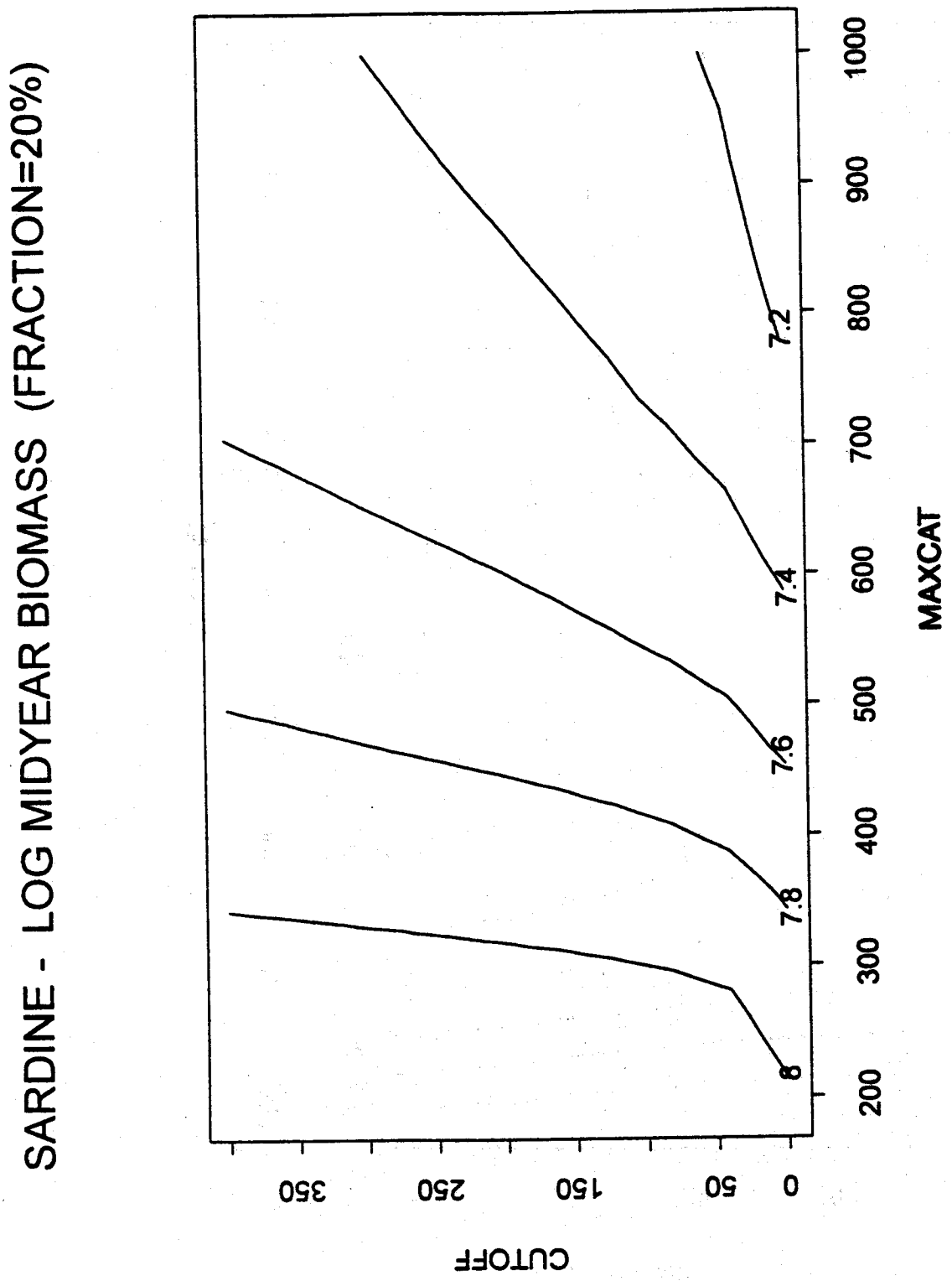

FIGURE 4.2.3-12.

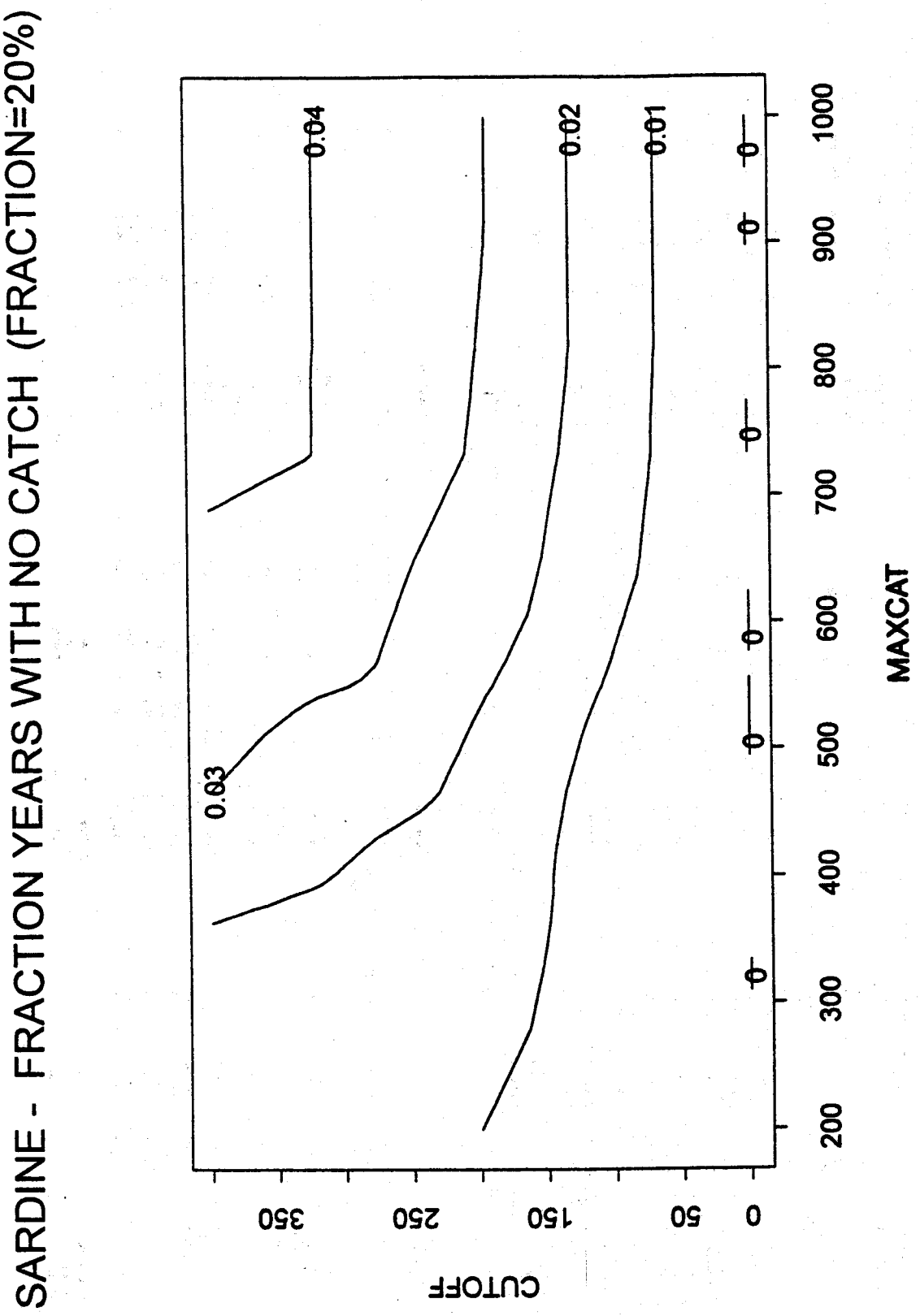

Table 4.2.4-1. Harvest formula and definition of overfishing options for Pacific sardine. Biomass, total harvest and US harvest are in units of mt. The annual exploitation rate is total harvest / biomass and is a measure of exploitation. Annual exploitation rate does not equal FRACTION, in general, because FRACTION is applied to the biomass minus CUTOFF.

Option 1

Biomass	Total Harvest	US Harvest	Annual Exploitation Rate
10,000	0	0	0%
20,000	0	0	0%
40,000	4,000	2,360	10%
50,000	6,000	3,540	12%
60,000	8,000	4,720	13%
80,000	12,000	7,080	15%
100,000	16,000	9,440	16%
200,000	36,000	21,240	18%
400,000	76,000	44,840	19%
600,000	116,000	68,440	19%
800,000	156,000	92,040	20%
1,000,000	196,000	115,640	20%
2,000,000	396,000	233,640	20%
3,000,000	400,000	236,000	13%
4,000,000	400,000	236,000	10%

FRACTION = 20%
CUTOFF = 20,000
MAXCAT = 400,000

Option 2

Biomass	Total Harvest	US Harvest	Annual Exploitation Rate
10,000	0	0	0%
20,000	0	0	0%
40,000	4,000	2,360	10%
50,000	6,000	3,540	12%
60,000	8,000	4,720	13%
80,000	12,000	7,080	15%
100,000	16,000	9,440	16%
200,000	36,000	21,240	18%
400,000	76,000	44,840	19%
600,000	116,000	68,440	19%
800,000	156,000	92,040	20%
1,000,000	196,000	115,640	20%
2,000,000	396,000	233,640	20%
3,000,000	596,000	351,640	20%
4,000,000	600,000	354,000	15%

FRACTION = 20%
CUTOFF = 20,000
MAXCAT = 600,000

Option 3 *** RECOMMENDED

Biomass	Total Harvest	US Harvest	Annual Exploitation Rate
10,000	0	0	0%
20,000	0	0	0%
40,000	0	0	0%
50,000	0	0	0%
60,000	2,000	1,180	3%
80,000	6,000	3,540	8%
100,000	10,000	5,900	10%
200,000	30,000	17,700	15%
400,000	70,000	41,300	18%
600,000	110,000	64,900	18%
800,000	150,000	88,500	19%
1,000,000	190,000	112,100	19%
2,000,000	390,000	230,100	20%
3,000,000	400,000	236,000	13%
4,000,000	400,000	236,000	10%

FRACTION = 20%
CUTOFF = 50,000
MAXCAT = 400,000

Option 4

Biomass	Total Harvest	US Harvest	Annual Exploitation Rate
10,000	0	0	0%
20,000	0	0	0%
40,000	0	0	0%
50,000	0	0	0%
60,000	2,000	1,180	3%
80,000	6,000	3,540	8%
100,000	10,000	5,900	10%
200,000	30,000	17,700	15%
400,000	70,000	41,300	18%
600,000	110,000	64,900	18%
800,000	150,000	88,500	19%
1,000,000	190,000	112,100	19%
2,000,000	390,000	230,100	20%
3,000,000	590,000	348,100	20%
4,000,000	600,000	354,000	15%

FRACTION = 20%
CUTOFF = 50,000
MAXCAT = 600,000

Option 5

Biomass	Total Harvest	US Harvest	Annual Exploitation Rate
10,000	0	0	0%
20,000	0	0	0%
40,000	0	0	0%
50,000	0	0	0%
60,000	0	0	0%
80,000	0	0	0%
100,000	0	0	0%
200,000	20,000	11,800	10%
400,000	60,000	35,400	15%
600,000	100,000	59,000	17%
800,000	140,000	82,600	18%
1,000,000	180,000	106,200	18%
2,000,000	380,000	224,200	19%
3,000,000	400,000	236,000	13%
4,000,000	400,000	236,000	10%

FRACTION = 20%
CUTOFF = 100,000
MAXCAT = 400,000

Option 6

Biomass	Total Harvest	US Harvest	Annual Exploitation Rate
10,000	0	0	0%
20,000	0	0	0%
40,000	0	0	0%
50,000	0	0	0%
60,000	0	0	0%
80,000	0	0	0%
100,000	0	0	0%
200,000	20,000	11,800	10%
400,000	60,000	35,400	15%
600,000	100,000	59,000	17%
800,000	140,000	82,600	18%
1,000,000	180,000	106,200	18%
2,000,000	380,000	224,200	19%
3,000,000	580,000	342,200	19%
4,000,000	600,000	354,000	15%

FRACTION = 20%
CUTOFF = 100,000
MAXCAT = 600,000

TABLE 4.2.4-2. Performance measures for sardine harvest formula and definition of overfishing options. CUTOFF, MAXCAT, definitions of overfishing, catch and biomass are in mt. Option 3 is recommended. Options 1 and 2 are roughly equivalent to the status quo.

	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5	OPTION 6
CUTOFF	20,000	20,000	50,000	50,000	100,000	100,000
SLOPE	0.2	0.2	0.2	0.2	0.2	0.2
MAXCAT	400,000	600,000	400,000	600,000	400,000	600,000
Definition of Overfishing	20,000	20,000	50,000	50,000	100,000	100,000
Average Catch	351	437	353	440	355	443
Catch Variance	10,855	39,274	10,098	38,355	9,672	37,740
Average Midyear Biomass	3,132	2,484	3,160	2,520	3,196	2,568
Average Log Catch	5.72	5.83	5.71	5.81	5.69	5.76
Ave. Log Midyear Biomass	7.75	7.44	7.79	7.48	7.83	7.53
Percent Years No Catch	0.1%	0.1%	0.4%	0.4%	0.8%	1.0%

FIGURE 4.3.3-1.

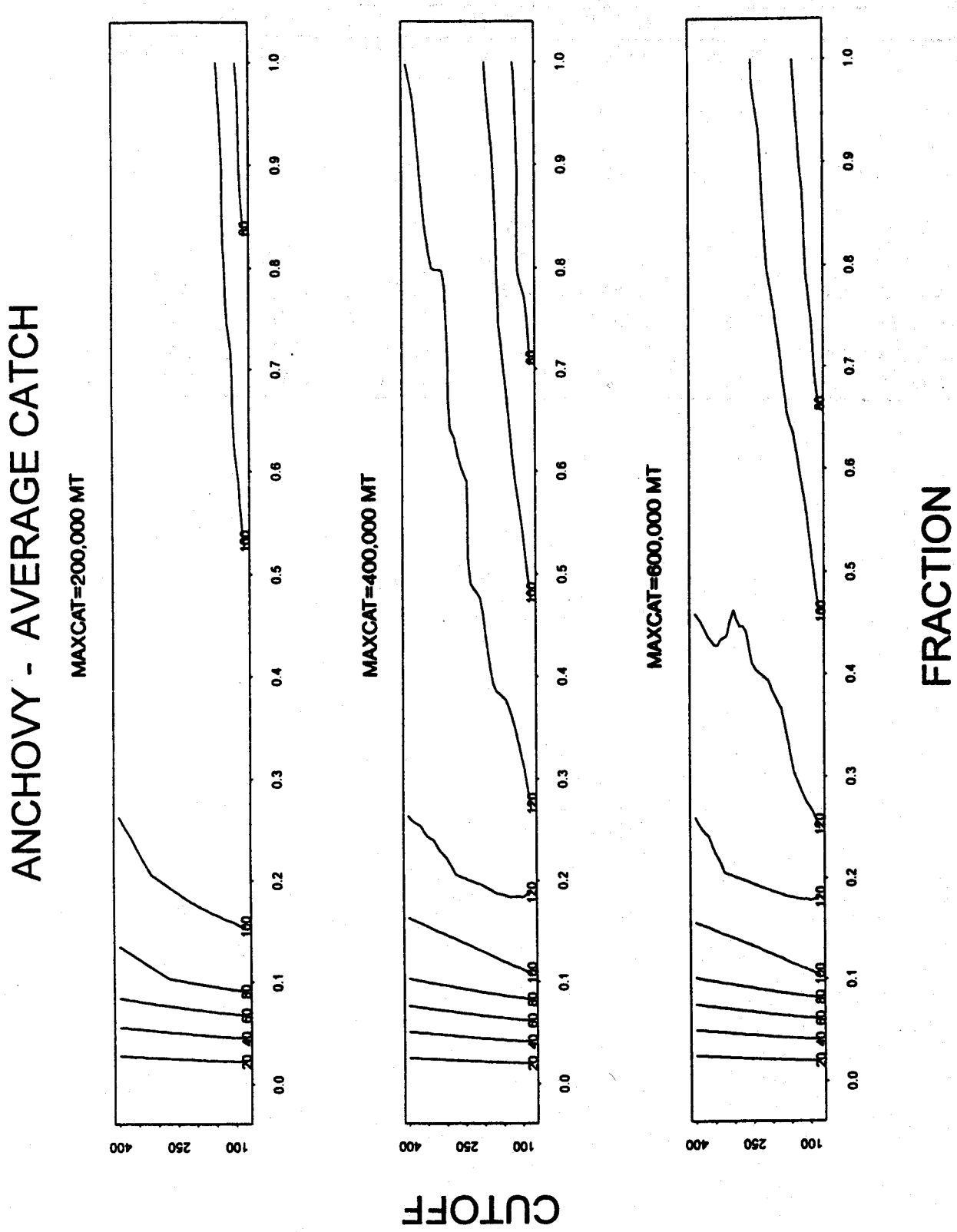
ANCHOVY - AVERAGE CATCH
MAXCAT=200,000 MT
MAXCAT=400,000 MT
MAXCAT=600,000 MT
FRACTION
CUTOFF
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
100
250
400
20
40
60
80
100
120
140

FIGURE 4.3.3-2.

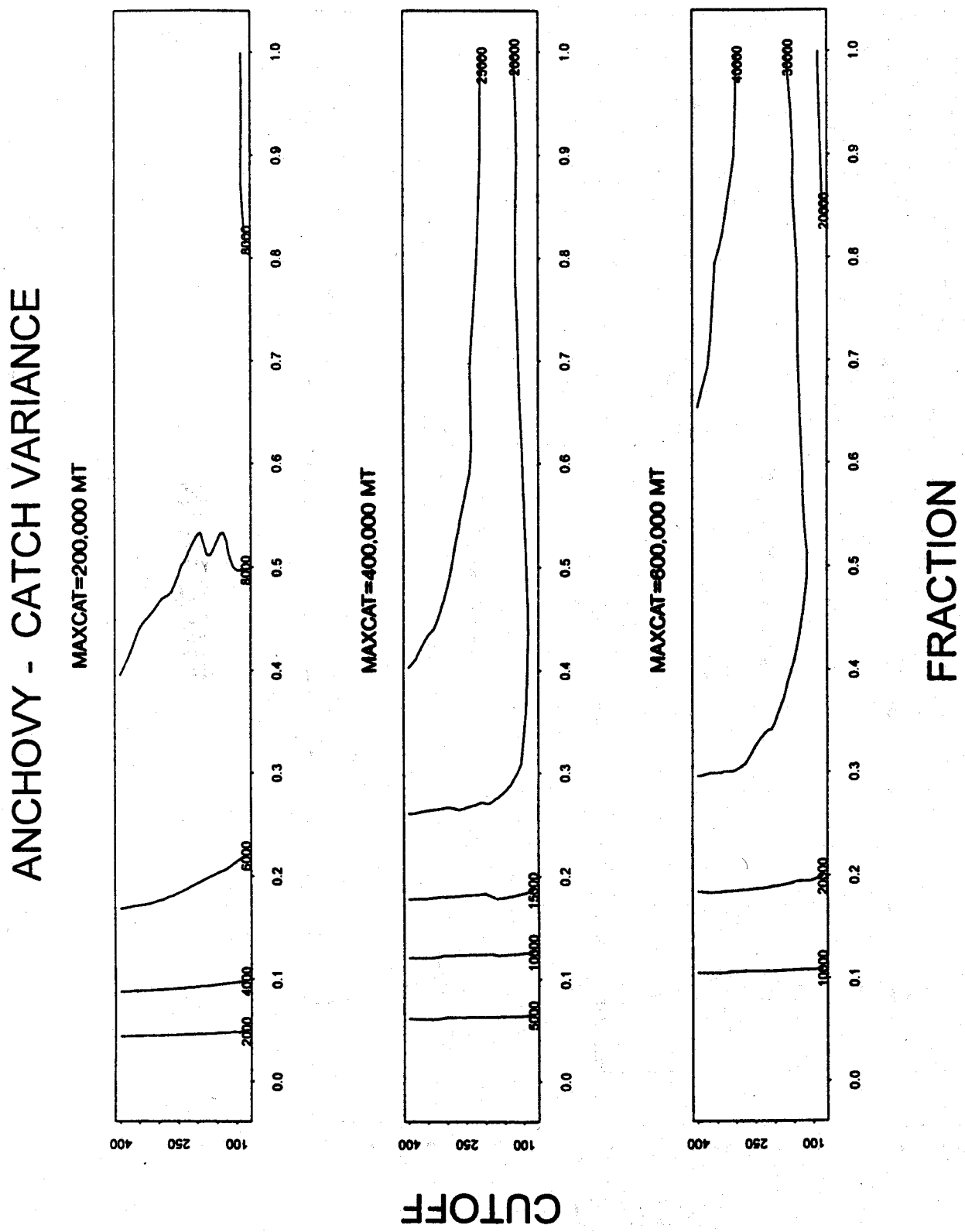
ANCHOVY - CATCH VARIANCE
MAXCAT=200,000 MT
MAXCAT=400,000 MT
MAXCAT=600,000 MT
2000
4000
6000
8000
5000
10000
15000
20000
25000
30000
40000
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
100
250
400
CUTOFF
FRACTION

FIGURE 4.3.3-3.

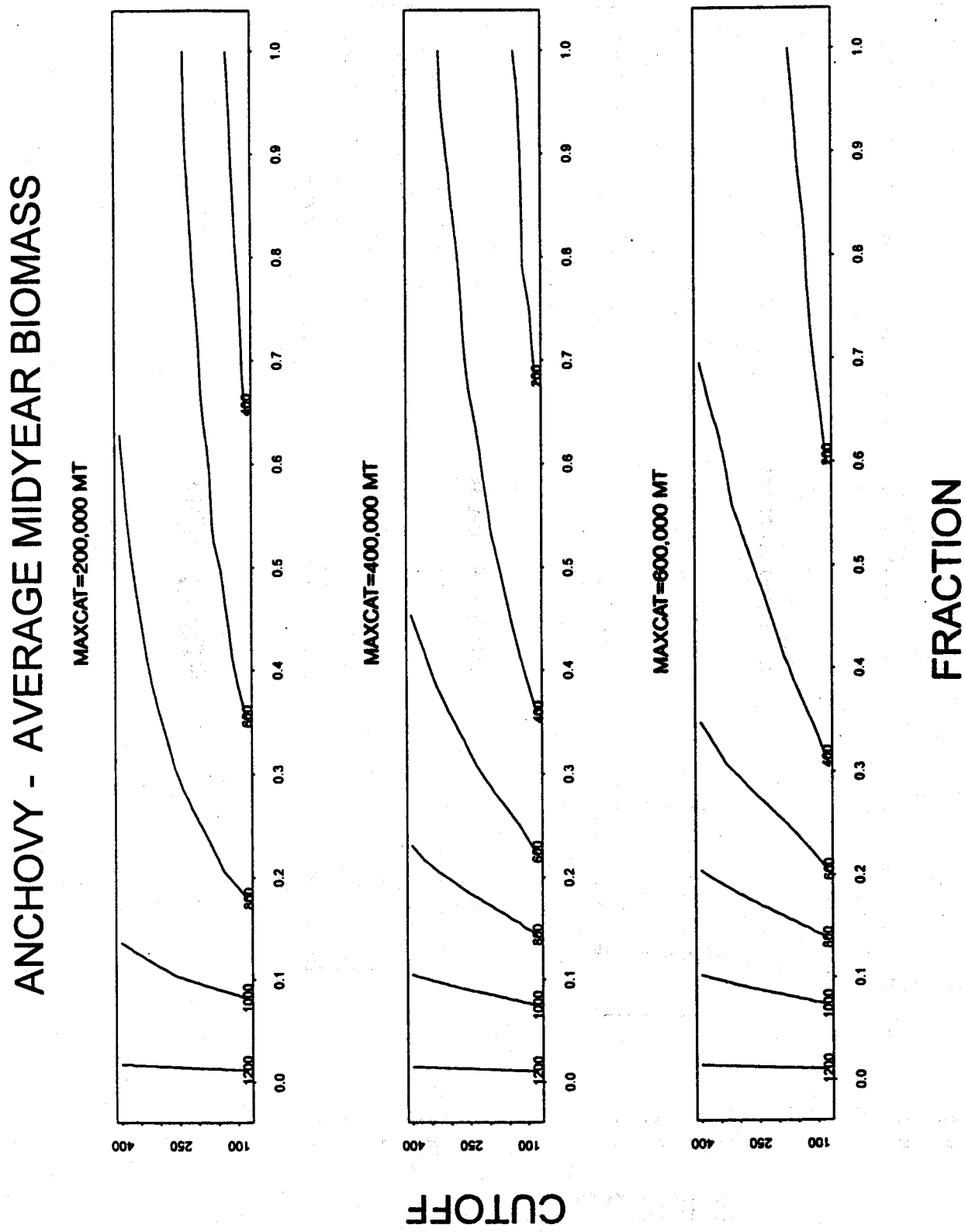
ANCHOVY - AVERAGE MIDYEAR BIOMASS
MAXCAT=200,000 MT
MAXCAT=400,000 MT
MAXCAT=600,000 MT
FRACTION
CUTOFF
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
100
250
400
1200
1000
800
600
400
200

FIGURE 4.3.3-4.

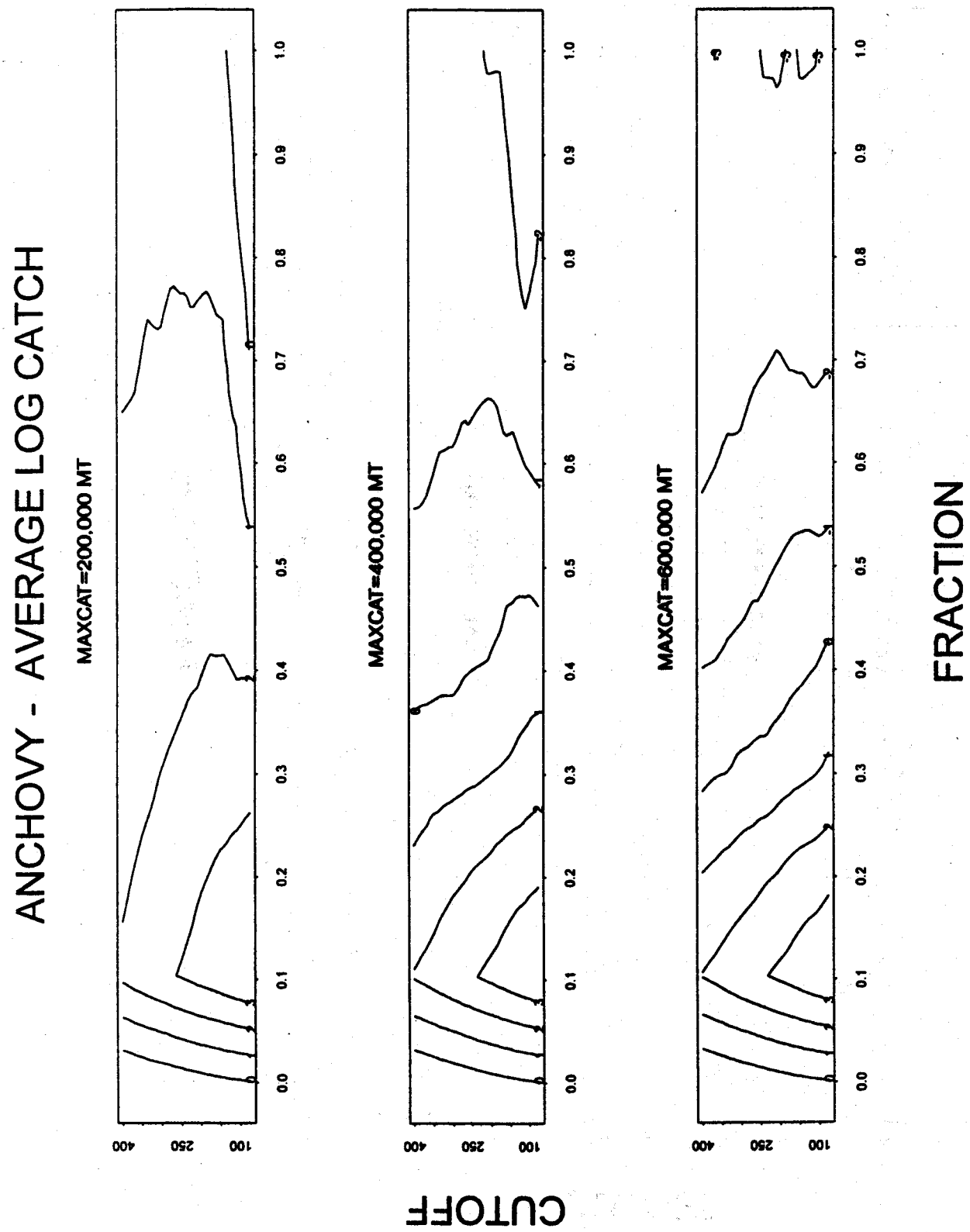
ANCHOVY - AVERAGE LOG CATCH
MAXCAT=200,000 MT
MAXCAT=400,000 MT
MAXCAT=600,000 MT
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
100
250
400
CUTOFF
FRACTION

FIGURE 4.3.3–5.

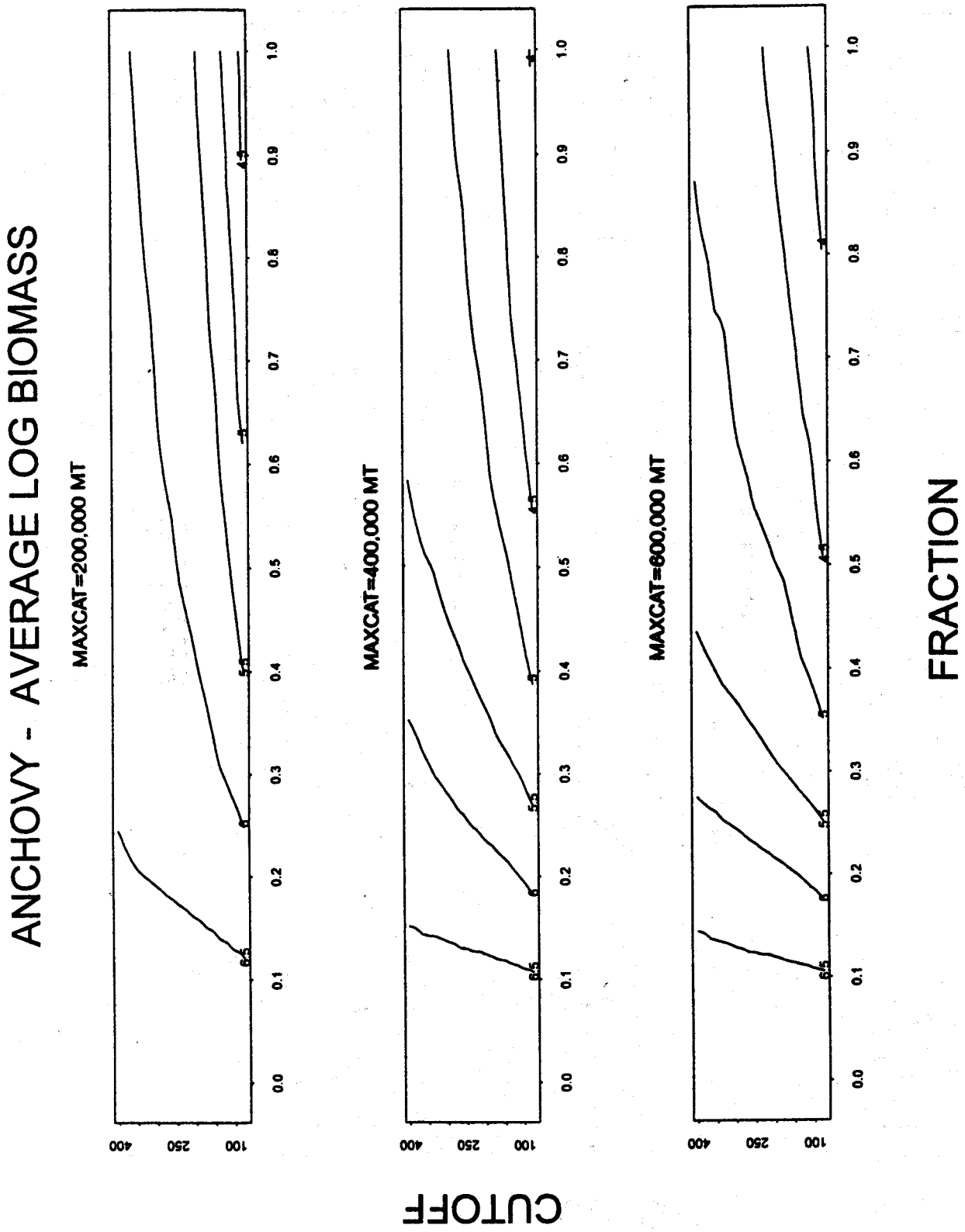
ANCHOVY - AVERAGE LOG BIOMASS
MAXCAT=200,000 MT
MAXCAT=400,000 MT
MAXCAT=600,000 MT
FRACTION
CUTOFF
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
100
250
400

FIGURE 4.3.3-6

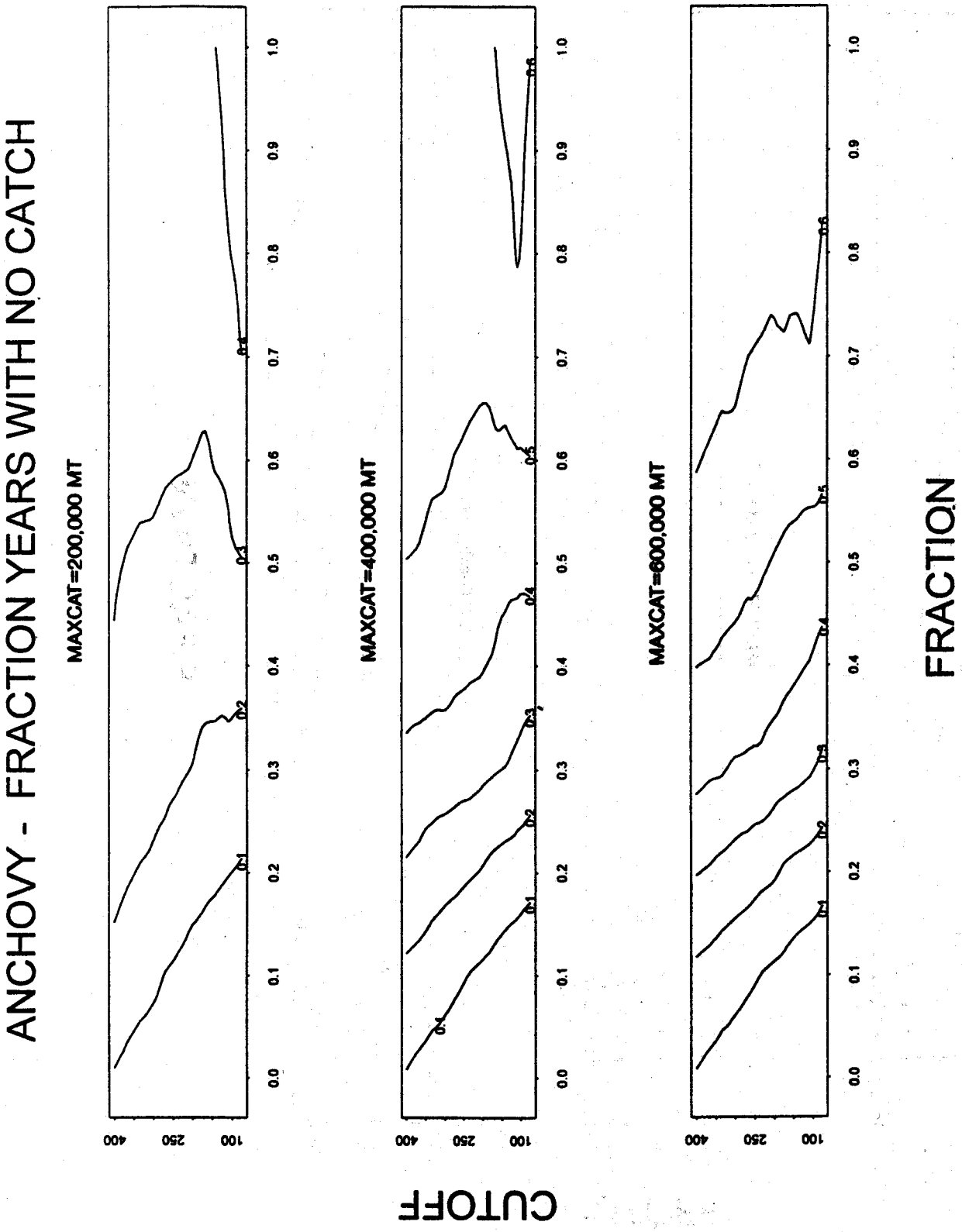
ANCHOVY - FRACTION YEARS WITH NO CATCH
MAXCAT=200,000 MT
MAXCAT=400,000 MT
MAXCAT=600,000 MT
FRACTION
CUTOFF
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
100
250
400

FIGURE 4.3.3-7.

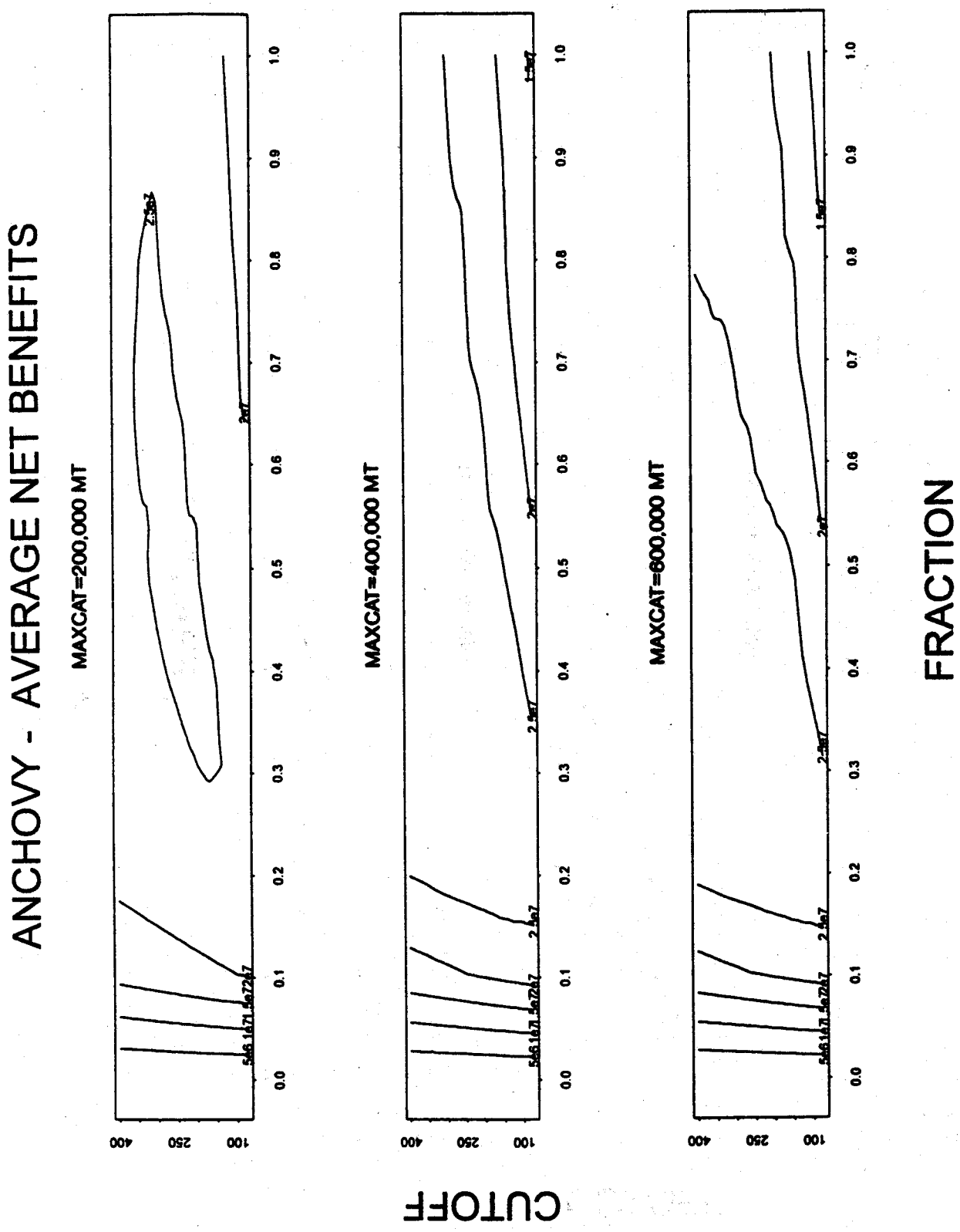
ANCHOVY - AVERAGE NET BENEFITS
MAXCAT=200,000 MT
MAXCAT=400,000 MT
MAXCAT=600,000 MT
CUTOFF
FRACTION

FIGURE 4.3.3-8.

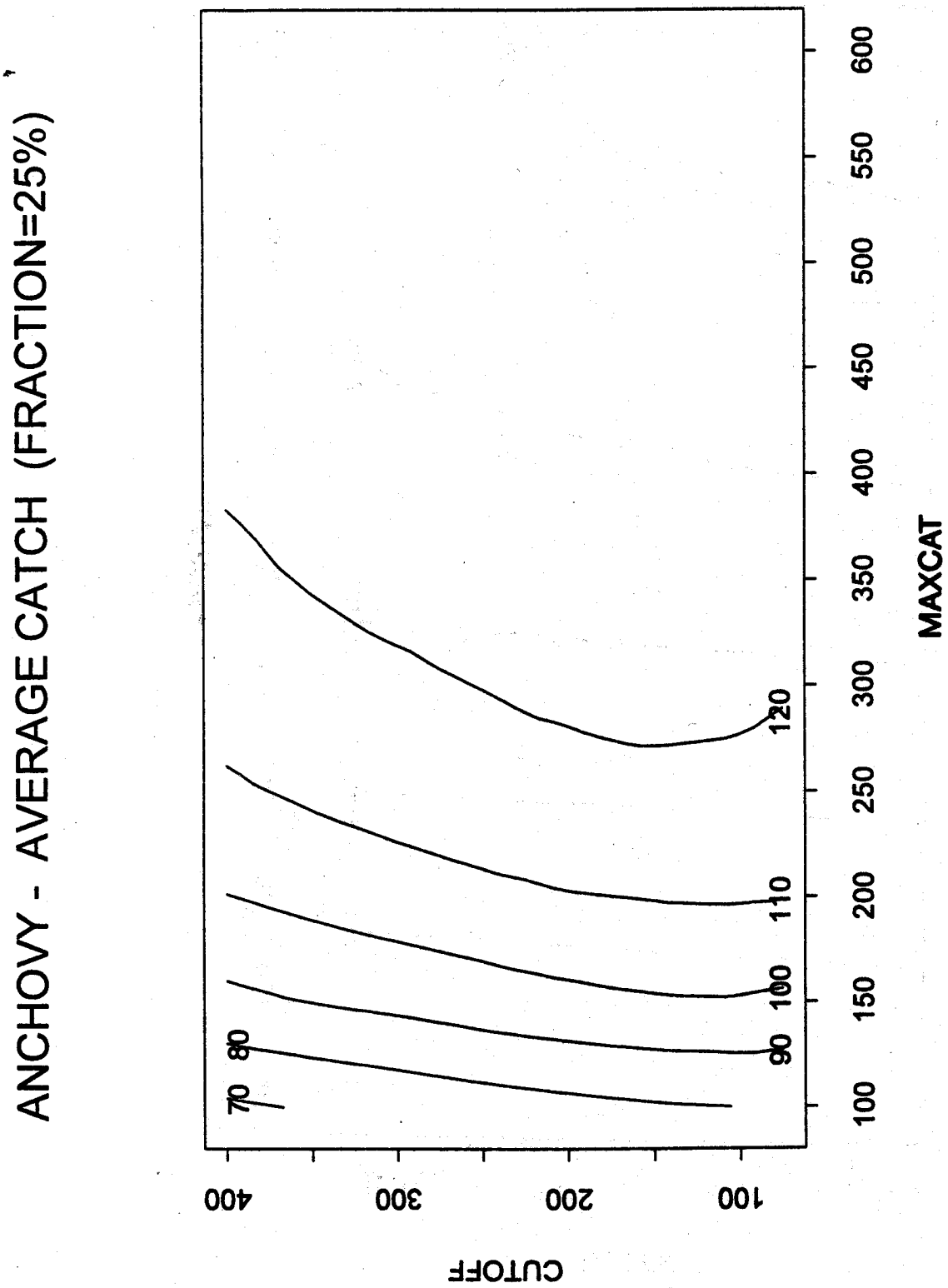
ANCHOVY - AVERAGE CATCH (FRACTION=25%)
CUTOFF
400
300
200
100
MAXCAT
100
150
200
250
300
350
400
450
500
550
600
70
80
90
100
110
120

FIGURE 4.3.3-9.

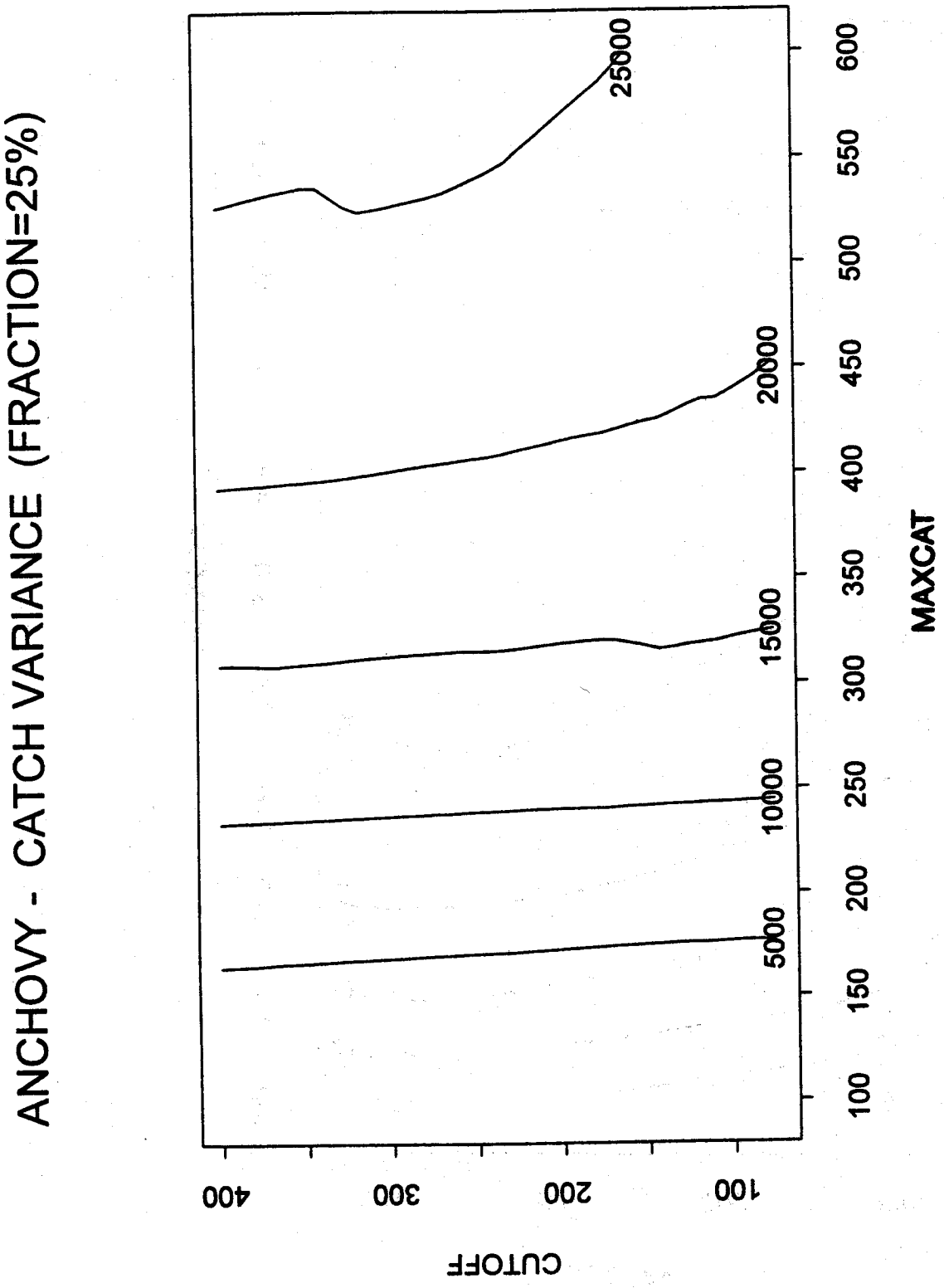
ANCHOVY - CATCH VARIANCE (FRACTION=25%)
CUTOFF
100
200
300
400
MAXCAT
100
150
200
250
300
350
400
450
500
550
600
5000
10000
15000
20000
25000

FIGURE 4.3.3-10.

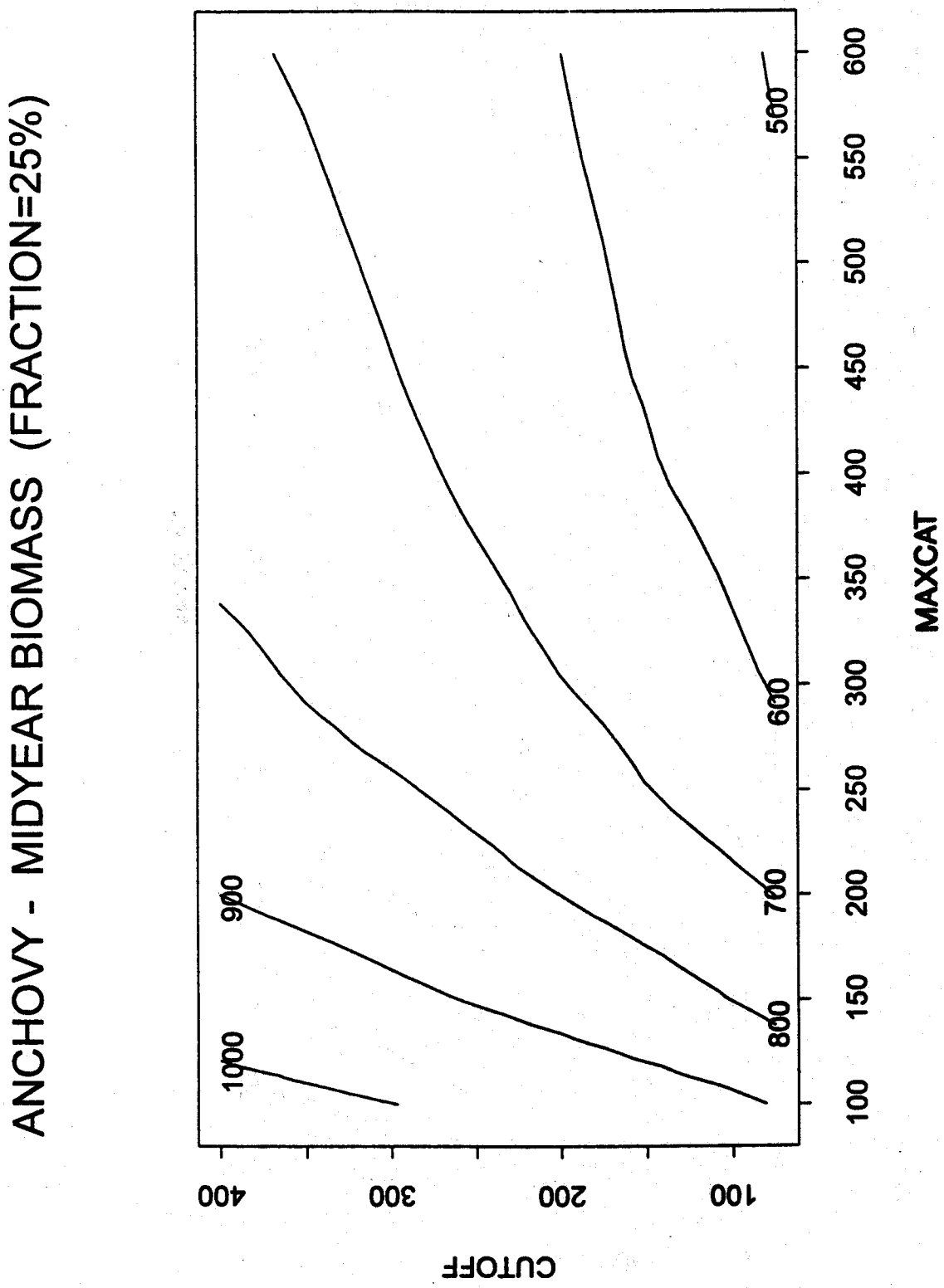

FIGURE 4.3.3-11.

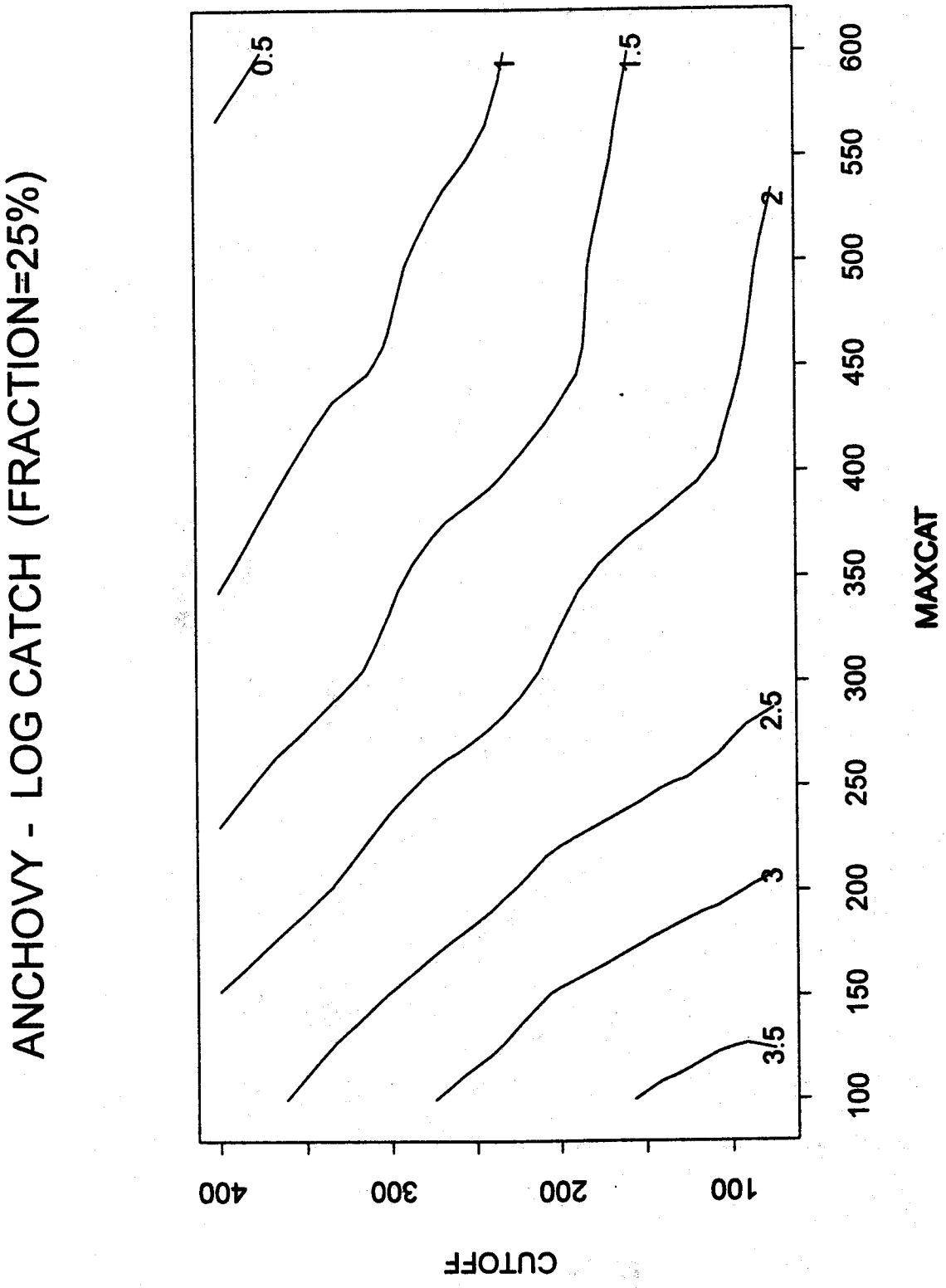

FIGURE 4.3.3-12.

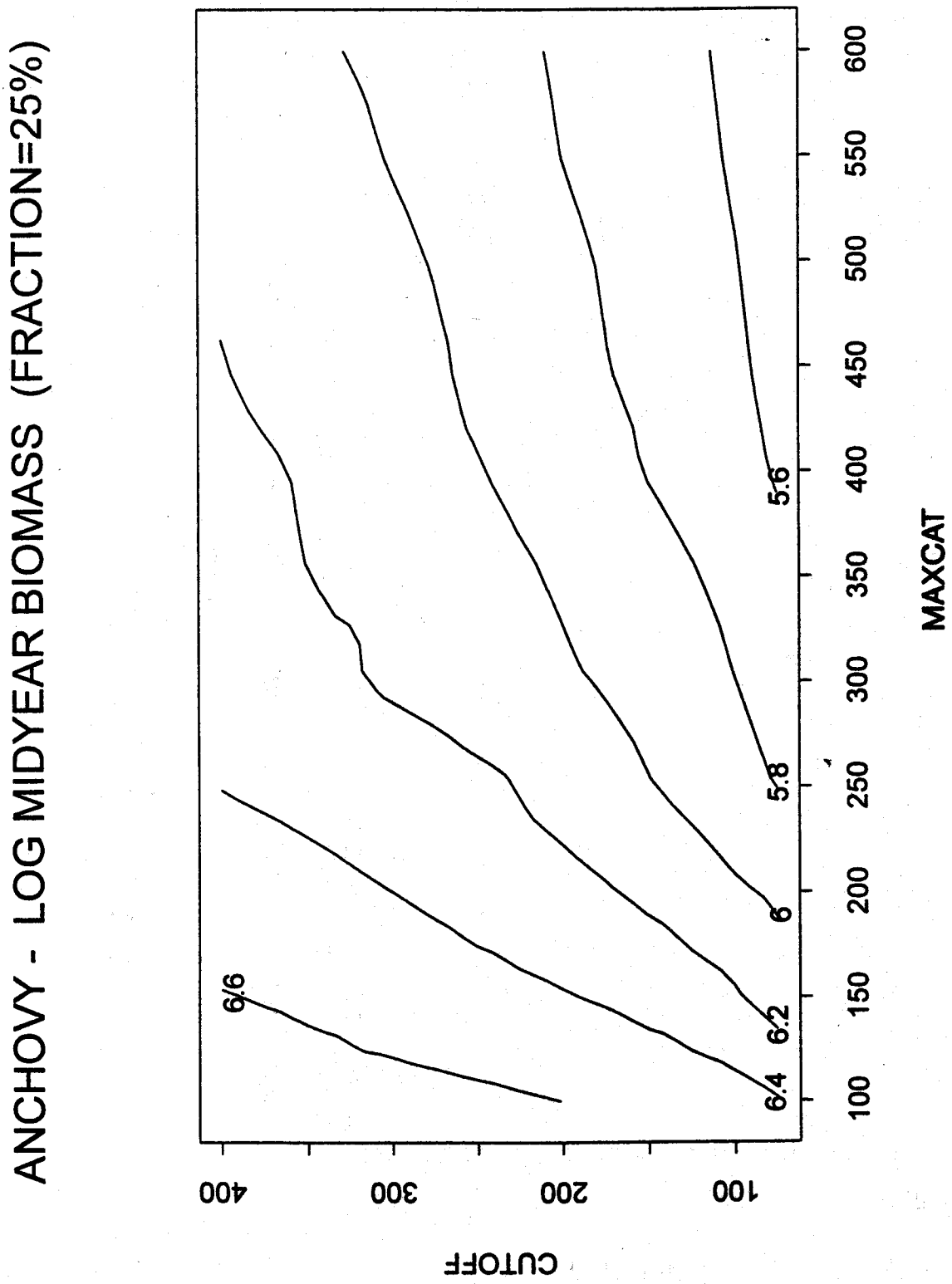

FIGURE 4.3.3-13.

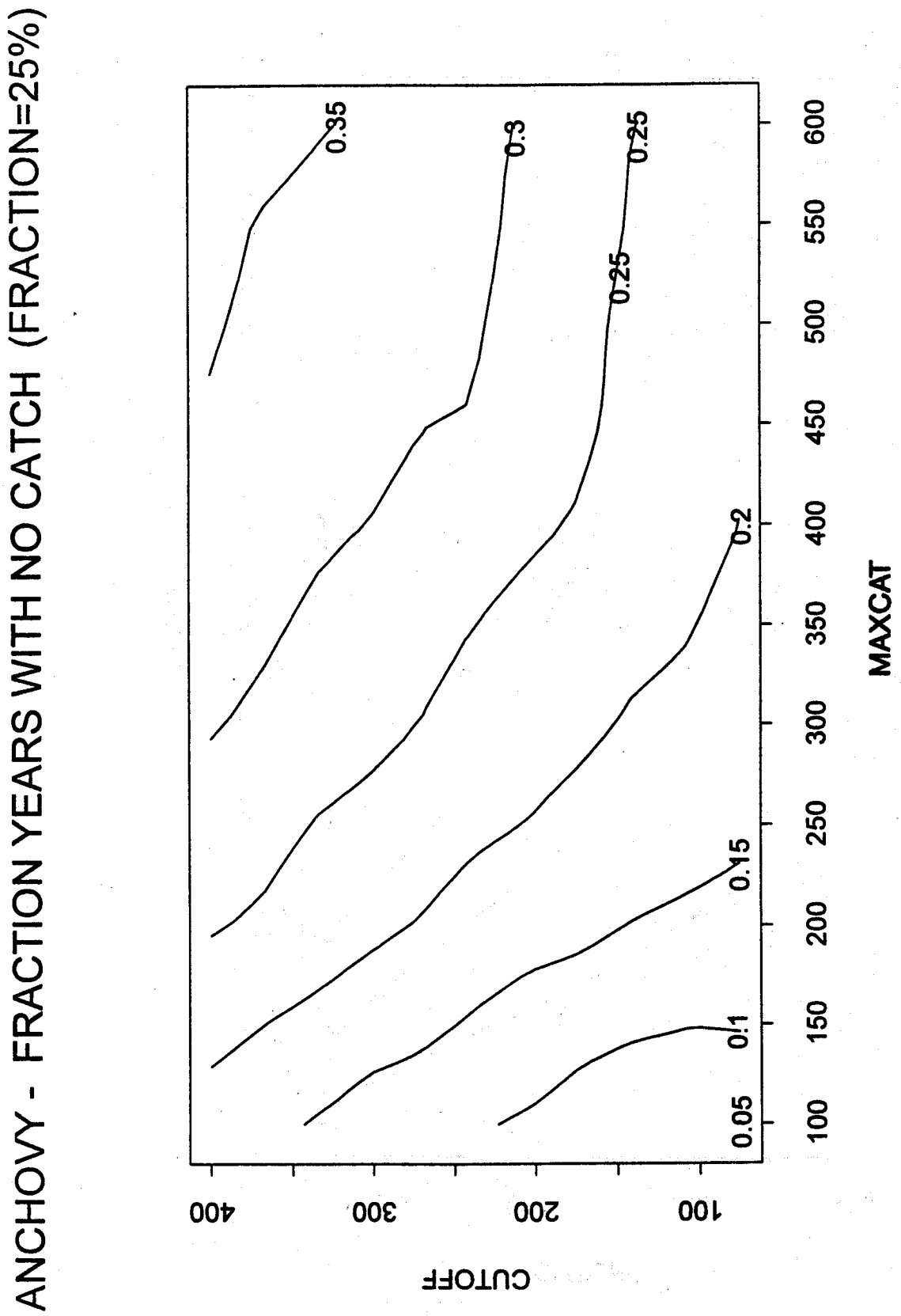

FIGURE 4.3.3-14.

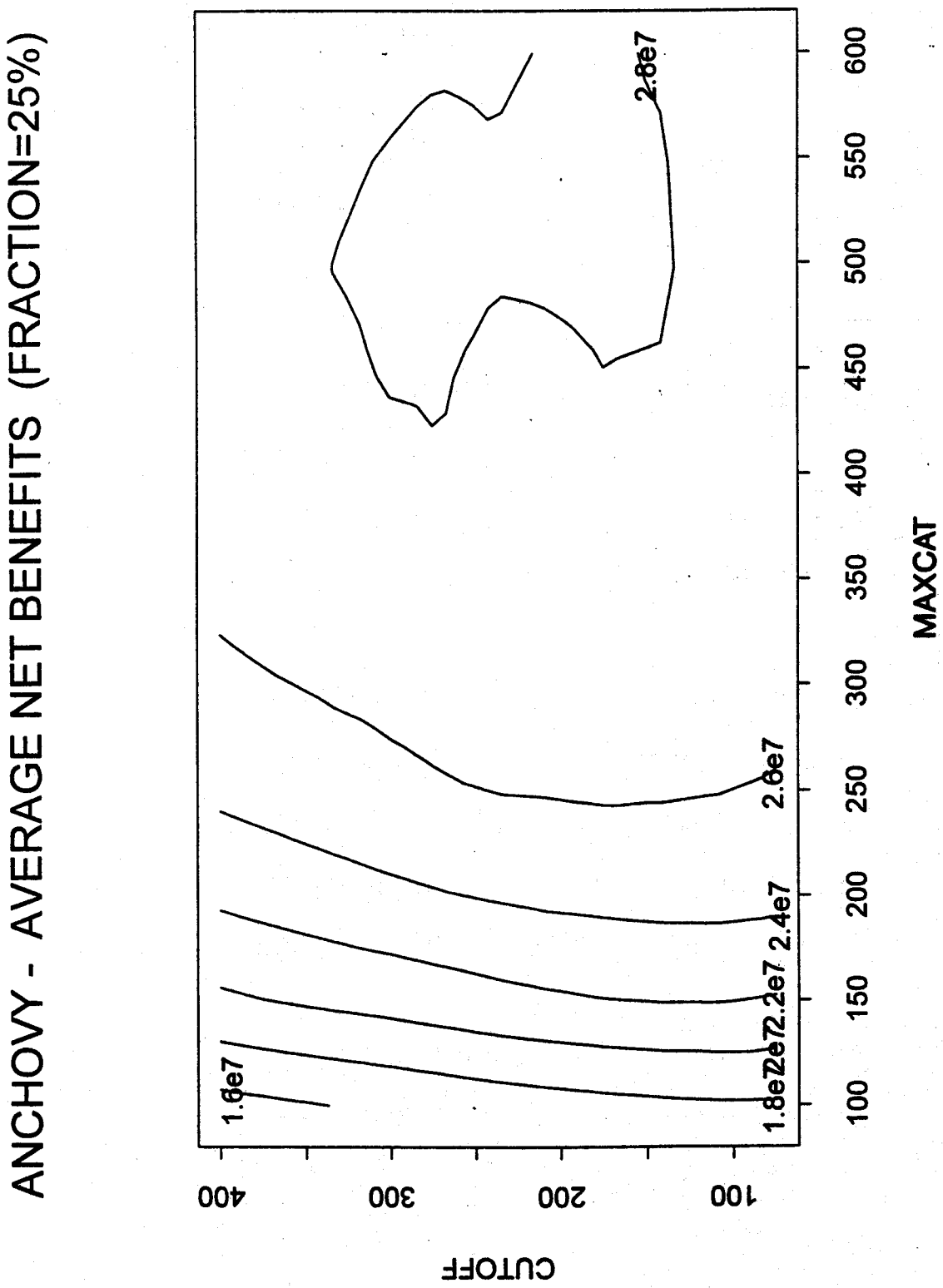

TABLE 4.3.4-1.

Table 4.3.4-1. Harvest formula and definition of overfishing options for northern anchovy. Biomass, total harvest and US harvest are in units of mt. The annual exploitation rate is total harvest / biomass and is a measure of exploitation. Annual exploitation rate does not equal FRACTION, in general, because FRACTION is applied to the biomass minus CUTOFF. Annual exploitation rate includes 8,000 mt of live bait harvest with a non-numeric OY at all biomass levels between CUTOFF and the definition of overfishing (75,000 mt).

Option 1

Biomass	Total Harvest	US Harvest (no bait)	US Harvest (with bait)	Annual Exploitation Rate
50,000	0	0	0	0%
75,000	0	0	8,000	11%
100,000	0	0	8,000	8%
125,000	6,250	5,125	13,125	11%
150,000	12,500	10,250	18,250	14%
175,000	18,750	15,375	23,375	15%
200,000	25,000	20,500	28,500	17%
225,000	31,250	25,625	33,625	17%
250,000	37,500	30,750	38,750	18%
275,000	43,750	35,875	43,875	19%
300,000	50,000	41,000	49,000	19%
400,000	75,000	61,500	69,500	21%
500,000	100,000	82,000	90,000	22%
1,000,000	200,000	164,000	172,000	21%
1,500,000	200,000	164,000	172,000	14%

FRACTION = 25%
CUTOFF = 100,000
MAXOY = 200,000

Option 2

Biomass	Total Harvest	US Harvest (no bait)	US Harvest (with bait)	Annual Exploitation Rate
50,000	0	0	0	0%
75,000	0	0	8,000	11%
100,000	0	0	8,000	8%
125,000	0	0	8,000	6%
150,000	0	0	8,000	5%
175,000	0	0	8,000	5%
200,000	0	0	8,000	4%
225,000	6,250	5,125	13,125	6%
250,000	12,500	10,250	18,250	8%
275,000	18,750	15,375	23,375	10%
300,000	25,000	20,500	28,500	11%
400,000	50,000	41,000	49,000	15%
500,000	75,000	61,500	69,500	17%
1,000,000	200,000	164,000	172,000	21%
1,500,000	200,000	164,000	172,000	14%

FRACTION = 25%
CUTOFF = 200,000
MAXOY = 200,000

Option 3 ***RECOMMENDED

Biomass	Total Harvest	US Harvest (no bait)	US Harvest (with bait)	Annual Exploitation Rate
50,000	0	0	0	0%
75,000	0	0	8,000	11%
100,000	0	0	8,000	8%
125,000	0	0	8,000	6%
150,000	0	0	8,000	5%
175,000	0	0	8,000	5%
200,000	0	0	8,000	4%
225,000	0	0	8,000	4%
250,000	0	0	8,000	3%
275,000	0	0	8,000	3%
300,000	0	0	8,000	3%
400,000	25,000	20,500	28,500	8%
500,000	50,000	41,000	49,000	12%
1,000,000	175,000	143,500	151,500	18%
1,500,000	200,000	164,000	172,000	14%

FRACTION = 25%
CUTOFF = 300,000
MAXOY = 200,000

Option 4

Biomass	Total Harvest	US Harvest (no bait)	US Harvest (with bait)	Annual Exploitation Rate
50,000	0	0	0	0
75,000	0	0	8,000	11%
100,000	0	0	8,000	8%
125,000	6,250	5,125	13,125	11%
150,000	12,500	10,250	18,250	14%
175,000	18,750	15,375	23,375	15%
200,000	25,000	20,500	28,500	17%
225,000	31,250	25,625	33,625	17%
250,000	37,500	30,750	38,750	18%
275,000	43,750	35,875	43,875	19%
300,000	50,000	41,000	49,000	19%
400,000	75,000	61,500	69,500	21%
500,000	100,000	82,000	90,000	22%
1,000,000	225,000	184,500	192,500	23%
1,500,000	300,000	246,000	254,000	21%

FRACTION = 25%
CUTOFF = 100,000
MAXOY = 300,000

Option 5

Biomass	Total Harvest	US Harvest (no bait)	US Harvest (with bait)	Annual Exploitation Rate
50,000	0	0	0	0%
75,000	0	0	8,000	11%
100,000	0	0	8,000	8%
125,000	0	0	8,000	6%
150,000	0	0	8,000	5%
175,000	0	0	8,000	5%
200,000	0	0	8,000	4%
225,000	6,250	5,125	13,125	6%
250,000	12,500	10,250	18,250	8%
275,000	18,750	15,375	23,375	10%
300,000	25,000	20,500	28,500	11%
400,000	50,000	41,000	49,000	15%
500,000	75,000	61,500	69,500	17%
1,000,000	200,000	164,000	172,000	21%
1,500,000	300,000	246,000	254,000	21%

FRACTION = 25%
CUTOFF = 200,000
MAXOY = 300,000

Option 6

Biomass	Total Harvest	US Harvest (no bait)	US Harvest (with bait)	Annual Exploitation Rate
50,000	0	0	0	0%
75,000	0	0	8,000	11%
100,000	0	0	8,000	8%
125,000	0	0	8,000	6%
150,000	0	0	8,000	5%
175,000	0	0	8,000	5%
200,000	0	0	8,000	4%
225,000	0	0	8,000	4%
250,000	0	0	8,000	3%
275,000	0	0	8,000	3%
300,000	0	0	8,000	3%
400,000	25,000	20,500	28,500	8%
500,000	50,000	41,000	49,000	12%
1,000,000	175,000	143,500	151,500	18%
1,500,000	300,000	246,000	254,000	21%

FRACTION = 25%
CUTOFF = 300,000
MAXOY = 300,000

STATUS QUO (ADJUSTED UNITS)

Biomass	Total OY	US OY	US CATCH	Annual Exploitation Rate
50,000	0	0	0	0%
75,000	0	0	8,000	11%
100,000	0	0	8,000	8%
125,000	0	0	8,000	6%
150,000	0	0	8,000	5%
175,000	0	0	8,000	5%
200,000	0	0	8,000	4%
225,000	0	0	8,000	4%
250,000	0	0	8,000	3%
275,000	0	0	8,000	3%
300,000	0	0	8,000	3%
400,000	0	0	8,000	2%
500,000	62,000	50,840	58,840	14%
1,000,000	200,000	164,000	172,000	21%
1,500,000	200,000	164,000	172,000	14%

FRACTION = 100%
CUTOFF = 438,000 = 300,000 x 1.46
MAXOY = 200,000

TABLE 4.3.4-2

Table 4.3.4-2. Performance measures for anchovy harvest formula options and the status quo. CUTOFF, MAXCAT, definitions of overfishing, catch and biomass are in mt. Net benefits in thousand dollars. Option 3 is recommended. The 438,000 mt CUTOFF under the status quo is a July 1 value equivalent to the 300,000 mt February 15 value used in the Northern Anchovy FMP. The 73,000 mt definition of overfishing under the status quo is a July 1 value equivalent to the 50,000 mt February 15 value used in the Northern Anchovy FMP.

	OPTION 1	OPTION 2	OPTION 3	OPTION 4	OPTION 5	OPTION 6	STATUS QUO
CUTOFF	100	200	300	100	200	300	438
SLOPE	0.25	0.25	0.25	0.25	0.25	0.25	1
MAXCAT	200	200	200	300	300	300	200
Definition of Overfishing	75,000	75,000	75,000	75,000	75,000	75,000	73,000
Average Catch	111	109	105	122	122	118	111
Catch Variance	6,403	6,656	6,921	13,911	13,910	14,211	9,064
Average Midyear Biomass	721	799	855	621	702	762	787
Average Log Catch	3.00	2.64	2.19	2.45	2.09	1.59	0.55
Ave. Log Midyear Biomass	6.03	6.26	6.40	5.81	6.03	6.17	6.24
Percent Years No Catch	13%	17%	21%	18%	22%	26%	38%
Net Benefits	$24,649	$24,439	$23,583	$27,194	$27,148	$26,471	$24,822

FIGURE 4.3.5-1.

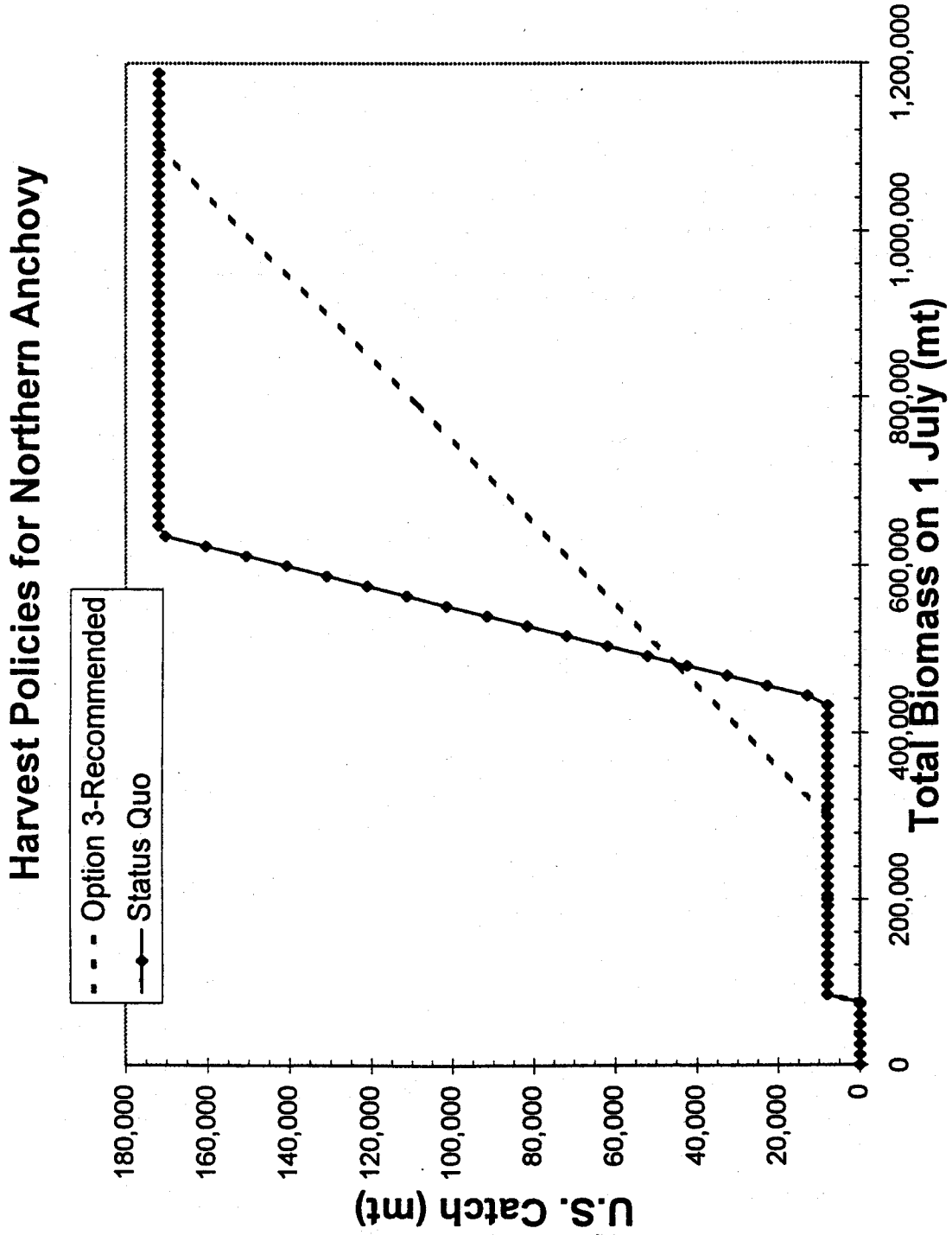
OYOPTANE Chart 2
Harvest Policies for Northern Anchovy
Option 3-Recommended
Status Quo
U.S. Catch (mt)
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
0
200,000
400,000
600,000
800,000
1,000,000
1,200,000
Total Biomass on 1 July (mt)

TABLE 4.5-1. Minimum and maximum estimates of average biomass and potential yield of jack mackerel by age group from MacCall and Stauffer (1983).

Ages (Years)	Average Biomass (thousand mt)	Potential Yield (thousand mt)
0-8	927-1,125	95-191
9-15	367-453	22-45
16-30	190-235	11-24
Total	1,484-1,812	128-260

5.0 BYCATCH AND ALLOCATION FOR COASTAL PELAGIC SPECIES

Bycatch refers to mortality of one species during fishing for another. Coastal Pelagic Species (CPS) support a multispecies fishery in which bycatch is common. Bycatch usually consists of other CPS but may include non-CPS as well. In addition, CPS may be taken as bycatch in non-CPS fisheries. For example, Pacific mackerel are taken in small quantities during the Pacific whiting fishery off Oregon and Washington, particularly during warm, El Niño years. Amounts of bycatch and bycatch rates will vary with changes in the stocks and fishery. For example, sardine tend to school with anchovy and Pacific mackerel of similar size when sardines are rare and anchovy and mackerel are abundant. When sardines school with other species, they are often taken as bycatch. When sardine become abundant they tend to form pure schools and are less common as bycatch.

5.1 Background

Current approaches for managing bycatch in the commercial CPS fishery are explained below.

5.1.1 Northern Anchovy

According to the Northern Anchovy Fishery Management Plan (FMP), there is no bycatch allowance for northern anchovy when the directed fishery is closed or the stock is in an overfished condition.

5.1.2 Pacific Sardine

Under current California regulations, a moratorium is imposed and incidental harvest is limited to 15 percent by weight in mixed loads when Pacific sardine biomass is less than 18,200 metric tons (mt) (equivalent to an overfished stock). When sardine abundance exceeds the 18,200 mt (20,000 short tons) level and the directed fishery is closed, the sardine bycatch allowance in mixed mackerel loads is 15 percent, 25 percent, 35 percent or 45 percent (by weight), depending on the levels of bycatch recently experienced in the fishery. The allowance rises by 10 percent whenever the bycatch during the previous month exceeds the previously established allowance by one-third. The allowance falls by 10 percent if (1) the same allowance was in effect during the previous three months, and (2) the combined bycatch during the previous three months was less than one-fourth of the allowance during that time.

The state of California sets aside a portion of the directed quota as an incidental reserve for bycatch, with the remainder going to the directed fishery. Any unused portion of the reserve is added to the directed quota later in the season.

5.1.3 Pacific Mackerel

Under current California regulations, a moratorium is imposed and bycatch is limited to 18 percent by numbers of fish in mixed loads when Pacific mackerel is less than 18,200 mt (20,000 short tons, equivalent to an overfished stock). When the abundance of Pacific mackerel is higher than 18,200 mt, a directed fishery quota may be set. If a quota is exhausted before the end of the season, then the directed fishery is closed and the state of California allows bycatch of up to 50 percent by numbers of fish for mixed loads larger than six short tons and up to 100 percent for mixed loads smaller than six short tons, as determined by the California Department of Fish and Game (CDFG) Director.

5.1.4 Jack Mackerel

There are no state or federal regulations regarding bycatch of jack mackerel.

5.2 Management Options

Options for this FMP all involve "bycatch allowances" (see below) and are intended to form a simple system for managing bycatch when quotas and harvest guidelines are exhausted. This system was designed so that intensive monitoring and inseason adjustments would not necessarily be required. The imprecise nature of biomass and optimum yield (OY) estimates for CPS, together with the current lack of management resources and depressed fishery, would make intensive inseason management impractical and unnecessary. The options provide enough flexibility, however, for more intensive monitoring and management of bycatch if conditions in the fishery change.

Bycatch allowances are the percent by weight of one species in the catch of another at some point where measurement is practical. In contrast, bycatch refers to actual mortality of one species during fishing for another, i.e., the total quantity of fish removed from the ocean and killed.

Under all options, the Regional Director would set bycatch allowances as percentages of total weight according to guidelines described in the FMP. Bycatch would normally be measured when a load is landed for enforcement purposes. Depending on the fishery, however, bycatch could be measured when a load is brought on deck, at first sale, at delivery, or at any other point that is appropriate and practical. In joint ventures, for example, bycatch allowances might be best applied as fish are delivered to a floating processor vessel. Similarly, bycatch allowances for fishing by factory trawlers might be best applied when loads of fish are brought on deck.

Bycatch allowances would come into force for overfished stocks or once a directed quota or harvest guideline was filled. Bycatch allowances do not exclude the possibility of trip limits or other regulations imposed to prolong the directed fishery or for other purposes.

Bycatch allowances would normally be set by the Regional Director at the same time as harvest guidelines or quotas. In addition, estimates of bycatch and bycatch rates would be considered in setting harvest guidelines and quotas. Bycatch allowances (like harvest guidelines and quotas) could be changed inseason but would generally remain constant through the fishing season unless a major resource conservation issue or error in OY or other calculations were discovered.

Control of bycatch using bycatch allowances is likely to be incomplete. Bycatch allowances discourage bycatch but they are measured at different times and there is opportunity for bycatch to be discarded before it can be measured. Discard of bycatch species may be less of a problem for CPS than in other fisheries because it is difficult to sort bycatch of small CPS in large loads. Difficulties in sorting, however, may lead to discard of entire loads.

Bycatch allowances are the primary tool for managing bycatch of overfished species or species with no harvest guideline or quota in the CPS fishery. Other management tools, such as fishing seasons or area restriction, might also be required to reduce bycatch. Bycatch allowances do not exclude the possibility of trip limits or other regulations imposed to reduce bycatch, prolong the directed fishery or for other purposes.

Option 1. Options for bycatch allowance when a resource is overfished:

a. anchovy 0 percent and all other CPS 0–15 percent by weight of the landed catch, as determined by the Southwest Regional Director
b. all CPS 0–15 percent by weight of the landed catch, as determined by the Southwest Regional Director

Option 2. Options for bycatch allowance when a resource is not overfished:

a. anchovy 0 percent and all other CPS 15–45 percent by weight of the landed catch, as determined by the Southwest Regional Director

b. all CPS 0–45 percent by weight of the landed catch, as determined by the Southwest Regional Director

Option 3. Exclude landings smaller than a minimum size (1 mt per trip or lower limit determined by the Regional Director according to guidelines in the FMP) from bycatch restrictions for Pacific mackerel when the directed quota for Pacific mackerel is exhausted and the resource is not overfished.

5.2.1 Analysis of Options

The options specify ranges rather than specific bycatch rates because rates, amounts and importance of bycatch will change as abundance of CPS and conditions in the fishery change. There is insufficient data at this time to specify specific bycatch rates that would cover all possible situations. For example, we have some experience with Pacific mackerel in mixed loads with jack mackerel during periods of low sardine abundance but we have no experience with mixed loads of mackerel and sardine when sardine are abundant.

Bycatch allowances will be necessary for overfished as well as non–overfished stocks because CPS at low levels of abundance tend to school with individuals of other species that are the same size. Pacific sardine were, for example, often taken with northern anchovy and Pacific mackerel (Table 5.2.1–1) when sardine biomass was low in the early 1980s.

5.2.1.1 Northern Anchovy

The 0 percent bycatch allowance for anchovy specified by Options (1a) and (2a) is consistent with the 0 percent bycatch allowance in the Northern Anchovy FMP and reflects the fact that anchovy bycatch has not generally occurred in other CPS fisheries. However, since a significant anchovy fishery did not develop until after the collapse of the sardine fishery in the 1950s, little information is available regarding the occurrence of mixed anchovy–sardine loads at medium to high levels of sardine abundance.

It is likely that the status quo regulations would be unworkable at high sardine and low anchovy abundance levels. Options 1b and 2b provide greater flexibility for dealing with anchovy bycatch that might unavoidably occur, for instance, in mixed juvenile sardine loads harvested in the bait fishery.

5.2.1.2 Pacific Sardine

All of the options allow bycatch allowances to be changed as determined by the Southwest Regional Director. This contrasts with the status quo for sardine which requires that bycatch allowances be adjusted according to a specific formula.

All options are at least as conservative as the status quo. The maximum allowances for an overfished stock under Options 1a and 1b (15 percent) are the same as the status quo. Option 2b provides a range of allowances whose upper limit (45 percent) is the same as the status quo and whose lower limit (0 percent) is lower (more conservative) then the status quo.

5.2.1.3 Pacific Mackerel

All of the options are more conservative than the status quo. The status quo bycatch allowance that applies when Pacific mackerel is overfished (18 percent by numbers of fish in mixed loads) is slightly higher than the allowances specified by Options 1a and 1b (0–15 percent). Options 2a and 2b specify a lower range of bycatch allowances than the status quo and do not exclude landings of six tons or less.

A minor component of the fishery for CPS targets groundfish and other non-CPS primarily but also takes small (200–300 pounds on average) but relatively pure (100 percent) loads of Pacific mackerel on a sporadic but year-round basis . The Newport Beach Dory Fleet in Orange County, California, is typical of this sort of operation. The Dory fleet currently consists of 12 small longline vessels powered by outboard motors and is limited to no more than 17 vessels by a local limited entry program. It has been in existence for more than 100 years, is recognized as a historical landmark and is an important local attraction. Negligible amounts of Pacific mackerel are taken but the fish are sold fresh for human consumption at relatively high prices. This well established segment of the CPS fishery could potentially be preempted by larger volume producers if a quota were filled before the end of a fishing season. Under the status quo, however, small volume/high value fishery segments are protected from closures of the directed mackerel fishery by California regulations that exempt loads of less than six tons from bycatch restrictions. Option 3, which would exclude catches of Pacific mackerel in loads of less than one mt from bycatch restrictions when Pacific mackerel is not overfished, provides a similar measure of protection.

Option 3 is similar in form and intent to existing California regulations, measures in the Groundfish FMP that provide limited entry permits to small limited entry fleets, and measures proposed for the CPS FMP that would allocate directed fishery quotas to low and high volume producers either by disposition (e.g. reduction versus live bait) or limited entry category (large vessel permit versus small vessel permit). Option 3 is not likely to result in catch beyond target levels because (1) historical data indicate that negligible amounts of additional fish would be taken, and (2) estimates of bycatch are deducted prior to setting harvest guidelines and quotas. In addition, Option 3 will enable the Regional Director to reduce the maximum size of trips excluded from bycatch allocations if amounts of mackerel taken under the exemption become too large. The default maximum of 1 mt per trip coincides with the definition of incidental landings (1 mt per trip) for license limitation in the CPS fishery but could be reduced by the Regional Director if conditions warrant.

5.2.2 Recommendations

The CPS Plan Development Team and CPS Advisory Subpanel recommend a bycatch allowance of 0–15 percent for each CPS when overfished (Option 1b) and an allowance of 0–45 percent for each CPS when not overfished (Option 2b). Allowing a range of allowances for anchovy as well as for other CPS provides flexibility to deal with anchovy bycatch in the sardine fishery at medium to high levels of sardine biomass. Criteria to be used by the Regional Director is setting bycatch allowances for overfished stocks (see below) are designed to result in minimum fishing mortality rates. Options 1b and 2b are consistent with the goals and objectives listed in the FMP. In particular, they promote efficiency and profitability in the fishery, provide year-round fishing opportunities, maintain existing CPS fishery segments, and avoid discard.

The CPS Plan Development Team and CPS Advisory Subpanel recommend Option 3 to exclude small loads (1 mt per trip or lower as determined by the Regional Director) from bycatch restrictions for Pacific mackerel when Pacific mackerel is not overfished. Exclusion of loads smaller than 1 mt from bycatch restrictions for Pacific mackerel under Option 3 will not result in catch beyond target levels because negligible amounts of fish are involved and because estimates of bycatch are deducted prior to setting harvest guidelines and quotas. Option 3 is more conservative than the status quo but consistent with current state regulations, other recommended options for the CPS FMP, and the Groundfish FMP. Option 3 is consistent with the goals and objectives listed in the FMP. In particular, it promotes efficiency and profitability in the fishery, provides year-round fishing opportunities, maintains existing CPS fishery segments, and avoids discard.

5.3 Live Bait

CPS are important as live bait in recreational fisheries for game fish, groundfish and salmon off California, Oregon and Washington.

5.3.1 Status Quo

Current approaches to anchovy and sardine for live bait are described below. Almost all live bait used in recent years has been anchovy although small but increasing amounts of sardine have also been used.

5.3.1.1 Pacific Sardine

In 1984 the state of California established a sardine live bait quota of 75 short tons, which was increased to 150 short tons in 1985 and 350 short tons in 1988. Increases above 350 short tons are allowed at the discretion of the CDFG Director, who raised the quota to 2,000 short tons in 1992 and reduced it to 1,000 short tons in 1993. When the sardine live bait fishery is closed, the sardine bycatch allowance in the live bait harvest is 15 percent by weight.

5.3.1.2 Northern Anchovy

The Northern Anchovy FMP places no restrictions (a non-numeric OY) on live bait harvest, except when the resource is overfished,[2/] at which time harvest for all uses (including live bait) is prohibited with no allowance for bycatch.

5.3.2 Management Options

Option 1. Allowable live bait harvest when resource is overfished:

a. No harvest allowed (status quo for anchovy)
b. Bycatch allowance of 0-15 percent, as determined by the Southwest Regional Director. Criteria and information to be considered by the Regional Director in setting bycatch allowances are given below.

Option 2. Allowable live bait harvest when resource abundance exceeds overfishing level:

a. No restrictions on harvest (non-numeric OY, status quo for anchovy)
b. 2,000 mt
c. 5,000 mt.

5.3.3 Analysis of Options

An advantage of Options 1b and 2a is that validity of logbook data used to monitor the live bait fishery will not be compromised.

5.3.3.1 Northern Anchovy

Since the late 1940s, the anchovy live bait harvest has been quite stable, averaging 4,834 mt and ranged from about 2,500 to 7,000 mt per year. Up until 1992, anchovy comprised over 95 percent of the annual live bait harvest in California and was the major source of live bait to the recreational fishery. In 1992, poor

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2// The Northern Anchovy FMP defines the resource to be overfished when the spawning biomass on February 15 (peak spawning season) falls below 50,000 mt in two consecutive seasons. The CPS FMP defines the resource as overfished when the total biomass on July 1 (beginning of the season) falls below 75,000 mt for a single season. The two definitions are similar because a 50,000 mt spawning biomass occurs at a total biomass of about 75,000 mt.

anchovy availability prompted bait haulers to rely more on sardine for live bait harvest. Although sardines are considered to be less suitable for chumming than anchovy, the two species are generally viewed as close substitutes as bait on the hook.

Monitoring the live bait harvest is difficult because the catch is not landed and not reported on fish tickets. The state of California currently monitors live bait harvest of all species via logbooks which are of uncertain accuracy because catches are self reported. No regulatory restrictions are currently placed on anchovy live bait harvest when the biomass exceeds the overfishing level because of the importance of anchovy as live bait to the California recreational fishery, the fact that live bait harvest are market limited, and the difficulty in validating logbook data. No live bait harvest is allowed under the status quo when the biomass falls below the overfishing level although bycatch of northern anchovy may be unavoidable under some conditions. Options 1a and 2a are consistent with the status quo approach to management. Option 2c corresponds closely to the annual average live bait harvest of anchovy during 1946–1992 (4,834 mt).

5.3.3.2 Pacific Sardine

Despite difficulties associated with monitoring live bait, the CDFG manages the sardine live bait harvest by quota. Options 2b and 2c are conceptually similar to the CDFG approach in that they place an absolute limit on live bait harvest when biomass is above the overfishing level, although the actual limits specified by these options are considerably higher than the status quo (1,000 short tons). Option 2b corresponds to the maximum live bait quota allowed since the moratorium was lifted in 1986 (2,000 short tons in 1992). Option 1b, the 0–15 percent bycatch allowance, corresponds approximately to the status quo (which uses 15 percent) for sardine live bait when the resource is overfished.

5.3.4 Recommendations

The CPS Plan Development Team and CPS Advisory Subpanel recommend Option 1b. The recommended option would, in effect, close the live bait fishery for anchovy or sardine when the stocks are overfished but allow a 0–15 percent bycatch allowance (as determined by the Southwest Regional Director). This option would minimize fishing impacts on overfished stocks without generating unnecessary discard from unavoidable bycatch or disrupting the valuable live bait fishery. Option 1b is consistent with the goals and objectives listed in the FMP. In particular, it avoids discard, encourages the collection of biological information, and fosters effective management and enforcement. Criteria to be used by the Regional Director in setting bycatch allowances for overfished stocks listed in the FMP are designed to result in minimum fishing mortality rates.

Given the importance of live bait to the California recreational fishery, the fact that live bait harvest is market-limited and the difficulty of validating logbook data, the CPS Plan Development Team and CPS Advisory Subpanel recommend Option 2a in which no restrictions are placed on live bait harvest of anchovy or sardine as long as the stock is not overfished. Option 2a is consistent with the goals and objectives listed in the FMP. In particular, it promotes efficiency and profitability in the fishery, avoids discard, encourages the collection of biological information, and fosters effective management and enforcement.

5.4 Allocation for Low-Volume Resource Uses

Low-volume/high value markets for CPS rely on a continuous supply of fish. Low-volume markets usually support higher exvessel prices than canning or reduction markets and generate products (dead bait, pet food, dried fish for human consumption, etc.) of relatively high value. In the absence of an allocation, it is possible that harvest guidelines or quotas would be filled early by boats supplying higher volume markets and that low-volume uses would be eliminated.

5.4.1 Status Quo

A number of management measures are used under current state and federal regulations to allocate CPS to low and high volume users.

5.4.1.1 Northern Anchovy

The Northern Anchovy FMP provides for a constant 7,000 mt nonreduction quota when biomass exceeds the overfishing level, of which 70 percent (4,900 mt) is made available to U.S. fishers. Nonreduction landings cannot exceed the nonreduction quota, nor can any unused portion of the nonreduction quota be made available to the reduction fishery.

5.4.1.2 Pacific Sardine

A portion of the sardine quota is reserved for dead bait, with the amount of the reserve being 250 short tons when the directed quota is greater than 0 mt and less than 2,500 short tons, and 500 short tons when the directed quota exceeds 2,500 short tons. The dead bait reserve is itself allocated geographically, with 62 short tons each going to northern and central California and the rest to southern California. The California Legislature is considering legislation that eliminates the reserve when the directed quota exceeds 10,000 short tons.

5.4.1.3 Pacific and Jack Mackerel

No allocations for specific uses.

5.4.2 Options for Type of Allocation

Two options for allocating CPS to low-volume uses are described in this section. Allocations for low-volume uses can be based on:

Option 1: specific resource uses or "disposition" (e.g., reserves for sardine dead bait, anchovy nonreduction, etc.); or

Option 2: possession of a small boat limited entry permit (low-volume reserves).

Option 2 is valid only if a two-tiered license limitation program is adopted.

5.4.2.1 Analysis of Options

Option 1 is similar to the status quo because specific use allocations are commonly made in CPS fisheries (i.e., the nonreduction quota for anchovy and the dead bait quota for sardine). Monitoring and enforcing specific-use allocations is difficult because the disposition of catch is not reliably reported on fish tickets. This problem is particularly acute for sardine dead bait. Currently, landings for all uses of sardine (other than live bait) are counted against the directed quota when the directed fishery is open. The dead bait quota becomes available in March,[3/] and overlaps with the directed quota when the two fisheries are open concurrently. Typically no fish tickets are coded as dead bait when the directed fishery is open, but an upsurge in landings reported as dead bait usually occurs after the directed fishery is closed. This upsurge tends to occur regardless of when the directed fishery closes and is often larger than the estimated demand for dead bait in the sport fishery. Thus, it appears that some of the landings made against the dead bait quota for sardine are used for other purposes. The state of California recently began requiring disposition data on all fish tickets for sardines, but it is difficult to determine whether the reported disposition is accurate.

3// The historical basis for this opening date was to ensure bait availability for the central California striped bass fishery, which was the major market for sardine dead bait in the late 1960s and early 1970s.

Reduction and nonreduction landings for anchovy are distinguished on the basis of landings at known reduction plants rather than by disposition codes reported on fish tickets. This approach doesn't work for sardine because not all sardine dead bait dealers are known and some dead bait dealers also accept sardines for other uses. In summary, problems with disposition data make monitoring and enforcement of specific use allocations impractical.[4/]

Option 2 provides a more general and robust approach to allocation. Trip limits likely to be imposed on small boat limited entry permit holders (10 mt per trip) and the nature of small boat operations will tend to focus the activity of small boats on low-volume uses such as dead bait and fresh fish. Higher trip limits likely to be imposed on large boat permit holders (100 mt per trip) and the nature of large boat operations will tend to focus the activity of large boats on high-volume (e.g., canning, reduction) as well as low-volume uses. Option 2 provides year-round harvest opportunities to small boat permit holders and the low-volume markets they serve. In addition to having access to the reserve, small boats could also compete with large boats for whatever remained of the unallocated portion of the harvest guideline, once the low-volume reserve was exhausted. Any portion of the low-volume reserve that was unused nine months into the season would be made available to all segments of the directed fishery at that time.[5/]

Monitoring landings made against the low-volume reserve would be relatively easy, because the identities of small boat permit holders will be known in the limited entry program. Thus, if the Council adopts a two-tiered limited entry program and if low-volume reserves are used to allocate CPS to low-volume uses, problems associated with relying on disposition codes on fish tickets can be avoided.

Vessels qualifying for a large boat permit on the basis of their window period landings would be allowed to opt instead for a small boat permit. This provision allows small boat users, who may qualify for large boat permits, to get small boat permits instead and benefit from the low-volume reserve. Reserving a portion of the harvest guideline for small boat permit holders provides an incentive for getting a small boat permit instead of a large boat permit. Because small boat permit holders are restricted to lower trip limits than large boat permit holders, this incentive would also help reduce harvesting capacity in the fishery.

5.4.2.2 Recommendations

The CPS Plan Development Team and CPS Advisory Subpanel recommend that allocation for low-volume uses of CPS be based on reserves for vessels with small boat limited entry permits rather than on specific resource uses. This approach makes it unnecessary to rely on disposition codes, which are sometimes misreported on fish tickets in order to bypass regulations.

4// This is not an issue for live bait harvests, which are subject to a separate reporting system (i.e., logbooks) rather than fish tickets.

5// The current California sardine dead bait quota is also flexible in that dead bait landings can be made against the directed quota as well as the dead bait quota, and any unused portion of the dead bait quota can be redistributed in season 50/50 between southern and northern California. By contrast, the current anchovy nonreduction quota is less flexible because anchovy nonreduction landings cannot exceed the nonreduction quota, and any unused portion of the nonreduction quota cannot be made available in season to other segments of the fishery.

Allocation for low-volume uses is consistent with the goals and objectives listed in the FMP. In particular, it promotes efficiency and profitability in the fishery, maintains existing fishery segments, fosters effective management and enforcement, and achieves OY.

5.4.3 Reserve Formulas

Options for specifying low-volume reserves are outlined in this section. Unless otherwise indicated, the analysis of low-volume reserve options in this section applies whether Council defines the reserve in terms of specific resource uses or in terms of small boat limited entry permit holders. Options for low volume reserves involve modest amounts of fish (no more than 5,000 mt). Low-volume reserves would not ordinarily, therefore, be further allocated to northern or southern fishing areas although geographic allocation of low-volume reserves could be accomplished under the framework procedure.

5.4.3.1 Management Options

Low-volume reserve options for sardine and Pacific mackerel are:

Species	Fraction	Cap (mt)
Pacific Sardine	5 percent, 10 percent	3,000; 5,000
Pacific Mackerel	5 percent, 10 percent	2,000; 3,000

The low-volume reserve would be a fraction of the harvest guideline or quota, with a cap on the maximum size of the reserve. The fraction would determine the size of the reserve at lower levels of biomass and the level of biomass at which the cap is reached, while the cap would determine the size of the reserve at higher levels of biomass. The fraction for low-volume allocation and reserves is not the same as the FRACTION parameter used in harvest formula options.

The options for anchovy are as follows:

Reserve	Offset or Addition to Harvest Guideline, or Quota?
5,740	Addition*
3,000 mt	Offset
5,000 mt	Offset

*Status quo option

The low-volume reserve for anchovy would become available when biomass exceeds the overfishing level (75,000 mt recommended). However, the harvest guideline for other directed fishing would become available at a higher biomass level (above 300,000 mt, according to the CPS Plan Development Team's recommended harvest formula).[6/]

For anchovy, the 3,000 and 5,000 mt options differ from the status quo in several important respects:

1. At biomass levels above 300,000 mt, the 3,000 and 5,000 mt reserves would be subtracted or offset against the first 3,000 (or 5,000) mt of the unallocated portion of the harvest guideline. Under the status quo, the low-volume reserve takes the form of a nonreduction quota which represents additional allowable harvest over and above the reduction quota, so there is no offset.

6// The reason that other directed fishing commences at a biomass level above the overfishing level is to ensure the availability of a forage reserve for dependent species (including the California brown pelican).

is currently made available to the U.S. fishery. The status quo nonreduction quota based on the Coastal Pelagic Species Plan Development Team's proposed harvest formula would be 5,740 mt (i.e., 82 percent of 7,000 mt), 82 percent being the current estimate of the portion of the anchovy stock in U.S. waters.^]114

Determining an appropriate allocation for small-volume uses of sardine is difficult. Only rough estimates of current landings for low-volume uses (e.g., dead bait) are available, due to questionable accuracy of disposition codes reported on fish tickets. Even if dead bait landings could be accurately estimated, it may be unreasonable to attach much importance to such estimates because the sardine fishery is still in an early stage of development.

An alternative approach would be to use the anchovy reserve for small-volume uses as a guideline for what would constitute a reasonable reserve for sardines, on the basis that sardine and anchovy serve the same markets. However, a sardine reserve which is lower than the anchovy reserve may also be justified on the basis that sardines are not likely to completely fill the market niche for anchovy even when anchovy are relatively scarce, given the tendency of anglers to prefer anchovy over sardine as dead bait.

Table 5.4.3.2.2-1 describes the sardine options in terms of their effect on the size of the low-volume reserve and the unallocated portion of the harvest guideline, based on a 50,000 mt CUTOFF for the sardine harvest formula and recommendations regarding other aspects of the formula.[8/]/ Table 5.4.3.2.2-2 is similar to Table 5.4.3.2.2-1, except that it is based on a more conservative 100,000 mt CUTOFF for the harvest formula.

1. Assuming a 50,000 mt CUTOFF for the harvest formula (Table 5.4.3.2.2-1), the low-volume reserve is zero when the biomass is below 50,000 mt and gradually increases thereafter to the level of the cap. The 3,000 mt cap is reached at a biomass of 559,000 mt under the 5 percent fraction and at 305,000 mt under the 10 percent fraction. The 5,000 mt cap is reached at a biomass of 898,000 mt under the 5 percent fraction and 474,000 mt under the 10 percent cap.

2. Assuming a 100,000 mt CUTOFF for the harvest formula (Table 5.4.3.2.2-2), the reserve is zero when the biomass is below 100,000 mt and gradually increases thereafter to the level of the cap. The 3,000 mt cap is reached at a biomass of 609,000 mt under the 5 percent fraction and at 355,000 mt under the 10 percent fraction. The 5,000 mt cap is reached at a biomass of 948,000 mt under the 5 percent fraction and 524,000 mt under the 10 percent cap.

Regardless of which harvest formula CUTOFF (50,000 or 100,000 mt) or which cap (3,000 or 5,000 mt) is assumed, the biomass level at which the cap is reached is almost twice as high with the 5 percent fraction than with the 10 percent fraction. Also, as the fraction increases from 5-10 percent, the low-volume reserve doubles but the unallocated portion of the harvest guideline declines by less than 5.5 percent. It is also interesting to note that the 10 percent fraction yields a reserve of 236 mt when the U.S. harvest is 2,360 mt (assuming a harvest formula CUTOFF of 50,000 mt) and a reserve of 295 mt when the U.S. harvest is 2,950 mt (assuming a harvest formula CUTOFF of 100,000 mt). These results closely resemble that aspect of current regulations allowing a 250 short ton reserve when the U.S. harvest

8// The CPS Plan Development Team's recommendations are for a 20 percent FRACTION, 400,000 mt MAXCAT, 59 percent portion in U.S. waters.

is currently made available to the U.S. fishery. The status quo nonreduction quota based on the Coastal Pelagic Species Plan Development Team's proposed harvest formula would be 5,740 mt (i.e., 82 percent of 7,000 mt), 82 percent being the current estimate of the portion of the anchovy stock in U.S. waters.^]113

2. At the beginning of seasons when both the low-volume reserve (3,000 or 5,000 mt) and unallocated portion of the harvest guideline are available (i.e., when the anchovy biomass exceeds 300,000 mt), both the reserve and the unallocated harvest guideline will be released at the beginning of the season. The low-volume fishery would be allowed to compete with other segments of the fishery for whatever remained of the unallocated harvest guideline once the reserve was exhausted. Also, utilization of the reserve would be monitored in season and any portion of the reserve which was unused nine months into the season would be made available to all segments of the directed fishery at that time. Under the status quo, a strict distinction is made between the nonreduction quota (i.e., the low-volume reserve) and the reduction quota (analogous to the harvest guideline for other directed uses in the FMP) so that nonreduction landings cannot exceed the nonreduction quota, nor can any unused portion of the nonreduction quota be reallocated in season to the reduction fishery.

5.4.3.2 Analysis of Options

5.4.3.2.1 Northern Anchovy

Unlike the low-volume reserve options for sardine and Pacific mackerel, which increase gradually up to a cap at biomass levels above the CUTOFF, each of the options for anchovy is a constant reserve at all biomass levels above the overfishing level (the definition of overfishing is lower than the CUTOFF for anchovy). The reason for this difference is to ensure an adequate supply of anchovy as dead bait to California's recreational fishery. The 3,000 mt option is approximately equal to recent annual nonreduction landings and about 50 percent greater than average annual nonreduction landings during 1965-1992 (2,044 mt) and the window period years 1986-1991 (2,026 mt). The 5,000 mt option is very similar to the maximum annual nonreduction landings experienced during 1965-1992 (5,836 mt in 1979).

Table 5.4.3.2.1-1 describes the three options for anchovy in terms of total harvest, U.S. harvest, the low-volume reserve and the unallocated portion of the U.S. harvest.[7//] At biomass levels of 75,000-300,000 mt, the U.S. harvest consists only of the low-volume reserve. Under the status quo and at biomass levels above 300,000 mt, the U.S. harvest is the sum of the low-volume reserve and the harvest guideline for other directed fishing. Under alternatives to the status quo option, U.S. harvest is never more than the harvest for directed fishing because the low-volume reserve is offset or subtracted from the total for directed fishing. The offset feature also affects the biomass at which the harvest guideline for other directed fishing becomes available: 300,000+ mt for the status quo, 315,000+ mt for the 3,000 mt option and 325,000+ mt for the 5,000 mt option. The U.S. harvest is consistently lower under the 3,000 mt option than the status quo option. The 3,000 mt option provides a smaller U.S. harvest than the 5,000 mt option at biomass levels of 75,000-315,000 mt and the same U.S. harvest at biomass levels above 315,000 mt.

5.4.3.2.2 Pacific Sardine

None of the options proposed corresponds to the current formula for the sardine dead bait allocation. The proposed options allow the reserve to vary continuously with the size of the directed quota up to a cap, while the status quo formula allows only two quota levels (250 and 500 short tons). Also, the cap specified by the proposed options (3,000 and 5,000 mt) is considerably higher than the 500 short ton maximum allowed under the status quo. While the status quo formula may be suitable at current low levels of sardine biomass, it is unrealistically low for medium to high sardine biomass levels, particularly in years when anchovy abundance is low (sardine being a substitute for anchovy as dead bait).

7// Table 5.4.3.2.1-1 is based on the CPS Plan Development Team's recommended harvest formula for anchovy: 300,000 mt cutoff, 25 percent fraction, 200,000 mt MAXCAT, 82 percent portion in U.S. waters.

is currently made available to the U.S. fishery. The status quo nonreduction quota based on the Coastal Pelagic Species Plan Development Team's proposed harvest formula would be 5,740 mt (i.e., 82 percent of 7,000 mt), 82 percent being the current estimate of the portion of the anchovy stock in U.S. waters."]115

is 2,500 short tons.[9/]

While current sardine regulations provide for geographic allocation of the dead bait quota,[10/] no options regarding geographic allocation of low-volume reserves are proposed here. The recommendation to change the starting date for the sardine season from January 1 to August 1 may mitigate the need for geographic allocation. The new season delays the start of the sardine season until fish are normally available in both northern and southern areas.

5.4.3.2.3 Pacific Mackerel

While low-volume harvests of anchovy and sardine are used largely for bait, the major low-volume use for Pacific mackerel is fresh fish for human consumption. The fresh fish market is served by purse seiners that also deliver to the canneries, as well as by smaller boats that specialize more in fresh fish deliveries. Of the approximately 40,000 short tons of mackerel landed annually during 1989-1990, about 25 percent (10,000 short tons) are estimated to have been delivered to the fresh market. During 1993, in contrast, about 60 percent (6,000 short tons) was delivered to the fresh market. This increase in the proportion of mackerel landings going to the market is largely due to the recent closure of a major southern California cannery. Many of the purse seiners that used to deliver to that cannery are selling fish to the fresh market and displacing some of the smaller boats that were customary suppliers of fresh fish.

The options considered for Pacific mackerel include fractions (5 percent, 10 percent) and caps (2,000 and 3,000 mt) that provide a somewhat lower level of allocation than the options considered for anchovy and sardine. The fresh fish market is apparently capable of absorbing 6,000-10,000 short tons of Pacific mackerel per year. A low-volume reserve of 6,000-10,000 mt is probably not appropriate if Council decides to base the low-volume reserve on small boat limited entry permits, however, because purse seiners who qualify for large boat limited entry permits will (at least in some circumstances) supply low- as well as high-volume markets.

Table 5.4.3.2.3-1 describes the Pacific mackerel options in terms of their effect on the size of the low-volume reserve and the unallocated portion of the harvest guideline, based on the recommended Pacific

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9// As indicated previously, current California state regulations provide for a sardine dead bait quota of 250 short tons when the US harvest is less than 2,500 short tons and 500 short tons when the US harvest exceeds 2,500 short tons.

10// The allocation is 62 short tons each for central and northern California with the remainder going to southern California.

is currently made available to the U.S. fishery. The status quo nonreduction quota based on the Coastal Pelagic Species Plan Development Team's proposed harvest formula would be 5,740 mt (i.e., 82 percent of 7,000 mt), 82 percent being the current estimate of the portion of the anchovy stock in U.S. waters.^]116

mackerel harvest formula.[11/] The reserve is zero when the biomass is below 20,000 mt and gradually increases thereafter to the level of the cap. The 2,000 mt cap is reached at a biomass of 211,000 mt under the 5 percent fraction and 116,000 mt under the 10 percent fraction. The 3,000 mt cap is reached at a biomass of 306,000 mt under the 5 percent fraction and 163,000 mt under the 10 percent fraction. Regardless of which cap (3,000 or 5,000 mt) is assumed, the biomass level at which the cap is reached is almost twice as high with the 5 percent fraction than with the 10 percent fraction. Also, as the fraction increases from 5 percent to 10 percent, the low-volume reserve doubles but the harvest guideline for other directed fishing declines by less than 5.5 percent.

5.4.3.3 Recommendations

The CPS Plan Development Team and the CPS Advisory Subpanel recommend the following allocations for low-volume uses of CPS. The recommendations are consistent with the goals and objectives listed in the FMP. In particular, they promote efficiency and profitability in the fishery, provide year-round fishing opportunities, maintain existing CPS fishery segments, avoid discard, and manage fishing effort, industry capacity, and capital to achieve other goals.

Northern Anchovy - 3,000 mt: Although 3,000 mt is less than the status quo allocation (4,900 mt), it is expected to provide adequately for low-volume uses of anchovy. It is approximately equal to recent (i.e., 1990-1991) annual nonreduction landings (3,180 mt) and 50 percent greater than average annual landings during 1965-1992 (2,044 mt) and the window period years 1986-1991 (2,026 mt). The 3,000 mt option provides a smaller US harvest (and thus a larger forage reserve) at biomass levels below the recommended CUTOFF (300,000 mt) for high volume directed fishing in the recommended harvest policy for northern anchovy. However, once a harvest guideline for high volume directed fishing becomes available at biomass levels in excess of 300,000 mt, low-volume fishers also have access to that harvest guideline once the low-volume reserve is exhausted. This option for allocation above the CUTOFF level is consistent with the 3,000 mt low-volume quota proposed for anchovy when biomass levels are lower than CUTOFF but above the definition of overfishing.

Pacific Sardine - 10 percent fraction and 3,000 mt cap: Although the dead bait market for sardine is currently smaller than the market for anchovy, a full-fledged sardine fishery is expected to serve the same low-volume markets as anchovy. Thus a cap similar to the one recommended for anchovy (3,000 mt) is warranted to allow for development of the fledgling sardine fishery for dead bait as well as for other low-volume uses of sardine. The 10 percent fraction is preferred because the 3,000 mt cap is reached at a much lower biomass under the 10 percent fraction (300,000-350,000 mt) than the 5 percent fraction (550,000-600,000 mt). Also, at biomass levels below 300,000-350,000 mt, the size of the reserve is twice as large under the 10 percent fraction than the 5 percent fraction, while the unallocated portion of the harvest guideline is reduced by less than 5.5 percent .

Pacific Mackerel - 10 percent fraction and 2,000 mt cap: A lower cap (2,000 mt) is recommended for Pacific mackerel than for anchovy and sardine, for two reasons: (1) Purse seiners who will likely qualify for large boat limited entry permits are able and willing (at least in some circumstances) to supply low- and well as high-volume markets for mackerel. Thus small boat permit holders (for whom the low-volume

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11// Total harvest and U.S. harvest are based on the CPS Plan Development Team's preferred harvest formula: 20,000 mt cutoff, 30 percent fraction, 70 percent portion in U.S. waters.

is currently made available to the U.S. fishery. The status quo nonreduction quota based on the Coastal Pelagic Species Plan Development Team's proposed harvest formula would be 5,740 mt (i.e., 82 percent of 7,000 mt), 82 percent being the current estimate of the portion of the anchovy stock in U.S. waters.^]117

reserve is intended) will likely not be the only vessels harvesting for low-volume uses,[12/] and (2) Pacific mackerel is not an important source of bait for California's recreational fishery (as is anchovy), nor will a significant dead bait market for mackerel likely develop in the future (as may be the case for sardine). The 10 percent fraction is preferred because the 2,000 mt cap is reached at a much lower biomass under the 10 percent fraction (116,00 mt) than the 5 percent fraction (211,000 mt). Also, at biomass levels below 116,000 mt, the size of the reserve is twice as large under the 10 percent fraction than the 5 percent fraction, while the unallocated portion of the harvest guideline is reduced by less than 5.5 percent.

5.5 North-South Allocation for Directed Fishery

Many CPS have traditionally been allocated to northern and southern segments of the CPS fishery under federal and state law. Seasons for CPS set out in this FMP are expected to reduce the need for north-south allocation because the start of the season is delayed until fish are normally available in both northern and southern regions. Low-volume reserves described above would not be further allocated to northern and southern fishery segments but could be in the future if conditions warrant.

5.5.1 Status Quo

The purpose of the northern allocations for sardine and anchovy has been to ensure harvest opportunities for the northern California fishery, which might otherwise be at a disadvantage because of inclement weather, timing of resource availability or market demand, competition from much greater harvesting or processing capacity in southern California, or other factors.

5.5.1.1 Northern Anchovy

The Northern Anchovy FMP specifies that 10,000 mt or 10 percent of the U.S. reduction quota (whichever is less) be reserved for the reduction fishery north of Point Buchon, California. Once the allocation is exhausted, northern California fishers also have access to whatever remains of the unreserved portion of the reduction quota. Any unused portion of the northern allocation is subject to inseason release to the southern reduction fishery.

5.5.1.2 Pacific Sardine

In 1988 the state of California began allocating 20 percent of the sardine directed quota to the fishery north of San Simeon Point; the allocation was increased to 33 percent in 1991. Legislation enacted on October 1, 1993 allows a 50/50 inseason redistribution of unused portions of all sardine quotas (including the northern allocation) between southern and northern California.

5.5.1.3 Pacific and Jack Mackerel

There is no geographic allocation of Pacific or jack mackerel harvests.

12// This point becomes irrelevant if the Council decides to base the low-volume reserve on specific resource uses rather than small boat limited entry permits.

is currently made available to the U.S. fishery. The status quo nonreduction quota based on the Coastal Pelagic Species Plan Development Team's proposed harvest formula would be 5,740 mt (i.e., 82 percent of 7,000 mt), 82 percent being the current estimate of the portion of the anchovy stock in U.S. waters.^]118

5.5.2 Management Options

Several options for a northern reserve were developed for anchovy and sardine. Low-volume reserves, if adopted, or other small allocations specifically exempted, would not normally be allocated to northern and southern areas. Each option designates the reserve as a fraction of the US harvest less the low-volume reserve and any allowances for bycatch (low-volume reserves and bycatch are not allocated to northern and southern regions). The anchovy options include a cap, while the sardine options do not:

Species	Fraction	Cap (mt)
Northern Anchovy	10 percent	5,000; 10,000
Pacific Sardine	10 percent, 33 percent	None

Whereas the northern allocation currently applies from Point Buchon, California, to the Oregon border for anchovy and from San Simeon Point, California, to the Oregon border for sardine, the new options for the northern allocation would apply from Pt. Piedras Blancas at 35° 40' N latitude (a few miles north of San Simeon Point) to the Canadian border for both species. Experience indicates that Pt. Piedras Blancas is better than Pt. Buchon for distinguishing between northern and southern segments of the CPS fishery because it is more difficult to evade allocation regulations by trucking fish around Pt. Piedras Blancas than around Pt. Buchon. Pt. Piedras Blancas is better than San Simeon Point because it is a larger geographic feature in the same general area.

Sardine options do not include a cap to allow for increases in the northern allocation as biomass increases and the fishery expands northward. A fraction without a cap allows the northern fishery to increase as the abundance of sardines increases in northern areas. Anchovy do not exhibit the marked northward expansion at high levels of biomass that is characteristic of sardine, so the effect of a northern allocation for anchovy would be largely limited to northern California. Thus a cap is warranted for options pertaining to a northern allocation for anchovy.

Under all of the options described above, the northern allocation and the remaining unallocated harvest guideline would be made available at the beginning of the season. The northern fishery would be allowed to compete with other fishery segments for whatever remained of the unallocated harvest guideline, once the northern reserve was exhausted. Also, any portion of the reserve that was unused nine months into the season would be made available to all segments of the directed fishery at that time.

5.5.3 Analysis of Options

5.5.3.1 Northern Anchovy

One way to evaluate the options for allocating anchovy is to look at the proportion of the harvest guideline taken in northern California during the 13 seasons when California had a significant reduction fishery (1969-1970 and 1981-1982). This analysis is complicated by the fact that biomass estimation procedures and harvest formulas changed significantly during the period of State management (1969-1970 and 1977-1978), earlier years of federal management (1978-1979 and 1982-1993) and again recently (beginning in 1982-1983, by which time the California reduction fishery had become inactive).[13/] During 1972-1973 and 1981-1982, northern California landings accounted on average for 9.2 percent of the actual

13// The change from the larval census to egg production method of estimating biomass, as well as changes in the reduction OY formula, are documented in the Council (1983).

is currently made available to the U.S. fishery. The status quo nonreduction quota based on the Coastal Pelagic Species Plan Development Team's proposed harvest formula would be 5,740 mt (i.e., 82 percent of 7,000 mt), 82 percent being the current estimate of the portion of the anchovy stock in U.S. waters.^]119

reduction quotas in those seasons and 5.9 percent of the harvest guidelines obtained by applying the CPS Plan Development Team's recommended harvest formula to the most current estimates of spawning biomass for those same seasons (Table 5.5.3.1-1). Thus, under the harvest formula recommended by the CPS Development Team and CPS Advisory Subpanel, there still appears to be a reasonable basis for at least the 10 percent fraction currently used for the northern allocation.

In terms of the cap, the 10,000 mt option for northern anchovy corresponds to the status quo and also closely corresponds to the record northern California landings experienced in the 1973-1974 season (10,324 mt). The 5,000 mt option corresponds roughly to average northern California landings during 1969-1970 and 1981-1982 (3,847 mt, Table 5.5.3.1-1). The decline in reduction capacity that has occurred in southern California since the early 1980s suggests that northern California may be at a lesser disadvantage in competing for the harvest guideline than it was in previous years, should there be a resurgence of the moribund reduction fishery. A 5,000 mt cap may be warranted on this basis.

Table 5.5.3.1-2 describes how the northern allocation would vary at different levels of biomass under the CPS Plan Development Team's recommended harvest formula.[14/] Under both options, the allocation is zero when the biomass is below 300,000 mt and gradually increases thereafter to the level of the cap. The 5,000 mt cap is reached at a biomass level of 544,000 mt, while the 10,000 mt cap is reached at a biomass of 788,000 mt.

5.5.3.2 Pacific Sardine

The northern California (i.e., Monterrey and San Francisco) share of statewide sardine landings was significantly higher during the historical fishery than the current fishery, averaging 59 percent (range 28-82 percent) during 1916-1945, then declining to 21 percent (range 12-44 percent) during 1946-1951 as the stock declined in abundance and contracted southward (Radovich 1981). Several factors contributed to the changes in landings shares between the historical and current period:

1. Since the sardine stock tends to expand northward as abundance increases, harvest opportunities in northern California were likely greater in the high-abundance years of the historical fishery than in the current fishery.

2. Relatively greater harvesting and processing capacity existed in northern California in the historical fishery than in the current fishery.

A northern California allocation would probably not have been justifiable under historical fishery conditions but changing circumstances prompted the State to establish such an allocation. In 1989 California began allocating the directed quota 20-80 percent between northern and southern California, then subsequently changed the allocation to 33-67 percent in 1991. About 17 percent of statewide directed landings during 1989-1992 were made in northern California. This fraction, however, is probably more reflective of the regulations imposed on the fishery than relative harvesting/processing capacity or market demand in northern and southern California, particularly since (until very recently) unused portions of the northern allocation could not be made available for harvest to the southern California fishery.

14// Total harvest and U.S. harvest are based on the CPS Plan Development Team's preferred harvest formula: 300,000 mt cutoff, 25 percent fraction, 200,000 mt MAXCAT, 82 percent portion in U.S. waters.

is currently made available to the U.S. fishery. The status quo nonreduction quota based on the Coastal Pelagic Species Plan Development Team's proposed harvest formula would be 5,740 mt (i.e., 82 percent of 7,000 mt), 82 percent being the current estimate of the portion of the anchovy stock in U.S. waters.^]120

During 1989-1990, when the directed quota was 907 mt and the north-south allocation was 20-80 percent, both northern and southern California used their entire allocations. In 1991, when the directed quota increased to 7,394 mt and the north-south allocation changed to 33-67 percent, southern California utilized 100 percent and northern California utilized about 40 percent of their respective allocations. The pace of southern California landings was so rapid in 1991 that the state of California restricted landings to one day per week to avoid quota overages in that area. In 1992, when the quota increased substantially to 20,412 mt and the allocation remained at 33-67 percent, southern California utilized 100 percent and northern California utilized 43 percent of their respective allocations. By contrast with 1991, the southern California allocation was not exhausted until late in the season, largely as a result of the significantly larger quota and the closure of a major southern California cannery in 1992.

Table 5.5.3.2-1 describes how the northern reserve for sardine would vary with biomass when the fraction is 10 percent and 33 percent under two alternative assumptions regarding the harvest formula CUTOFF (50,000 and 100,000 mt).[15/] Under a harvest formula CUTOFF of 50,000 mt, the northern reserve is equal to the low-volume reserve when the biomass reaches 50,000-305,000 mt, and exceeds the low-volume reserve at biomass levels above 305,000 mt. Under a harvest formula CUTOFF of 100,000 mt, the northern reserve is equal to the low-volume reserve when the biomass reaches 100,000-355,000 mt, and exceeds the low-volume reserve at biomass levels above 355,000 mt. Under the 33 percent fraction, the northern allocation exceeds the low-volume allocation at all levels of biomass (Table 5.5.3.2-1).

5.5.4 Recommendations

The CPS Plan Development Subpanel and CPS Plan Development Team reached consensus on the recommendation for northern anchovy. The CPS Plan Development Subpanel was not able to reach consensus on the recommendation for sardine so the recommendation is made by the Team.

Northern Anchovy - 10 percent fraction, 5,000 mt cap: During those seasons when California had a significant reduction fishery (1972-1973 and 1981-1982), northern California landings averaged 9.2 percent of the actual reduction quotas in those seasons and 5.9 percent of the harvest guidelines obtained by applying the CPS Plan Development Team's recommended harvest formula to the most current estimates of spawning biomass for those same seasons (Table 5.5.3.1-1). Thus, even under the new harvest formula recommended by the Team, there appears to be a reasonable basis for the 10 percent fraction currently used for the northern allocation on northern anchovy. The 5,000 mt cap is preferred to the current 10,000 mt cap because (1) 5,000 mt corresponds roughly to average northern California landings during 1972-1973 and 1981-1982 (3,847 mt; and (2) the decline in reduction capacity that has occurred in southern California since the early 1980s suggests that northern California may be at a lesser disadvantage in competing for the harvest guidelines than it was in previous years.

Pacific Sardine - 10 percent fraction: During the two most recent sardine seasons (1991-1992), northern California has utilized about 40 percent of the 33 percent allocated to it, which translates to slightly over 10 percent (i.e., 13 percent =40 percent of 33 percent) of the directed quota.

For each species, the northern allocation and the remaining unallocated harvest guideline would be made available at the beginning of the season. The northern fishery would be allowed to compete for whatever

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15// Total harvest and U.S. harvest are based on the CPS Plan Development Team's recommended harvest formula: 20 percent FRACTION, 400,000 mt MAXCAT, 59 percent portion in U.S. waters. The reserve for low-volume uses is based on a 10 percent fraction and a 5,000 mt cap.

is currently made available to the U.S. fishery. The status quo nonreduction quota based on the Coastal Pelagic Species Plan Development Team's proposed harvest formula would be 5,740 mt (i.e., 82 percent of 7,000 mt), 82 percent being the current estimate of the portion of the anchovy stock in U.S. waters.^]121

remained of the unallocated portion of the harvest guideline, once the northern reserve was exhausted. Also, any portion of the northern reserve that was unused nine months into the season would be made available to all segments of the directed fishery at that time. These provisions ensure that northern landings are not strictly limited by the size of the northern allocation and that the northern allocation is fully utilized.

The recommendations are consistent with the goals and objectives listed in the FMP. In particular, they promote efficiency and profitability in the fishery, provide year-round fishing opportunities, maintain existing CPS fishery segments, avoid discard, and manage fishing effort, industry capacity, and capital to achieve other goals.

TABLE 5.2.1-1. Sardine bycatch allowance and estimated sardine bycatch rate in the Pacific mackerel fishery, 1983-1991.[a/b/]

Year	Bycatch Allowance	Bycatch Rate
1983	15 percent	1.0 percent
1984	15 percent	0.4 percent
1985	15 percent	1.3 percent
1986	15 percent	1.4 percent
1987	25 percent	3.0 percent
1988	35 percent	5.0 percent
1989	35 percent	4.5 percent
1990	35 percent	3.0 percent
1991	35 percent	3.5 percemt

a/ Bycatch rate defined as the ratio of sardine landings to sardine plus mackerel landings made after closure of the directed sardine fishery.

b/ Source: California Department of Fish and Game, unpublished.

TABLE 5.4.3.2.1-1. Effect of changes in biomass on total harvest, U.S. harvest, the low-volume reserve and the unallocated portion of the U.S. harvest, as computed for each of the low-volume reserve options for northern anchovy.[a/b/]

	Status Quo Nonreduction alloc.				3,000 mt Low-Volume Reserve				5,000 mt Low-volume Reserve			
Biomass	Total Harvest	U.S. Harvest	Low-volume	Unallocated portion	Total Harvest	U.S. Harvest	Low-volume	Unallocated portion	Total Harvest	U.S. Harvest	Low-volume	Unallocated portion
≤75K	0	0	0	0	0	0	0	0	0	0	0	0
75K-300K	7,000	5,740	5,740	0	3,000	3,000	3,000	0	5,000	5,000	5,000	0
301K	**7,250**	**5,945**	**5,740**	**205**	3,000	3,000	3,000	0	5,000	5,000	5,000	0
310K	9,500	7,790	5,740	2,050	3,000	3,000	3,000	0	5,000	5,000	5,000	0
315K	10,750	8,815	5,740	3,075	**3,750**	**3,075**	**3,000**	**75**	5,000	5,000	5,000	0
325K	13,250	10,865	5,740	5,125	6,250	5,125	3,000	2,125	**6,250**	**5,125**	**5,000**	**125**
350K	19,500	15,990	5,740	10,250	12,500	10,250	3,000	7,250	12,500	10,250	5,000	5,250
400K	32,000	26,240	5,740	20,500	25,000	20,500	3,000	17,500	25,000	20,500	5,000	15,500
450K	44,500	36,490	5,740	30,750	37,500	30,750	3,000	27,750	37,500	30,750	5,000	25,750
500K	57,000	46,740	5,740	41,000	50,000	41,000	3,000	38,000	50,000	41,000	5,000	36,000
600K	82,000	67,240	5,740	61,500	75,000	61,500	3,000	58,500	75,000	61,500	5,000	56,500
700K	107,000	87,740	5,740	82,000	100,000	82,000	3,000	79,000	100,000	82,000	5,000	77,000
800K	132,000	108,240	5,740	102,500	125,000	102,500	3,000	99,500	125,000	102,500	5,000	97,500
900K	157,000	128,740	5,740	123,000	150,000	123,000	3,000	120,000	150,000	123,000	5,000	118,000
1000K	182,000	149,240	5,740	143,500	175,000	143,500	3,000	140,500	175,000	143,500	5,000	138,500

a/ At some biomass levels, the proposed low-volume reserve options affect total harvest and U.S. harvest, as well as the low-volume reserve and the unallocated portion of U.S. harvest. Table entries are based on the CPS Plan Development Team's recommended harvest formula (300,000 mt CUTOFF, 25 percent FRACTION, 200,000 mt MAXCAT, 82 percent portion in U.S. waters).

b/ Bold faced and underlined means minimum biomass where unallocated portion of U.S. harvest becomes available.

- The unallocated portion of the U.S. harvest may include a reserve for bycatch.

Formulas associated with Status Quo Nonreduction Allocation

Conditions	Total Harvest	U.S. Harvest	Low-volume	Unallocated portion
B≤75K	0	0	0	0
75K<B≤300K	7K	7K*82 percent	7K*82 percent	0
B>300K	7K+(B-300K)*25 percent	Total*82 percent	7K*82 percent	(B-300K)*25 percent *82 percent)

Formulas associated with proposed low-volume reserve (LVCap=3,000 or 5,000 mt)

Conditions	Total Harvest	U.S. Harvest	Low-volume	Unallocated
B≤75K	0	0	0	0
75K<B≤300K	LVCap	LVCap	LVCap	0
B>300K & Total *82 percent ≤ LVCap	(B-300K)*25 percent	LVCap	LVCap	0
B>300K & Total *82 percent >LVCap	(B-300K)*25 percent	Total*82 percent	LVCap	U.S. Harvest-LVCap

Note: Because the CPS Plan Development Team's recommended harvest formula provides 82 percent of total harvest to U.S. fishers, the status quo U.S. nonreduction quota under the recommended harvest formula is 7,000 mt * 82 percent = 5,740 mt. This differs somewhat from the U.S. nonreduction quota under the current harvest formula: 7,000 mt* 70 percent = 4,900 mt.

TABLE 5.4.3.2.2-1. Effect of changes in biomass on total harvest, U.S. harvest, the low-volume reserve and the unallocated portion of the U.S. harvest, as computed for each of the low-volume reserve options for Pacific sardine, assuming a harvest formula CUTOFF of 50,000 mt.[a/b/]

			5%/3000 mt		5%/5000 mt		10%/3000 mt		10%/5000 mt	
Biomass	Total Harvest	U.S. Harvest	Low-volume	Unallocated	Low-volume	Unallocated	Low-volume	Unallocated	Low-volume	Unallocated
≤50K	0	0	0	0	0	0	0	0	0	0
60K	2,000	1,180	59	1,121	59	1,121	118	1,062	118	1,062
70K	4,000	2,360	118	2,242	118	2,242	236	2,124	236	2,124
80K	6,000	3,540	177	3,363	177	3,363	354	3,186	354	3,186
90K	8,000	4,720	236	4,484	236	4,484	472	4,248	472	4,248
100K	10,000	5,900	295	5,605	295	5,605	590	5,310	590	5,310
200K	30,000	17,700	885	16,815	885	16,815	1,770	15,930	1,770	25,930
300K	50,000	29,500	1,475	28,025	1,475	28,025	2,950	26,550	2,950	26,550
305K	51,000	30,090	1,505	28,585	1,505	28,585	**3,000**	27,090	3,009	27,081
400K	70,000	41,300	2,065	39,235	2,065	39,235	3,000	38,300	4,130	37,170
474K	84,800	50,032	2,502	47,530	2,502	47,530	3,000	47,032	**5,000**	45,032
500K	90,000	53,100	2,655	50,445	2,655	50,445	3,000	50,100	5,000	48,100
559K	101,800	60,062	**3,000**	57,062	3,003	57,059	3,000	57,062	5,000	55,062
600K	110,000	64,900	3,000	61,900	3,245	61,655	3,000	61,900	5,000	59,900
700K	130,000	76,700	3,000	73,700	3,835	72,865	3,000	73,700	5,000	71,700
800K	150,000	88,500	3,000	85,500	4,425	84,075	3,000	85,500	5,000	83,500
898K	169,600	100,064	3,000	97,064	**5,000**	95,064	3,000	97,064	5,000	95,064
900K	170,000	100,300	3,000	97,300	5,000	95,300	3,000	97,300	5,000	95,300
1000K	190,000	112,100	3,000	109,100	5,000	107,100	3,000	109,100	5,000	95,300
2000K	390,000	230,100	3,000	227,100	5,000	225,100	3,000	227,100	5,000	225,100
≥2050K	400,000	236,000	3,000	233,000	5,000	231,000	3,000	233,000	5,000	231,000

a/ Also based on the CPS Plan Development Team's recommendations of a 20 percent FRACTION, 400,000 mt MAXCAT and 59 percent allocation of total harvest to U.S. fishers. Low-volume=U.S. harvest*fraction up to cap. Unallocated = U.S. harvest - Low-volume. The unallocated portion of the U.S. harvest would include a reserve for bycatch.

b/ Bold and underlined means minimum biomass at which the low volume reserve reaches the cap.

TABLE 5.4.3.2.2-2. Effect of changes in biomass on total harvest, U.S. harvest, the low-volume reserve and the unallocated portion of the U.S. harvest, as computed for each of the low-volume reserve options for Pacific sardine, assuming a harvest formula CUTOFF of 100,000 mt.[a/b/]

	Total		5%/3000 mt		5%/5000 mt		10%/3000 mt		10%/5000 mt	
Biomass	Harvest	U.S. Harvest	Low-volume	Unallocated	Low-volume	Unallocated	Low-volume	Unallocated	Low-volume	Unallocated
≤100K	0	0	0	0	0	0	0	0	0	0
125K	5,000	2,950	148	2,802	148	2,802	295	2,655	295	2,655
150K	10,000	5,900	295	5,605	295	5,605	590	5,310	590	5,310
175K	15,000	8,850	443	8,407	443	8,407	885	7,965	885	7,965
200K	20,000	11,800	590	11,210	590	11,210	1,180	10,620	1,180	10,620
300K	40,000	23,600	1,180	22,420	1,180	22,420	2,360	21,240	2,360	21,240
355K	51,000	30,090	1,505	28,585	1,505	28,585	**3,000**	27,090	3,009	27,081
400K	60,000	35,400	1,770	33,630	1,770	33,630	3,000	32,400	3,540	31,860
500K	80,000	47,200	2,360	44,840	2,30	44,840	3,000	44,200	4,720	42,480
524K	84,800	50,032	2,501	47,531	2,501	47,531	3,000	47,032	**5,000**	45,032
600K	100,000	59,000	2,950	56,050	2,950	56,050	3,000	56,000	5,000	54,000
609K	101,800	60,062	**3,000**	57,062	3,003	57,059	3,000	57,062	5,000	55,062
700K	120,000	70,800	3,000	67,800	3,540	67,260	3,000	67,800	5,000	77,600
900K	160,000	94,400	3,000	91,400	4,720	89,680	3,000	91,400	5,000	89,400
948K	169,600	100,064	3,000	97,064	**5,000**	95,064	3,000	97,064	5,000	95,064
1000K	180,000	106,200	3,000	103,200	5,000	101,200	3,000	103,200	5,000	101,200
2000K	380,000	224,200	3,000	221,200	5,000	219,200	3,000	221,200	5,000	219,200
≥2100K	400,000	236,000	3,000	233,000	5,000	231,000	3,000	233,000	5,000	231,000

a/ Also based on the Team's recommendations of a 20% FRACTION, 400,00 mt MAXCAT and 59% allocation of Total harvest to U.S. fishers. Low-volume = U.S. harvest * fraction up to cap. Unallocated = U.S. harvest - Low-volume.

b/ Bold and underlined means the minimum biomass at which the low-volume reserve reaches the cap. The unallocated portion of the U.S. harvest would include a reserve for bycatch.

TABLE 5.4.3.2.3-1. Effect of changes in biomass on total harvest, U.S. harvest, the low-volume reserve and the unallocated portion of the U.S. harvest, as computed for each of the low-volume reserve options for Pacific mackerel.[a/b/]

	Total		5%/2000 mt		5%/3000 mt		10%/2000 mt		10%/3000 mt	
Biomass	Harvest	U.S. Harvest	Low-volume	Unalloc	Low-volume	Unalloc	Low-volume	Unalloc	Low-volume	Unalloc
≤20K	0	0	0	0	0	0	0	0	0	0
30K	3,000	2,100	105	1,995	105	1,995	210	1,890	210	1,890
40K	6,000	4,200	210	3,990	210	3,990	420	3,780	420	3,780
50K	9,000	6,300	315	5,985	315	5,985	630	5,670	630	5,670
100K	24,000	16,800	840	15,960	840	15,960	1,680	15,120	1680	15,120
116K	28,800	20,160	1,008	19,152	1,008	19,152	**2,000**	18,160	2,016	18,144
150K	39,000	27,300	1,365	25,935	1,365	25,935	2,000	25,300	2,730	24,570
163K	42,900	30,030	1,502	28,528	1,502	28,528	2,000	28,030	**3,000**	27,030
200K	54,000	37,800	1,890	35,910	1,890	35,910	2,000	35,800	3,000	34,800
211K	57,300	40,110	**2,000**	38,110	2,006	38,104	2,000	38,110	3,000	37,110
300K	84,000	58,800	2,000	56,800	2,940	55,860	2,000	56,800	3,000	55,800
306K	85,800	60,060	2,000	58,060	**3,000**	57,060	2,000	58,060	3,000	57,060
400K	114,000	79,800	2,000	77,800	3,990	76,800	2,000	77,800	3,000	76,800

a/ Based on the CPS Plan Development Team's recommendations of a 20,000 mt CUTOFF, 30 percent FRACTION and 70 percent allocation of total harvest to U.S. fishers.
- Low-volume = U.S. harvest * fraction up to cap.
- Unalloc = U.S. harvest - Low-volume
- The unallocated portion of the U.S. harvest would include a reserve for bycatch.

b/ Boldface and underline means the minimum biomass at which a low-volume reserve reaches a cap.

TABLE 5.5.3.1-1. Northern California reduction landings in metric tons (mt) and as a proportion of: 1) statewide reduction landings, 2) the reduction quota applicable during the season, and 3) what the allowable harvest for the directed fishery would have been if the harvest formula recommended by the CPS Plan Development Team were applied to the most current estimate of spawning biomass for the 1969-1970 to 1981-1992 seasons.

	Reduction Landings (mt)					Number California Landings as % of:		
Season	No. Cal	Total	Original Reduction Quota[a/]	Spawning biomass (mt)[b/]	Team's Recomm. HG (mt)[c/]	Calif. Landings	Oreg. Red. Quota	Team's Recomm. HG
1969-70	1,833	75,726	127,007	181,000	0	2.4%	1.4%	--
1970-71	596	73,258	68,040	151,000	0	0.8%	0.9%	--
1971-72	1,192	48,468	68,040	131,000	0	2.5%	1.8%	--
1972-73	2,134	68,510	99,791	379,000	51,885	3.1%	2.1%	4.1%
1973-74	10,324	109,396	104,327	403,000	59,065	9.4%	9.9%	17.5%
1974-75	6,050	105,767	104,327	735,000	158,390	5.7%	5.8%	3.8%
1975-76	4,800	127,829	104,327	817,000	182,921	3.8%	4.6%	2.6%
1976-77	4,542	96,562	104,327	743,000	160,783	4.7%	4.4%	2.8%
1977-78	6,543	68,656	104,327	499,000	87,786	9.5%	6.3%	7.5%
1978-79	1,065	48,870	52,919	363,000	47,098	2.2%	2.0%	2.3%
1979-80	2,146	32,431	105,325	639,000	129,669	6.6%	2.0%	1.7%
1980-81	4,297	60,689	150,957	498,000	87,486	7.1%	2.8%	4.9%
1981-82	4,493	45,452	370,226	336,000	39,021	9.9%	1.2%	11.5%

a/ Source: Thomson et. al. 1993.

b/ Source: Jacobson and Lo 1993.

c/ Computed as [(B*1.46)-300,000]*25%*82%, where B=spawning biomass (Jacobson and Lo 1993), 1.46 converts spawning biomass on February 15 to total biomass on July 1, 200,000 mt is the harvest formula CUTOFF, 25% is the harvest formula FRACTION, and 82% is the U.S. share of the total harvest.

TABLE 5.5.3.1-2. Effect of changes in biomass on total harvest, U.S. harvest, the low-volume reserve, the northern reserve, and the remaining unallocated portion of the U.S. harvest, as computed for each of the northern reserve options for northern anchovy.[a/b/]

				10%/5K mt Cap		10%/10K mt Cap	
Biomass	Total Harvest	U.S. Harvest	Low-volume	North	Unalloc	North	Unalloc
≤75K	0	0	0	0	0	0	0
75K-300K	3,000	3,000	3,000	0	0	0	0
325K	6,250	5,125	3,000	213	1,912	213	1,912
350K	12,500	10,250	3,000	725	6,525	725	6,525
375K	18,750	15,375	3,000	1,538	10,837	1,538	10,837
400K	25,000	20,500	3,000	2,050	15,450	2,050	15,450
450K	37,500	30,750	3,000	3,075	24,675	3,075	24,675
500K	50,000	41,000	3,000	4,100	33,900	4,100	33,900
544K	61,000	50,020	3,000	**5,000**	42,020	5,002	42,018
550K	62,500	51,250	3,000	5,000	43,250	5,125	43,125
600K	75,000	61,500	3,000	5,000	53,500	6,150	52,350
700K	100,000	82,000	3,000	5,000	74,000	8,200	70,800
788K	122,000	100,040	3,000	5,000	92,040	**10,000**	87,040
800K	125,000	102,500	3,000	5,000	94,500	10,000	89,500
900K	150,000	123,000	3,000	5,000	115,000	10,000	110,000
1000K	175,000	143,500	3,000	5,000	135,500	10,000	130,000

a/ Based on the CPS Plan Development Team's recommendations of a 300,000 mt CUTOFF, 25 percent FRACTION, 200,000 mt MAXCAT and 82 percent allocation of Total harvest to U.S. fishers. Also based on the Team's recommendations regarding the low-volume reserve 3,000 mt with 1:1 offset).

- North = U.S. harvest * 10 percent up to cap of 5,000 or 10,000 mt.
- Unalloc. = U.S. harvest - Low-volume - North
- The unallocated portion of the U.S. harvest may include a reserve for bycatch.

b/ Bold and underlined means the minimum biomass level at which the northern reserve reaches the cap.

TABLE 5.5.3.2-1. Effect of changes in biomass on total harvest, U.S. harvest, the low-volume reserve, the northern reserve and the remaining unallocated portion of the U.S. harvest, as computed for each of the northern reserve options for Pacific sardine, under two alternative assumptions regarding the harvest formula CUTOFF (50,000 and 100,000 mt).[a/b/]

50,000 mt CUTOFF:

				10% No. allocation		33% No. allocation	
Biomass	Total Harvest	U.S. Harvest	Low-volume	North	Unalloc	North	Unalloc
≤50K	0	0	0	0	0	0	0
60K	2,000	1,180	118	118	944	389	673
70K	4,000	2,360	236	236	1,888	779	1,345
80K	6,000	3,540	354	354	2,832	1,168	2,018
90K	8,000	4,720	472	472	3,776	1,558	2,690
100K	10,000	5,900	590	590	4,720	1,947	3,363
200K	30,000	17,700	1,770	1,770	14,160	5,841	10,089
300K	50,000	29,500	2,950	2,950	23,600	9,735	16,815
305K	51,000	30,090	**3,000**	**3,009**	24,081	9,930	17,160
400K	70,000	41,300	3,000	4,130	34,170	13,629	24,671
500K	90,000	53,100	3,000	5,310	44,790	17,523	32,577
1000K	190,000	112,100	3,000	11,210	97,890	36,993	72,107
2000K	390,000	230,100	3,000	23,010	204,090	75,933	151,167
≥2050K	400,000	236,000	3,000	23,600	209,400	77,880	155,120

100,000 mt CUTOFF:

				10% No. allocation		33% No. allocation	
Biomass	Total Harvest	U.S. Harvest	Low-volume	North	Unalloc	North	Unalloc
≤100K	0	0	0	0	0	0	0
125K	5,000	2,950	295	295	2,360	974	1,681
150K	10,000	5,900	590	590	4,720	1,947	3,363
175K	15,000	8,850	885	885	7,080	2,921	5,044
200K	20,000	11,800	1,180	1,180	9,440	3,894	6,726
300K	40,000	23,600	2,360	2,360	18,880	7,788	13,452
355K	51,000	30,090	**3,000**	**3,009**	24,081	9,930	17,160
400K	60,000	35,400	3,000	3,540	28,860	11,682	20,718
500K	80,000	47,200	3,000	4,720	39,480	15,576	28,624
1000K	180,000	106,200	3,000	10,620	92,580	35,046	68,154
2000K	380,000	224,200	3,000	22,420	198,780	73,986	147,214
≥2100K	400,000	236,000	3,000	23,600	209,400	77,880	155,120

a/ Based on the CPS Plan Development Team's recommendations of a 20 percent FRACTION, 400,000 mt MAXCAT and 82 percent allocation of total harvest to U.S. fishers. Also based on the CPS Plan Development Team's recommendations regarding the low-volume reserve (10 percent fraction, 3,000 mt cap).

- North=harvest*fraction
- Unalloc=U.S. harvest - LowVol - North
- The unallocated portion of the U.S. harvest would include a reserve for bycatch.

b/ Bold and underlined means the minimum biomass level at which the northern reserve exceeds the low-volume reserve.

1.0 FOUR PRINCIPLE OPTIONS ANALYZED

This document describes and analyzes four options considered by the Pacific Fishery Management Council (Council) for management of the fishery for coastal pelagic species (CPS). The options range from no fishery management plan (FMP) for CPS to a single FMP for management of all CPS. Estimates of recurrent annual costs to the federal government are presented for each option. Cost estimates and data were provided by the National Marine Fisheries Service (NMFS).

Information about the history of the CPS FMP and current management situation in the FMP. CPS stocks and the fishery are described in Appendix A.

1.0.1 Background

Four principal options were considered for managing CPS: 1) drop the anchovy FMP (no Council or federal involvement in managing 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.

Cost estimates for Option 4 are given with a license limitation program which is a preferred option for the CPS FMP. Costs for Option 4 and a CPS FMP will be somewhat lower if a limited entry program is not adopted.

1.1 Summary of Cost Estimates

Estimates of annual recurrent federal costs (summarized below; details in section 1.6–1.7) for all options are relatively low because the anchovy FMP and CPS FMP are simple and because status quo assessment and monitoring efforts are already at low levels.

Three types of costs were estimated: administrative, scientific and enforcement. Direct labor costs were increased by 21–24 percent (depending on area) to account for an employers surcharge (employee benefits) and by an additional 60–67 percent (depending on area) to cover administration, supervision, training and other types of overhead. Administrative costs include travel and time required at meetings of the Coastal Pelagic Species Management Team, CPS Advisory Subpanel, publication of annual harvest guidelines, publication of fishery closures, changing incidental harvest rates, daily coordination, and review by the Council and Scientific and Statistical Committee.

Scientific costs include costs of a biologist for stock assessment, an economist for monitoring the fishery, and surveys. Enforcement costs increase if the FMP for CPS is adopted because the number of federally managed species increases and because of the need for enforcing limited entry regulations. Port sampling is carried out by the state of California under a grant from the Interjurisdictional Fisheries Act which is not affected by Council management of CPS.

Option 4 (an FMP for all CPS) could be implemented with or without a license limitation program. Initial administrative costs for issuing permits in the license limitation program (assuming 77 small boat permits, 72 large boat permits, and 20 gillnet vessels displaced by Proposition 132) would be about $8,619 which could be recovered from applicants (about $51 each for 169 permits).

The cost estimates for Option 4 (with license limitation) are relatively low because options developed for issuing license limitation permits admit all present participants. Initial costs for a limited entry program with fewer boats (and potentially greater long term benefits from reduced fishery capacity), would probably increase initial administrative costs because of appeals. More restrictive options for issuing permits have not been developed, however, and procedures for issuing permits and making appeals are not outlined in the draft FMP. Thus, it is not possible to provide alternative cost estimates at this time. Regardless of the number of permits involved, it may be possible to limit administrative costs by using the recently established NMFS Fisheries Permits Office and by streamlining the permit process. California has informally agreed to help NMFS with the costs of administring the license limitation program for CPS.

Annual Costs of Options for Managing CPS

	Administrative Costs	Science Costs	Enforcement Costs	Total Costs
Option 1 (Drop the anchovy FMP)	$0	$162,460	$0	$162,460
Option 2 (Status-quo)	$10,398	$162,460	$13,250	$186,108
Option 3 (Amend the anchovy FMP)	$10,398	$162,460	$13,250	$186,108
Option 4 (FMP for CPS with license limitation)	$24,416[1/]	$290,695	$20,252	$335,363

Scientific costs are the largest component under all options. NMFS has informally agreed to provide California Department of Fish and Game (CDFG) with assistance in monitoring and assessing CPS stocks if an FMP is not implemented. Thus, science costs under Option 1 (drop the anchovy FMP) are the same as under Option 2 (the status quo). Options 1, 2 and 3 assume a survey every eight years, continuous collection of fish spotter data, and the time of a NMFS biologist (25 percent time), and economist (17 percent time). Option 4 assumes a survey every five years, continuous collection of fish spotter data, and additional time by a NMFS biologist (75 percent time) and economist (50 percent time).

The difference in cost between the status-quo and the FMP for CPS ($149,000) is primarily increased science costs from increasing the frequency of research surveys. More frequent research surveys would be desirable but not are essential. If necessary, CPS could be managed with surveys conducted at current intervals. Thus, costs under the CPS FMP could approach status-quo costs if necessary.

1.1.1 Personnel Shortages

The number of NMFS personnel available to work on CPS is currently adequate to support all four options as long as the number of CDFG personnel involved in CPS management is not reduced. Any transfers, retirements or other loss of staff would, however, make it difficult for NMFS to meet its responsibilities under all options. This situation is due to declines in NMFS personnel over the last decade and current budgetary difficulties that make it difficult to fill vacant positions.

1.2 Option 1: No FMP Management for CPS

Under this option, Council would drop the FMP for northern anchovy and federal authority in managing anchovy would cease. Management of CPS in state waters would revert to California, Oregon and Washington (with the exception of jack mackerel north of 39° N Latitude which are managed under the Groundfish FMP).

Science costs under this option do not decrease because NMFS has informally agreed to continue providing CDFG with data and technical advice. Administration and enforcement costs, however, fall to zero.

1/ Does not include $8,841 cost for issuing permits that could be recovered from permit applicants (about $51 per applicant, see Section 1.6.4).

Effects on Anchovy Management

Under this option, NMFS would cease annual stock assessment activities for northern anchovy and production of annual reports describing the economic status of the CPS fishery. California Code §8190 indicates that CDFG should assess and manage northern anchovy but only if federal funds are provided. No state law exists regarding quotas in the anchovy fishery so management would depend on the judgement, policies, and best information available to the California Fish and Game Commission unless additional state legislation were passed. Collection of CalCOFI data by NMFS would probably continue in the short term. Collection of fish spotter data by NMFS (used to estimate relative abundance of anchovy and other CPS) would cease. NMFS technical advice and CalCOFI data would remain available to CDFG as long as they were available.

Benefits to NMFS from this option would be minor as relatively few resources are used for administrative and enforcement purposes. Any additional resources made available could be used by NMFS for other fisheries although no specific plans are available. There are no benefits to CDFG.

The main disadvantage of this option is extra demands placed on CDFG and increased risk to stocks and U.S. fisheries. Reliable stock assessments might not be feasible; too much harvest and low biomass levels might result. Low biomass levels would hurt the fishery and might adversely effect dependent species.

Effects on Management of Pacific Mackerel and Sardine

Extra demands placed on CDFG would further reduce state resources available to manage Pacific mackerel and sardine.

Effects on Endangered Species

Harvest policies in the current FMP are designed to maintain a forage reserve for endangered and biologically dependent species. Provisions in the anchovy FMP and draft CPS FMP protect the forage reserve by reducing fishing when the biomass of anchovy falls to moderate levels (300,000 mt) and by eliminating fishing mortality when the biomass falls to very low levels (75,000 mt). It is unlikely that regulation by the state of California would provide the same degree of protection to endangered species.

This option does not address any of the goals and objectives for the CPS FMP listed in the FMP.

1.3 Option 2: Status Quo

Under this option, Council would use the existing FMP for northern anchovy, without modification, to manage northern anchovy and not undertake additional responsibilities for management of CPS. NMFS responsibilities for anchovy management and CDFG responsibility for Pacific mackerel and sardine would continue. Assessment of sardine and mackerel stocks by CDFG could continue at present levels if NMFS continues to provide survey data and technical advice, although some erosion of management efforts might occur due to ongoing reduction in CDFG budgets.

This option does not address goals and objectives for sardine, mackerels or the CPS fishery as a whole. In addition, the existing optimum yield (OY) formula for anchovy leads to relatively low average catch levels, high interannual catch variance, low net benefits, and low average biomass levels. Thus, this option does not promote full utilization, efficiency and profitability, year-round fishing opportunities, maintain existing fishery segments, protect U.S. fishery investment, or achieve optimum yield in the anchovy fishery.

1.4 Option 3: Amend the Anchovy FMP

Under this option, Council would amend the existing FMP to address management of anchovy but undertake no additional responsibilities for other CPS. The basis for this option is bycatch, allocation and harvest formula options developed and analyzed for anchovy in the draft CPS FMP.

Most important among the provisions for amending the anchovy plan are new harvest formula options. In the current FMP, the optimum yield (OY) and quota for reduction fishing are calculated as either: 1) 100 percent of the spawning biomass in excess of 300,000 mt, when the spawning biomass is in excess of 300,000 mt, or 2) zero if the spawning biomass is less than 300,000 mt. The recommended option for amending the anchovy harvest formula would reduce the cutoff from 300,000 mt spawning biomass to 200,000 mt (or its equivalent value in total biomass at the beginning of the fishing season) and the fraction of the biomass used to calculate the quota from 100 percent to 25 percent. For example, the quota at 300,000 mt of spawning biomass would be (300,000–200,000) x 0.25 = 25,000 mt of which about 82 percent or 20,500 mt would be available in the US. In addition, the definition of overfishing would likely be changed from a two year criteria to a one year criteria (i.e. overfishing would occur whenever the stock biomass decreases to below 50,000 mt instead of when the stock biomass decreased to below 50,000 mt for two years in a row).

Benefits from this approach would accrue to several processors who convert anchovy to meal and the fishers who supply them. Fishery benefits might be significant if prices became large enough to make reduction or other large volume fishing profitable as a sideline activity (i.e. more than about \$50 mt^{-1}). For example, the additional exvessel revenue from 20,500 mt of additional catch at a spawning biomass of 300,000 mt would be \$1,025,000. In addition to fishery benefits, changing the harvest formula is expected to generate biological benefits because reducing the fraction from 100 percent to 25 percent should maintain higher biomass levels over the long term. Once the anchovy FMP is amended, costs to NMFS and CDFG under this option are equivalent to the status quo.

The biggest deficiency in this approach is that it does little to contribute to management of Pacific mackerel and sardine stocks which are more important economically than northern anchovy.

This option addresses goals and objectives as they apply to northern anchovy but does not address goals and objectives as they apply to other CPS. It does not address the goal of providing adequate forage for dependent species to the extent that sardine are important as forage.

1.5 Option 4: Develop an FMP for all CPS

The FMP for CPS is described and analyzed extensively in Appendix B to the FMP. Only the costs and main benefits and disadvantages are discussed here.

Consolidation of responsibilities for CPS under a single FMP would make management of directed fisheries and bycatch more efficient and effective. Management of all CPS under a single FMP would facilitate international management, scientific cooperation, data collection and exchange of data. Although joint management of CPS with Mexico is unlikely, scientific cooperation, data collection (surveys) in Mexican waters, and exchange of fishery data are important to management of fisheries in the U.S.

In the absence of an FMP for CPS, it is likely that scientific expertise and capability in NMFS will deteriorate to the point where collection of data and field studies are impaired. NMFS has informally agreed to continue assisting CDFG with management of CPS if an FMP for CPS is not implemented. Data collection and analysis programs in NMFS are at low but adequate levels but it appears that any additional loss of NMFS personnel would seriously undermine federal capabilities to conduct research and assist in management of CPS. Loss of NMFS involvement is likely given current budget constraints unless there are clear federal responsibilities in an FMP for management of the fishery.

There is a high probability for rapid development of CPS fisheries, particularly for sardine, that could not be managed effectively without an FMP and a limited entry program. 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. California could develop a limited entry plan unilaterally but vessels from other states could freely enter the fishery as long as fish were landed in Oregon, Washington or offshore.

NMFS could manage CPS under emergency authority if a crisis were to develop. While acting under emergency authority, NMFS can open or close a fishery to all vessels but cannot address allocation questions which may be paramount. An FMP provides a more comprehensive and effective approach that can handle all contingencies.

At the present time, neither NMFS nor CDFG have enough scientific or monitoring resources to manage CPS on their own but their combined resources are sufficient. An FMP would tend to maintain the level of federal involvement while making the most efficient use of combined federal and state resources.

Costs for implementing the CPS FMP are low relative to all alternatives, even if a license limitation system is adopted. Most of the costs in writing the plan have already been expended. The difference in cost between the status-quo (Option 1) and the FMP for CPS (Option 4) is only $149,000 and due to increasing the frequency of research surveys. If necessary, CPS could be managed with surveys conducted at current intervals. Thus, costs under the CPS FMP could approach status-quo costs if necessary.

Current regulations for northern anchovy prohibit reduction fishing at typical biomass levels. This problem could be addressed by amending the FMP for northern anchovy but the anchovy fishery is relatively unimportant economically and costs would be nearly the same as implementing a more comprehensive and effective FMP for all CPS.

Industry strongly supports an FMP and limited entry in the CPS fishery. Strong industry support is unusual and an important advantage in implementing an FMP with limited entry at this time.

It is likely that support among a large body of constituents for Council and federal fisheries management processes would slip if the CPS FMP is not implemented. It is well known that one of the NMFS science centers (the Southwest Fisheries Science Center) was built to specifically to address problems in the sardine fishery. In addition, the importance of sardine and anchovy as forage and bait for gamefish is well known and perceptions about adverse effects of large scale commercial fishing on gamefish are common.

An FMP for CPS would make it possible for federal authorities to better serve constituents. Fisheries in southern and central California, other than a minor fishery for northern anchovy and the groundfish fishery that operates primarily in northern areas, are not currently served by the Council or NMFS to a significant degree.

1.6 Detailed Cost Estimates for Management of CPS[2/]

Estimating costs of managing CPS requires a review at three levels of operation: (1) Administrative support, (2) Scientific support, and (3) Enforcement support. Added to all direct labor costs is an employer's surcharge, which is the estimated costs of NOAA's contribution for employee benefits (Southwest Region--24.1 percent, Southwest Fisheries Science Center--20.6 percent). Also added to all direct labor costs is a general support cost, which includes the assistant administrators, line office directors and their staffs, supervision and management support above the program operating level, and training that is not attributable to a single operational program (Southwest Region--67.1 percent, Southwest Fisheries Science Center--51.9 percent).

In making calculations, a GS/13-8 was used for supervisory positions, a GS/12.5 was used for staff positions, and a GS/6-4 was used for secretarial positions.

2/ Prepared by NMFS, Southwest Region.

1.6.1 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 costs are often underestimated, because there is no way to determine how difficult some issues may be; the ability to account for reflection and debate is limited. Estimates are more useful for comparing one option to another than for considering the costs of a single option in isolation.

Estimates are based on staff time to review and edit documents and perform tasks. Costs above the staff level are included in the overhead costs; therefore, the figures are an estimate of costs rather than time. This document does not address the question of whether there are enough personnel or enough personnel time available to complete tasks.

Annual Meeting of the Coastal Pelagics Species Management Team

An annual meeting is held with the advisors in Long Beach to review the annual biomass estimates. Pacific 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 already 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 team and two regional personnel, although all team members may not attend the meeting.

Travel of three people from La Jolla:

$.25/mile X 226 miles (round trip) X 2 trips = $113.00

La Jolla labor costs (includes driving time):

$23.71/hr X 8hrs X 2 meetings X 3 people = $1,138.08

Regional labor costs:

$23.71/hr X 4 hrs/meeting X 2 people/meeting X 2 meetings=$379.36

Advisory Subpanel Travel

Estimate of the annual cost of sending subpanel members to meetings is approximately $1,500.00. Most members are in southern California and some members may not attend.

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.

Labor cost of preparing initial harvest guidelines and quotas:

2hrs X $23.71/hr X 2 rules = $94.84

Labor cost of reviewing initial harvest guidelines and quotas (supervisor level):

1hr X $30.69/hr X 2 rules = $61.38

Secretarial costs (final documents plus copies):

1/3hrs X $11.68/hr X 2 rules = $7.79

Publication costs:

1 page X $375.00/page X 2 rules = $750.00

Labor cost of preparing final harvest guidelines and quotas:

2hrs X $23.71/hr X 2 rules = $94.84

Labor cost of reviewing final harvest guidelines and quotas (supervisor level):

1hr X $30.69/hr X 2 rules = $61.38

Secretarial costs (final documents plus copies):

1/3hrs X $11.68/hr X 2 rules = $7.79

Publication costs:

1 page X $375.00/page X 2 rules = $750.00

Labor cost of Central Office review of initial harvest guidelines and quotas:

3hrs X $23.71/hr X 2 rules = $142.26

Labor cost of Central Office review of final harvest guidelines and quotas:

3hrs X $23.71/hr X 2 rules = $142.26

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 mackerel. This has not been true for anchovy in the past; however, if a small harvest is permitted as proposed, a closure is likely. When Pacific mackerel abundance is high, closing the fishery has not been necessary, because the market has been limited. Nevertheless, the assumption here is that the fishery will be closed each year, as abundance is likely to remain low during the immediate future. What actions will be necessary for sardine are not known, although, here too, harvest is expected to keep pace with abundance during the immediate future.

Labor cost of preparing closure notice:

2hrs X $23.71/hr X 3 rules = $142.26

Labor cost of reviewing closure notice (supervisor level):

1/3hrs X $30.69/hr X 3 rules - $30.69

Secretarial costs:

1/3hrs X $11.68/hr X 3 rules = $11.68

Labor cost of Central Office review of closure notice:

2hrs X $23.71/hr X 3 rules = $142.26

Publication costs:

1 column X $375.00/page(3 columns) X 1/3 X 3 rules = $375.00

Changing Incidental Harvest Amounts

In each announced harvest guideline, a quantity is reserved to allow for an incidental harvest. If a harvest guideline 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 harvest guideline 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:

1hr/notice X $23.71/hr X 3 notices = $71.13

Labor cost of reviewing changes in catch rate (supervisor level):

1/3hr/notice X $30.69/hr X 3 notices = $30.69

Secretarial costs (final documents plus copies):

1/3hrs X 11.68/hr X 3 notices = $11.68

Publication costs:

1 column X $375.00/page(3 columns/page) X 3 notices = $375.00

Labor cost of Central Office review of changes in incidental catch rates:

1hr/notice X $23.71/hr X 3 notices = $71.13

Travel of NMFS Team Member and One NMFS Employee to Two Council Meetings

$390.00 (air fair and two days per diem, Portland) X 2 = $780.00

16hr(2 days) X $23.71/hr X 2 = $758.72

Coordination

There is a need to include a figure for labor to cover day to day operations of supporting a coastal pelagics plan.

2hr/week X 52 weeks X $23.71/hr = $2,465.84

Telephone = $500.00

Supplies = $500.00

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 coastal pelagics.

Scientific review of biomass estimates (anchovy, Pacific mackerel, sardine. Jack mackerel is a fixed quota.):

1hr/review X 3 reviews X 10 individuals x $23.71/hr = $711.30

Review time of the Council, Council staff, and others, which is assumed to be 1/10 of a Council meeting per year.

1/10 X $32,000.00 = $3,200.00

ADMINISTRATIVE SUPPORT CPS FMP

Direct Labor Costs	$9,778
Travel Costs	$2,393
Publication Costs	$2,250
Supplies	$500
Telephone	$500
Employer's Contribution Surcharge (24.1 percent)	2,356
NOAA Support (67.9 percent)	6,639
TOTAL	24,416

1.6.2 Scientific Support

CPS Sampling

Currently, CDFG conducts a sampling program for coastal pelagics under a grant from the Interjurisdictional Fisheries Act. The total cost of the project is given below; however, NMFS funds only seventy-five percent of the cost of the grant. If an FMP for coastal pelagics were implemented, NMFS most likely would either contract or issue a grant for port sampling as has been traditionally done for other fisheries on the Pacific Coast. This project provides basic biological data such as length, weight, age, sex, and maturity of coastal pelagics, as well as providing landings data and species composition.

The cost of this project is not included in the totals, because its existence is assumed to continue under all options. If the sardine population increases, additional funds will most likely be needed to expand port sampling.

Personnel costs:	$110,500.00		82,875.00
Fringe benefits:	$24,291.00		18,218.25
Travel:	$4,000.00		3,000.00
Supplies:	$3,400.00	X 75 percent =	2,550.00
Telephone:	$700.00		525.00
Training:	$600.00		450.00
Rent:	$15,725.00		11,793.75
Indirect Costs:	$35,330.00		26,497.50
	$194,546.00		145,909.50

*Each budget category above is multiplied by .75 to arrive at federal cost (ex. The federal cost of Personnel costs = $82,875).

Coastal Pelagics Assessment

This activity provides support for the biological, social, and economic assessment work needed to support a plan. This includes seventy-five percent of the time of one biologist and fifty percent of the time of one economist.

Personnel Costs:	$61,655.00
Travel:	2,000.00
Telephone:	700.00
Supplies:	500.00
Printing	500.00
	$65,355.00

$49,324.00 X 75 percent = $36,993
$49,324.00 X 50 percent = $24,662

Special Surveys

This activity provides the support for special surveys needed to obtain data on individual species. This may include extending the range of a normal survey or a special effort to determine spawning rates and fecundity. A special survey is assumed to be needed every five years; therefore, the annual cost is one-fifth of the total cost. This activity also includes a contract for fish-spotter data, which is used for an indices of abundance.

Personnel costs:	$60,000.00		=	$12,000.00
Travel:	1,000.00		=	200.00
Telephone:	700.00	/5yrs	=	140.00
Supplies:	3,000.00		=	600.00
	$64,700.00			12,940.00

Fish spotter survey contract: $27,000.00/yr
Ship time = 3 boats X 20 days X $11,000/day = $660,000.00
$660,000/5yrs = $132,000.00

SCIENTIFIC SUPPORT COASTAL PELAGICS FMP	
Direct Labor Costs	$73,655
Travel	$2,200
Telephone	$840
Supplies	$1,100
Contracts	$27,000
Ship time	$132,000
Printing	$500
Employer's Contribution Surcharge (20.6 percent)	$15,173
NOAA Support (51.9 percent)	$38,227
TOTAL	$290,695

1.6.3 Enforcement Support

For a limited entry system to be effectively regulated, the Enforcement Division would aim to board at least 25 percent of the vessels in the fleet annually. The estimates range from 40 agent-days to 120 agent-days. Sixty agent-days is assumed, because obtaining compliance with the regulations is not expected to be difficult.

The following estimate is based on a GS 7-5 pay grade for Los Angeles, which includes the enforcement agent's locality pay. No overtime pay is included, although overtime is a common expense in fisheries enforcement.

Vessel monitoring = 60 days X 8hrs/day X $19.37/hr	= $9,297.60
Travel	= $2,000.00
Telephone	= $100.00
Supplies	= $300.00

ENFORCEMENT SUPPORT	
Direct Labor Costs	$9,298
Travel	$2,000
Telephone	$100
Supplies	$300
Employer's Contribution Surcharge (24.1 percent)	$2,241
NOAA Support (67.9 percent)	$6,313
TOTAL	$20,252

1.6.4 Permit Costs

The coastal Pelagics FMP divides the fishing fleets into two basic categories, small volume harvesters and large volume harvesters. Generally, the small volume harvesters use a variety of gear and sell to fresh fish and other specialty markets. The large volume users use purse seines and primarily sell to canneries. The permit for small volume harvesters would limit harvests to 10 mt per trip, and the permit for large volume harvesters would limit harvests to 100 mt per trip. In this way, some control is exerted on harvesting capacity without trying to develop measures of carrying capacity or by attempting to control vessel length, attributes both of which are often difficult to administer. Vessels with small boat permits would not be allowed to convert to a large boat permit by buying up some multiple of small boat permits.

Another variable in harvesting capacity is the proposed inclusion of those gill net vessels eliminated by California Proposition 132 that wish to fish for coastal pelagics. These vessels would be assigned a conditional permit, which could be converted to a small vessel permit by meeting performance standards. How many vessel owners might wish to participate in this program is unknown; therefore only a rough estimate can be made. Vessels landing 1 mt or less of coastal pelagic species would not have to possess a limited entry permit. In view of the above, the number of vessels that would have to be issued permits is:

Small vessels:	60
Large vessels:	83
Proposition 132 vessels:	30[3/]
	173

Following is a summary of the costs incurred by implementing a limited entry program. This would be an added cost to a coastal pelagics plan if a limited entry program were implemented. The administrative costs of issuing permits could be recovered from the applicants, in which case the costs would be passed on to the fishermen. A permit would cost approximately $51.00, depending on the number of applicants and the method of allocating the costs of setting up a data base system,

Set up permit files on data base: 40hrs X $23.71/hr = $948.40

Maintain data base system: 1hr/month X $23.71/hr X 12 months = $284.52

Review application for completeness: 0.1hr/permit X 173 permits X $23.71/hr = $410.18

Return incomplete application (5 percent return rate): .17hr/permit X 9 permits X $23.71/hr = $36.28

Phone calls to verify information: .08hr/permit X 17 permits (173 X 10 percent) X $23.71/hr = $32.25

Check landings data to determine qualification: .25hr/permit X 173 permits X $23.71/hr = $1,025.40

Enter permit information in data base: .09hr/permit X 173 permits X $23.71/hr = $369.16

Print and mail permit: .09hr/permit X 173 permits X $23.71/hr = $369.16

Appeals: 26 vessels(15 percent X 173) X 1hr X 23.71/hr = $616.46
26 vessels X .5hr X $30.69/hr(supervisory time)=$398.97

3/ There are 142 potential gill and trammel net boats that may apply for permits; however, industry sources say that no more than 30 vessels would apply because of the costs of conversion and the unknown market for coastal pelagics. The actual number that might apply is uncertain.

PERMIT COSTS	
Set up and maintain database	$1,233
Reviewing applications	$479
Determining qualification	$1,025
Entering permit information	$369
Print and mailing permits	$369
Appeals	$1,015
Telephone	$120
Supplies	$100
Employer's Contribution Surcharge (24.1 percent)	$1,082
NOAA Support (67.9 percent)	$3,049
TOTAL	$8,841

1.7 Detailed Cost Estimates for Existing or Amended Anchovy Plans

Support for an amended anchovy plan is assumed to be the same as the original plan, although the amended plan would provide a small quota that might require slightly more administrative and enforcement work.

1.7.1 Administrative Support

Travel of three people from La Jolla:

$.25/mile X 226 miles (round trip) X 1 trip = $56.54

La Jolla labor costs (includes driving time):

$23.71/hr X 8hrs X 1 meeting X 3 people = $569.04

Regional labor costs:

$23.71/hr X 4 hrs/meeting X 2 people/meeting X 1 meeting = $189.68

Advisory Subpanel Travel

Estimate of the cost of sending subpanel members to meetings is approximately $750.00. Most members are in southern California and some members may not attend. The costs would be one-half the costs of those supporting a coastal pelagics plan.

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 There would be only one rule for the anchovy plan rather than two.

Labor cost of preparing initial harvest guidelines and quotas:

2hrs X $23.71/hr X 1 rule = $47.42

Labor cost of reviewing initial harvest guidelines and quotas (supervisor level):

1hr X $30.69/hr X 1 rule = $30.69

Secretarial costs (final documents plus copies):

1/3hrs X $11.68/hr X 1 rule = $3.90

Publication costs:

1 page X $375.00/page X 1 rule = $375.00

Labor cost of preparing final harvest guidelines and quotas:

2hrs X $23.71/hr X 1 rule = $47.42

Labor cost of reviewing final harvest guidelines and quotas (supervisor level):

1hr X $30.69/hr X 1 rule = $30.69

Secretarial costs (final documents plus copies):

1/3hrs X $11.68/hr X 2 rules = $3.90

Publication costs:

1 page X $375.00/page X 1 rule = $375.00

Labor cost of Central Office review of initial harvest guidelines and quotas:

3hrs X $23.71/hr X 1 rule = $71.13

Labor cost of Central Office review of final harvest guidelines and quotas:

3hrs X $23.71/hr X 2 rule = $71.13

Closing Fisheries

This estimate is based on the assumption that a notice of closure will have to be issued each year for anchovy. This has not been true in recent years; however, if a small harvest is permitted as proposed, a closure is likely.

Labor cost of preparing closure notice:

2hrs X $23.71/hr X 1 rule = $47.42

Labor cost of reviewing closure notice (supervisor level):

1/3hrs X $30.69/hr X 1 rule - $10.23

Secretarial costs:

1/3hrs X $11.68/hr X 1 rule = $3.89

Labor cost of Central Office review of closure notice:

2hrs X $23.71/hr X 1 rules = $47.42

Publication costs:

1 column X $375.00/page(3 columns) X 1/3 X 1 rules = $125.00

Changing Incidental Harvest Amounts

Incidental rates are not changed in the anchovy plan.

Travel of NMFS Team Member and One NMFS Employee to One Council Meetings

$390.00 (air fair and 2 days per diem, Portland) X 1 =$390.00

16hr(2 days) X $23.71/hr X 1 = $379.36

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 coastal pelagics.

Scientific review of the biomass estimate for anchovy:

1hr/review X 1 review X 10 individuals x $23.71/hr = $237.10

Review time of the Council, Council staff, and others, which is assumed to be 1/20 of a Council meeting per year.

1/20 X $32,000.00 = $1,600.00

ADMINISTRATIVE SUPPORT ANCHOVY FMP

Direct Labor Costs	$3,390
Travel Costs	$1,197
Publication Costs	$875
Supplies	$500
Telephone	$500
Employer's Contribution Surcharge (24.1 percent)	$817
NOAA Support (67.9 percent)	$2,302
TOTAL	$10,398

1.7.2 Scientific Support

It is assumed that port sampling of coastal pelagics will continue as a task of CDFG funded by the Interjurisdictional Fisheries Act.

Coastal Pelagics Assessment

This activity provides support for the biological, social, and economic assessment work needed to support a plan. This includes twenty-five percent of the time of one biologist and seventeen percent of the time of one economist.

Personnel costs:	$20,716.00
Travel:	$2,000.00
Telephone:	$700.00
Supplies:	$500.00

Printing	$500.00
	$24,416.00

$49,324.00 X 25 percent = $12,331.00
$49,324.00 X 17 percent = $ 8,385.00

Special Surveys

A special survey is assumed to be conducted every eight years (the actual frequency since 1986). This activity also includes a contract for fish-spotter data, which is used for indices of abundance.

Personnel costs:	$60,000.00		=	$7,500.00
Travel:	1,000.00		=	125.00
Telephone:	700.00	/8yrs	=	88.00
Supplies:	3,000.00		=	375.00
	$64,700.00			$8,088.00

Contract: $27,000.00/yr
Ship time = 3 boats X 20 days X $11,000/day = $660,000.00
$660,000/8yrs = $82,500.00

SCIENTIFIC SUPPORT ANCHOVY FMP

Direct Labor Costs	28,216
Travel	2,125
Telephone	788
Supplies	875
Printing	500
Contracts	27,000
Ship time	82,500
Employer's Contribution Surcharge (20.6 percent)	5,812
NOAA Support (51.9 percent)	14,644
TOTAL	162,460

1.7.3 Enforcement Support

Enforcement costs are estimated at the lowest level, which is 40 agent-days. Presently, this also is an overestimate, because no reduction quota exists.

vessel monitoring = 40 days X 8hrs/day X $19.37/hr	=$6,198.40
Travel	= $1,000.00
Telephone	= 50.00
Supplies	= 300.00

ENFORCEMENT SUPPORT ANCHOVY FMP	
Direct Labor Costs	$6,198
Travel	$1,000
Telephone	$50
Supplies	$300
Employer's Contribution Surcharge (24.1 percent)	$1,494
NOAA Support (67.9 percent)	$4,208
TOTAL	$13,250

1.8 Summary Tables

The total costs for the coastal pelagics plan includes estimated permit costs of $8,841.00.

TOTAL COSTS ANCHOVY FMP	
Administrative Support	$10,398
Scientific Support	$162,460
Enforcement Support	$13,250
TOTAL	$186,108

TOTAL COSTS CPS FMP	
Administrative Support	$24,416
Scientific Support	$290,695
Enforcement Support	$20,252
TOTAL	**$335,363**

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