UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, Maryland 20910

DEC 5 1990

MEMORANDUM FOR: Distribution*

FROM: Joe P. Clem
Chief, Plans and Regulations Division

SUBJECT: Review of Amendment 6 to the Northern Anchovy Fishery Management Plan

Attached is a copy of Amendment 6 to the Northern Anchovy Fishery Management Plan (FMP). The Pacific Fishery Management Council has submitted this amendment for Secretarial review.

Amendment 6 defines overfishing in compliance with the 50 CFR Part 602 national standards guidelines, addresses the habitat and vessel safety requirements of Public Law 99-659, and requires that all fishing under U.S. jurisdiction cease when the spawning biomass is below 50,000 mt for two succeeding years.

Please provide your comments by January 25, 1991, and direct inquiries to Joanna Flanders at (301) 427-2343.

Attachment

*Distribution

F/CM - Schaefer, Crestin, Hochman
F/CM1 - Blatt, Fricke
F/CM2 - Clem, Leedy, Miller
F/CM3 - Parsons
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GCEL - Kraniotis
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N/ORM3 - Cousins
CS/ES - Cottingham
OGC - Malone
GC - Campbell, Johnson
OMB - Minsk
SBA - Hankins
F/PR2 - Karnella
F/PR3 - Gallagher
F/RE1 - Holliday
F/RE3 - Meehan
F/RE - Everett

SIXTH AMENDMENT

TO THE

NORTHERN ANCHOVY FISHERY MANAGEMENT PLAN

Incorporating the Environmental Assessment,
Regulatory Impact Review/Initial Regulatory Flexibility Analysis
and
Requirements of Other Applicable Law

Pacific Fishery Management Council
Metro Center, Suite 420
2000 SW First Avenue
Portland, Oregon 97201

NOVEMBER 1990

ACKNOWLEDGEMENTS

This revision (Amendment Number 6) of the Northern Anchovy Fishery Management Plan was prepared by the Anchovy Plan Development Team of the Pacific Fishery Management Council for consideration by the Secretary of Commerce.

Anchovy Plan Development Team

Richard Klingbeil (Chairman), California Department of Fish and Game
Cynthia Thomson, National Marine Fisheries Service
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ES.0 EXECUTIVE SUMMARY

ES.1 Background and Current Management Regime

The central subpopulation of northern anchovy ranges from approximately San Francisco, California to Punta Baja, Baja California. The subpopulation is harvested by both U.S. and Mexican fisheries. The harvests are used: (1) for reduction to meal and oil; (2) as live bait in recreational fisheries; and (3) for other non-reduction uses, largely as dead bait and pet food. Anchovy are subject to predation in all of their life stages by numerous marine fishes, mammals and birds, including the endangered California brown pelican.

The central subpopulation is the management unit for the "Northern Anchovy Fishery Management Plan". The FMP was approved by the Council in June 1978 and was implemented by the Secretary of Commerce on September 13, 1978. The FMP was most recently amended in 1983. Current regulations impose no numeric limit on live bait catch and provide a 7,000 mt quota for other non-reduction uses. The regulations also specify an OY for the reduction fishery of (1) 0 when the spawning biomass is less than or equal to 300,000 mt, and (2) the difference between the spawning biomass and 300,000 mt, up to a limit of 200,000 mt, when the spawning biomass is greater than 300,000 mt.

The biological rationale for the 300,000 mt threshold is to prevent depletion of the resource and to provide an adequate forage reserve for marine fishes, mammals, and birds. Implicit in this approach is the judgment that relatively small catches (for non-reduction uses) can be allowed when the spawning biomass is below 300,000 mt without significantly impacting the resource's long-term reproductive potential.

ES.2 Issues and Need for Amendment

At its April 1990 meeting, the Council made the following recommendations that:

1. the OY formula in the current FMP be amended to allow a small reduction fishery when the spawning biomass falls below 300,000 mt. This action was a follow-up to an emergency rule allowing a modest reduction quota in the 1989/1990 season despite a spawning biomass of 214,000 mt (which would normally result in no quota for the reduction fishery). The rationale for the rule was that a small reduction harvest in 1989/1990 would pose no danger to the stock because total biomass, in contrast to spawning biomass, was thought to be high. Spawning biomass was low during 1989/1990 despite the high level of total biomass, due to unusually cold water temperatures during the spawning season.

2. overfishing be defined as any harvests in excess of OY, where OY is determined according to the harvest formula in the FMP. This action was taken to comply with recently revised guidelines for National Standard 1 of the Magnuson Fishery Conservation and Management Act.

The Council submitted its analysis and recommendations for the "Sixth Amendment to the Northern Anchovy Fishery Management Plan" (dated April 1990) to NMFS in Washington, DC. NMFS returned the document with the requests that the Council:

1. reconsider its recommendation regarding the definition of overfishing; and

2. satisfy Public Law 99-659, which requires all plans and amendments submitted to the Secretary of Commerce after January 1, 1987 to: (a) include readily available information regarding the effect of habitat on the fishery, and (b) consider and, if necessary, provide for temporary adjustments for access to the fishery by vessels who are prevented from harvesting due to unsafe weather conditions.

This document augments and modifies the Council's original analysis and recommendations by:

1. expanding the range of options for the definition of overfishing; and

2. providing the necessary information to satisfy the habitat and vessel safety provisions of Public Law 99-659.

ES.3 Habitat Requirement of Public Law 99-659

Section 3.0 of the amendment summarizes available information regarding the geographic range of the population, water temperature and water quality requirements of juvenile and adult fishes, and necessary conditions for larval survival.

ES.4 Vessel Safety Requirement of Public Law 99-659

Regulations limiting participation in the reduction fishery include a quota system and summer and nearshore closures. A separate non-reduction quota limits participation in the non-reduction fishery (other than live bait). The Council examined the plausibility of four different scenarios pertaining to the effect of these regulations on vessel safety.

Available evidence indicates that the FMP does not pose any extraordinary risks to vessel safety. The anchovy fisheries have historically not been competitive and the reduction and non-reduction quotas have seldom been exhausted. Weather is only one of several factors limiting fishing activity in the winter/spring months. Availability and oil content of anchovy and the demand for bait by the recreational fishery tend to decline during months when weather tends to be inclement. For these reasons, formal procedures for adjusting regulations to encourage vessel safety are not warranted at this time.

ES.5 Specification of Options

The Council considered three options for amending the reduction OY formula and three options for the definition of overfishing.

ES.5.1 Reduction OY Options

The three reduction OY options are as follows:

1. Status Quo. Status quo involves no modification to the current FMP and OY formulas. Under this option, the reduction OY is: (a) 0 when the spawning biomass is less than or equal to 300,000 mt, and (b) the difference between the spawning biomass and 300,000 mt, up to a limit of 200,000 mt, when the spawning biomass is greater than 300,000 mt.

2. Unconditional Option. Under the unconditional option, the reduction OY is: (a) 7,000 mt when the spawning biomass is less than or equal to 307,000 mt, and (b) the difference between the spawning biomass and 300,000 mt, up to a limit of 200,000 mt, when the spawning biomass is greater than 307,000 mt.

3. Conditional Option. Under the conditional option, the reduction OY depends on the level of total, as well as spawning biomass. Under this option, the reduction OY formula is: (a) the same as the status quo formula when total biomass is less than 375,000 mt, and (b) the same as the unconditional option formula when total biomass is greater than or equal to 375,000 mt. The conditional option is meant to provide the reduction fishery with a small quota when unusual circumstances similar to those in 1989/1990 prevail (i.e., high total biomass but low spawning biomass). This option is a hybrid of the status quo and conditional options. It is less restrictive than the status quo but more restrictive than the unconditional option.

ES.5.2 Overfishing Options

The three overfishing options are as follows:

1. No-Lower-Cutoff Option. The no-lower-cutoff option defines overfishing as any harvest in excess of OY, where OY is determined according to the harvest formula in the FMP. It allows unlimited live bait harvests and a 7,000 mt quota for other non-reduction uses, regardless of the level of spawning biomass. Its effect on the reduction fishery at low levels of abundance will depend on which reduction OY option is chosen. If status quo is chosen, the no-lower-cutoff option will disallow all reduction fishing when the spawning biomass is less than or equal to 300,000 mt. If the unconditional option is chosen, it will allow a 7,000 mt reduction harvest when the spawning biomass is less than or equal to 307,000 mt. If the conditional option is chosen, it will: (a) disallow all reduction fishing when the spawning biomass is less than or equal to 300,000 mt and total biomass is less than 375,000 mt, and (b) allow a 7,000 mt reduction harvest when the spawning biomass is less than or equal to 307,000 mt and total biomass is greater than or equal to 375,000 mt.

2. Lower-Cutoff Option. The lower-cutoff option defines overfishing as harvests of any kind during seasons when the spawning biomass falls below 50,000 mt. Unlike the no-lower-cutoff option, this option disallows all fishing (for reduction, live bait and all other non-reduction uses) during seasons when the spawning biomass is less than 50,000 mt.

3. Two-Year Lower-Cutoff Option. The two-year-lower-cutoff option defines overfishing as harvests of any kind when the spawning biomass during the current and preceding season was less than 50,000 mt. Under this option, 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 2 consecutive seasons, and the closure continues in subsequent seasons until the spawning biomass equals or exceeds 50,000 mt.

ES.5.3 Combining Reduction OY and Overfishing Options

The reduction OY options and overfishing options were combined to yield a total of nine options (Table ES.5-1). Options 1 through 3 are combinations of the status quo, conditional and unconditional reduction quota options with the no-lower-cutoff option for overfishing. Options 1L through 3L are combinations of the three reduction quota options with the lower-cutoff option for the definition of overfishing. Options 1L* through 3L* are combinations of the three reduction quota options with the two-year-lower-cutoff option for the definition of overfishing.

ES.6 Summary of Impacts

ES.6.1 Biological/Economic Impacts

A simulation model was used to analyze the long-term effects of each of the options on total biomass, reduction catch and profit, frequency of reduction fishery closures, and breeding success of brown pelicans. The effects of the various options on these variables were virtually identical. Several factors contributed to this outcome:

1. The simulation results and economic analysis suggest that reduction fishing becomes unprofitable at low levels of biomass (i.e., that economic constraints tend to protect the stock from overfishing by the reduction fleet when biomass is low). Thus, the largest component of the potential total catch (i.e., the reduction harvest) is eliminated at low levels of spawning biomass. This general picture is consistent with the history of the reduction fishery during recent years when harvests have been low due to low ex-vessel prices.

2. Unlike the reduction fishery, the non-reduction fisheries are potentially profitable even at low levels of abundance. However, spawning biomass levels below 50,000 mt occurred very infrequently in the course of the simulations, so the potential effect of modest non-reduction harvests at low levels of biomass was not well represented in the results.

Additional simulations were run in order to determine the possible effects of a 50,000 mt spawning biomass cutoff for all fishing. This analysis focussed on the time it would take for the stock to recover from low levels of spawning biomass to 300,000 mt under Options 1, 1L, and 1L*. Mean time to recovery was 7.9 years for Options 1L and 1L* and 8.6 years for Option 1, a difference of 0.7 years. In other words, the results suggest that it would take 0.7 fewer years, on average, for the stock to recover from 25,000 mt to 300,000 mt with a lower cutoff under Options 1L and 1L* than without a lower cutoff under Option 1.

These results appear to be supported by historical data, which indicate that the stock was able to rebound from low levels of abundance in the mid-1950s, despite annual harvests of 25,000 to 30,000 mt. It should also be noted, however, that the parameters in the simulation model were estimated from data for 1964-1985, which were medium to high biomass years (Jacobson and Thomson 1989). Thus, the estimates of mean recovery times are extrapolations and possibly unreliable. The true difference in mean recovery times with and without a 50,000 mt cutoff may be larger.

Although biological effects and economic effects on the reduction fishery appear to be the same for all options, the lower-cutoff options for the definition of overfishing (Options 1L through 3L and 1L* through 3L*) could have an adverse economic impact on the non-reduction fleet and recreational fishery in low

Table ES.5-1. Summary of options. The maximum reduction OY for all options is 200,000 mt. All figures expressed in mt. Abbreviations "SB" used for spawning biomass, "TB" for total biomass, and "K" for thousands.[a/]

		OY		
Option	Conditions	Reduction	Live Bait	Other Non-Reduction
Reduction quota options combined with no-lower-cutoff option for the definition of overfishing:				
1. Status Quo	SB≤300K	0	Unlimited	7K
	SB>300K	SB-300K	Unlimited	7K
2. Unconditional	SB≤307K	7K	Unlimited	7K
	SB>307K	SB-300K	Unlimited	7K
3. Conditional	TB≥375K and			
	SB≤307K	7K	Unlimited	7K
	SB>307K	SB-300K	Unlimited	7K
	TB<375K and			
	SB≤300K	0	Unlimited	7K
	SB>300K	SB-300K	Unlimited	7K
Reduction quota options combined with lower-cutoff option for the definition of overfishing:				
1L. Status Quo	SB<50K	0	0	0
	50K≤SB≤300K	0	Unlimited	7K
	SB>300K	SB-300K	Unlimited	7K
2L. Unconditional	SB<50K	0	0	0
	50K≤SB≤307K	7K	Unlimited	7K
	SB>307K	SB-300K	Unlimited	7K
3L. Conditional	TB≥375K and			
	SB<50K	0	0	0
	50K≤SB≤307K	7K	Unlimited	7K
	SB>307K	SB-300K	Unlimited	7K
	TB<375K and			
	SB<50K	0	0	0
	50K≤SB≤300K	0	Unlimited	7K
	SB>300K	SB-300K	Unlimited	7K

Table ES.5-1. Summary of options (continued).

Option	Conditions	OY Reduction	OY Live Bait	OY Other Non-Reduction
Reduction quota options combined with two-year-lower-cutoff option for the definition of overfishing:				
1L*. Status Quo	SB<50K (2nd season)	0	0	0
	SB<50K (1st season)	0	Unlimited	7K
	50K≤SB≤300K	0	Unlimited	7K
	SB>300K	SB-300K	Unlimited	7K
2L*. Unconditional	SB<50K (2nd season)	0	0	0
	SB<50K (1st season)	7K	Unlimited	7K
	50K≤SB≤307K	7K	Unlimited	7K
	SB>307K	SB-300K	Unlimited	7K
3L*. Conditional	TB≥375K and			
	SB<50K (2nd season)	0	0	0
	SB<50K (1st season)	7K	Unlimited	7K
	50K≤SB≤307K	7K	Unlimited	7K
	SB>307K	SB-300K	Unlimited	7K
	TB<375K and			
	SB<50K (2nd season)	0	0	0
	SB<50K (1st season)	0	Unlimited	7K
	50K≤SB≤300K	0	Unlimited	7K
	SB>300K	SB-300K	Unlimited	7K

a/ Reduction and non-reduction quotas for U.S. fishermen are 70 percent of the figures shown for "Reduction" and "Other Non-Reduction" fishing.

biomass years. Anchovy are the major source of bait for the recreational fishery; the next best substitute is sardines. The sardine population, however, collapsed in the early 1950s and has only recently shown signs of recovery. Therefore, sardines are currently not available in sufficient quantities to serve as a substitute for anchovy as bait, and the timetable for their recovery is highly uncertain at this time.

ES.6.2 Administrative Implications

Implementation of each of the nine options requires that spawning biomass, or spawning biomass and total biomass, be estimated annually. Costs of biomass estimation are expected to be the same for all nine options.

Monitoring of reduction and non-reduction landings, as required by the FMP, is accomplished via landings receipts, which are provided by fish processors to the California Department of Fish and Game. Because the State of California uses these receipts as the basis for its "use tax" on commercial landings, this recordkeeping requirement would continue even in the absence of the FMP. None of the options considered in this amendment adds to this paperwork burden or imposes any additional compliance costs on the fishing industry.

The costs to the government of monitoring reduction and non-reduction (other than live bait) landings are expected to be the same for all options. Options 1L through 3L and 1L* through 3L*, however, impose additional responsibilities with regard to monitoring live bait catch when the spawning biomass is less than or equal to 50,000 mt. Unless closure of all fisheries under Options 1L through 3L and 1L* through 3L* is accompanied by specification of an incidental catch allowance for anchovies in other fisheries, the possibility of substituting other baits for anchovies when anchovy biomass is low would be limited. This is because anchovy are usually taken incidentally during fishing for other species that might be used as bait. In this regard Options 1L*-3L* provide a practical advantage over Options 1L through 3L in that a spawning biomass estimate less than 50,000 mt in a given season could be used to trigger preparations (e.g., analyses used to specify incidental catch allowances) for possible closure in the following season.

Monitoring and enforcing incidental catch allowances would be difficult since it would require sampling of catches that are alive and highly motile. Accurate estimation of incidental take may not be possible without causing some mortality to the fish in baitwells and receivers.

ES.7 Absence of Bilateral Management Agreement

Although the central subpopulation of northern anchovy is a transboundary stock, there is no bilateral agreement between the U.S. and Mexico regarding its management. The FMP addresses the issue of unilateral management by specifying OY for the stock as a whole, then allocating 70 percent of it to the U.S. and 30 percent to Mexico. The allocation formula is based on the observation that 70 percent of anchovy larvae (and presumably, the spawning biomass) during 1951-1975 were found in U.S. waters. Because Mexico is not bound by this formula, it is possible that combined U.S. and Mexican harvests will exceed OY in some years. This may have the effect of decreasing the stock level and total OY in subsequent years.

ES.8 Recommended Options

ES.8.1 Reduction OY Formula

The Council has deferred the final decision on this issue until the U.S. Fish and Wildlife Service issues a revised opinion, pursuant to formal consultation with NMFS under Section 7 of the Endangered Species Act, as to how the unconditional option (i.e., 7,000 mt reduction OY when the spawning biomass is less than 300,000 mt) would affect brown pelicans (see Section 2.3). In the interim, the Council recommends no modification to the existing OY formula (i.e., the status quo option). Under the status quo option, reduction OY is (a) 0 when the spawning biomass is less than or equal to 300,000 mt and (b) the difference between the spawning biomass and 300,000 mt, up to a limit of 200,000 mt, when the spawning biomass is greater than 300,000 mt. The status quo is the most conservative of the options considered and provides ample protection for the anchovy stock and brown pelicans.

ES.8.2 Definition of Overfishing

The preponderance of evidence from the simulation model and from historical data suggests that the least restrictive no-lower-cutoff option for the definition of overfishing is sufficiently conservative to protect the stock from overfishing. The modest reduction and non-reduction harvests that would occur at low levels of spawning biomass are not expected to significantly affect the stock's ability to rebound from low levels of abundance. The Council, however, is aware that: (1) the simulation model was parameterized with data from medium- to high-biomass years so that results for low biomass years may be unreliable, and (2) the ability of the stock to rebound from low levels in the 1950s may have been partially due to favorable environmental conditions that may not exist in the future. Thus, modest harvests when biomass levels are low may, despite the results of analyses described above, have adverse effects on the long-term productivity of the stock. In view of these uncertainties, the Council recognizes the desirability of a definition of overfishing that curtails all fishing at low levels of spawning biomass.

The Council also recognizes: (1) the relative imprecision with which spawning biomass in the most recent season is estimated in the absence of an EPM measurement and/or when spawning biomass is low, (2) enforcement problems and adverse economic effects associated with curtailing the live-bait fishery for anchovy, and (3) similarity in the expected biological and economic effects of the lower-cutoff and two-year-lower-cutoff options.

An advantage of the two-year-lower-cutoff option is that a spawning biomass estimate less than 50,000 mt in the first season could be used to: (1) trigger preparations (e.g., analyses used to specify incidental catch allowances, see Section 8.4.2) for possible closure in the second season and (2) improve data collection and spawning biomass estimation procedures prior to making the spawning biomass estimate that might result in closure during the second season. Another advantage of the two-year-lower-cutoff option relative to the lower-cutoff option is reduced likelihood that the fishery would be closed due to a single erroneous or imprecise spawning biomass estimate.

Given the desirability of a cutoff, the enforcement and economic problems associated with a cutoff, apparent similarity of the lower-cutoff and two-year-lower-cutoff options, and other advantages, the Council recommends adoption of the two-year-lower-cutoff for the definition of overfishing.

1.0 CONTENTS AND SPECIAL INDEXES

1.1 Table of Contents

1.2 Index for Use as Environmental Assessment

1.3 Index for Use as Regulatory Impact Review

1.4 Definition of Acronyms

CalCOFI	California Cooperative Oceanic Fisheries Investigations
CDFG	California Department of Fish and Game
Council	Pacific Fishery Management Council
EA	Environmental Assessment
EEZ	exclusive economic zone
EPM	egg production method
FMP	fishery management plan
IRFA	Initial Regulatory Flexibility Analysis
MFCMA	Magnuson Fishery Conservation and Management Act
mt	metric tons
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OY	optimum yield
RIR	Regulatory Impact Review

2.0 ISSUES AND NEED FOR AMENDMENT

2.1 Reduction Quota at Low Levels of Spawning Biomass

The spawning biomass of northern anchovy (Engraulis mordax) during February 1989 was estimated to be 237,000 metric tons (mtons). In contrast, total biomass during February 1989 was estimated to be 1,008,000 mt. The unusually large discrepancy between spawning and total biomass estimates (Table 2.1-1) was attributed to the effect of unusually cold water temperatures during the peak spawning period on the sexual maturity of one-year-old fish (Jacobson and Lo 1989).

Currently, the Northern Anchovy Fishery Management Plan requires that the anchovy reduction fishery be closed when the spawning biomass falls below 300,000 mt. Because of the high level of total biomass, however, the Scientific and Statistical Committee of the Council concluded that a modest domestic reduction fishery during the 1989/1990 season would produce no significant adverse effect on anchovy abundance. Therefore, the Council requested and the Department of Commerce approved an emergency rule allowing a domestic reduction harvest of 5,000 mt in the 1989/1990 season. The rule, which was to be effective from September 25, 1989 to December 23, 1989, was published in the Federal Register on September 29, 1989. An extension was later granted until March 23, 1990. The Council decided to follow up on this emergency rule with an amendment to the FMP.

2.2 Definition of Overfishing

National Standard 1 of the MFCMA states that "Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry." Revision of the guidelines for National Standard 1 was precipitated, in part, by recommendations from the NOAA Fishery Management Study. A series of workshops, draft revisions, and public comment periods followed, resulting in publication of the revised National Standard in the Federal Register on July 24, 1989, effective August 23, 1989.

In order to assure that Councils give appropriate consideration to long-term reproductive potential of fish stocks, the revised guidelines require each existing and future plan to specify, to the maximum extent possible, an objective and measurable definition of overfishing, with an explanation of how the definition was determined and how it relates to biological potential. The intended effect of the revised guidelines is to assure that the long-term reproductive capacity of managed stocks is not jeopardized, that depleted stocks are rebuilt, and that the possibility for economically viable harvests is maintained.

The guidelines require that a definition of overfishing be prepared as an amendment to all existing plans and submitted to the Secretary of Commerce on or before November 23, 1990. The Council decided to address this requirement at the same time as the amendment to allow a small reduction fishery when the spawning biomass falls below 300,000 mt.

2.3 Current Status of Amendment

At its April 1990 meeting, the Council adopted recommendations that: (1) provide a 7,000 mt quota to the reduction fishery when the spawning biomass falls below 300,000 mt and (2) define overfishing as any harvest in excess of OY, where OY is determined according to the harvest formula in the FMP.

The Council submitted its analysis and recommendations for the Sixth Amendment to the Northern Anchovy Fishery Management Plan (dated April 1990) to NMFS in Washington, DC in May 1990. After reviewing the document, NMFS returned the amendment with the request that the Council:

1. reconsider its recommendation regarding the definition of overfishing; and
2. satisfy provisions of Public Law 99-659.

Public Law 99-659, which became effective in November 1986, requires that all plans and amendments submitted to the Secretary of Commerce after January 1, 1987:

1. "include readily available information regarding the significance of habitat to the fishery and assessment as to the effects which changes to that habitat may have upon the fishery," and

2. consider and, if necessary, provide for "temporary adjustments, after consultation with the U.S. Coast Guard and persons utilizing the fishery, regarding access to the fishery for vessels otherwise prevented from harvesting because of weather or other ocean conditions affecting the safety of the vessels."

In accordance with the advice provided by NMFS, the Council's analysis and recommendations were augmented and modified in a revised Amendment 6 to the Anchovy Fishery Management Plan (dated August 1990) by:

1. expanding the range of options for the definition of overfishing; and
2. providing the necessary information to satisfy the habitat and vessel safety provisions of Public Law 99-659.

At its July 1990 meeting, the Council was informed that the U.S. Fish and Wildlife Service did not concur with NMFS opinion that Amendment 6 to the Northern Anchovy Fishery Management Plan posed no threat to brown pelicans (an endangered species whose principal forage is anchovies). NMFS therefore requested a formal consultation with the U.S. Fish and Wildlife Service under Section 7 of the Endangered Species Act. NMFS provided U.S. Fish and Wildlife Service with all relevant information and a meeting between U.S. Fish and Wildlife Service, NMFS, and Council representatives was organized.

U.S. Fish and Wildlife Service issued its opinion on October 23, 1990 in a letter addressed to the Regional Director, Southwest Region, NMFS which stated that Amendment 6 did not jeopardize the continued survival of brown pelicans, a so-called "no jeopardy" opinion.

In addition to prohibiting actions that jeopardize the continued survival of endangered species, Section 9 of the Endangered Species Act prohibits any "incidental take" which is defined to include actions that significantly impair behavioral patterns such as breeding and feeding. The October 23, 1990 opinion by U.S. Fish and Wildlife Service anticipated that an unquantifiable level of incidental take would occur under the proposed Amendment 6 and outlined a number of nondiscretionary steps to be undertaken by the Council and NMFS in order to minimize potential problems. U.S. Fish and Wildlife Service concern about incidental take arose from the Council's intention to adopt: (a) the unconditional option for determining reduction OY at low levels of spawning stock biomass and (b) the two-year-lower-cutoff option for the definition of overfishing. As described in Section 7.0, the unconditional option for determining reduction OY would allow an additional 7,000 mt of harvest at low levels of spawning biomass and the two-year-lower-cutoff option for the definition of overfishing would close all fisheries if the estimated spawning biomass fell below 50,000 mt for two years in a row. According to the October 23, 1990 opinion issued by U.S. Fish and Wildlife: (a) increased harvests at low levels of spawning biomass that might result from the unconditional option for determining reduction OY could delay recovery of the anchovy biomass to levels that would allow successful reproduction by brown pelicans and (b) the 50,000 mt cut-off level for all fishing was too low because low levels of spawning biomass are difficult to measure and because of the length of time necessary for the anchovy biomass to recover in the presence of fishing from 50,000 mt to levels that would allow successful reproduction by brown pelicans. In addition, concern about the lack of EPM measurements for spawning biomass estimates in recent years was expressed (see Section 8.3).

In a subsequent letter to the Regional Director, Southwest Region, NMFS dated October 31, 1990, U.S. Fish and Wildlife Service rescinded the incidental take section of its October 23 opinion so that the issue could be reanalyzed and opinion revised. As of October 31, 1990, therefore, the U.S. Fish and Wildlife Service opinion was officially one of no jeopardy. A revised opinion had not been prepared by the U.S. Fish and Wildlife Service prior to the Council's meeting in November and the November 23 deadline for submission of a definition of overfishing to the Secretary of Commerce.

In view of the approaching deadline for submission of a definition of overfishing, the Council decided at its meeting in November to proceed with adoption of a definition of overfishing but to defer a final decision on the reduction OY formula until after the U.S. Fish and Wildlife Service issued a revised opinion. This decision is discussed further in Sections 9 and ES.8.1.

3.0 HABITAT INFORMATION REQUIREMENTS OF PUBLIC LAW 99-659

3.1 Biological Information

This section summarizes available information regarding the habitat requirements of northern anchovy. A more detailed account is contained in Sections 3.1 and 4.2 of Amendment 5 to the Northern Anchovy Fishery Management Plan (Council 1983).

3.1.1 Geographic Range and Relationship to Marine Ecosystem

The population of northern anchovy is distributed from the Queen Charlotte Islands, British Columbia to Magdalena Bay, Baja California. The population is divided into northern, central and southern subpopulations. The central subpopulation, which is the management unit of the Northern Anchovy Fishery Management Plan, ranges from approximately San Francisco, California 38°N to Punta Baja, Baja California 30°N. The bulk of the central subpopulation is located in the Southern California Bight, an approximate 20,000 square nautical mile area bounded by Point Conception, California in the north and Point Descanso, Mexico in the south. The subpopulation is harvested by both U.S. and Mexican fisheries.

Anchovy is subject to natural predation throughout all of its life stages: egg, larval, juvenile, adult. Anchovy eggs and larvae, as part of the zooplankton complex, fall prey to an assortment of invertebrate and vertebrate planktivores, including adult anchovies. 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 marine fishes (some of which have recreational and commercial value), mammals, and birds (including the endangered California brown pelican Pelecanus occidentalis californicus). Anderson etal. (1980) and Anderson etal. (1982) document a link between brown pelican breeding success and anchovy abundance. In general, however, very little is known about the actual quantities of anchovy consumed or the percentage of anchovies in predator diets relative to other forage species.

3.1.2 Habitat Requirements

The northern anchovy is an epipelagic species although it has been observed at depths of 300 meters. Adults tend to remain relatively offshore. Juveniles are often found close inshore, in shallow waters, and in estuaries, as well as offshore. As is common among clupeoids, the range of the central subpopulation expands and contracts with population size.

Adult anchovies have been regularly observed off southern California in waters where surface temperatures range from 12 to 20°C. There is some evidence that anchovies tend to avoid high surface temperatures by remaining deeper in the water column, as demonstrated by the anomalous conditions in November 1976 (Mais 1976). The lower lethal temperature for adult northern anchovy was 7°C in laboratory acclimation tests, while temperatures below 10°C were lethal to developing larvae (Brewer 1976). Spawning usually occurs in temperatures between 12 and 15°C, which are typical during late winter.

Information regarding the water quality requirements and preferences of anchovy is largely anecdotal. Oxygen depletion has caused occasional fish kills in both Santa Cruz Harbor and Fish Harbor at Terminal Island, Los Angeles. In 1973-1974, oxygen depletion due to die-off of massive dinoflagellate blooms caused fish kills in Fish Harbor, as well as other locations in coastal waters. Anchovies often congregate around areas of sewage outfall, such as White's Point off Palos Verdes Peninsula, and formerly, around the outfalls of the Terminal Island fish processors and sewage treatment plant, where dumping of wastes results in attractive food supplies for anchovies. Fish catches by commercial partyboats decreased dramatically off the Orange County Sanitation District outfall after conversion to a deep water outlet (Soule and Oguri 1982, p. 373).

The impacts of cannery and sewage waste on anchovy have been studied extensively only in the Los Angeles Harbor area. In this case, anchovy reduction processing was only one of the various fishery products contributing to canner effluent. Cannery wastes for many years were dumped into Inner Fish Harbor along with pumpings from boat holds and human wastes. The waters were frequently anoxic and the debris-laden bottom was devoid of benthic microorganisms.

In 1964, two cannery discharges were relocated outside Fish Harbor in Los Angeles Harbor not far from the sewage treatment outfall (Soule and Oguri 1973, p. 7). The discharge of cannery wastes is most critical during the fall of the year when seasonal die-off of biota from late summer and early fall plankton blooms and water column turnover place a heavy natural oxygen demand on the receiving waters (Chamberlain 1975, p. 13). Soule and Oguri (1976, p. ii) report that

> under [then] present conditions, a small zone within approximately 200 feet of the outfalls exists where numbers of species are low. Adjacent to this zone is a zone of enrichment which extends through most of the outer harbor. Beyond that, conditions return to average coastal populations. The regulations of waste loadings and control of pollutants in the past 6-year period has brought the harbor ecosystem from a depauperate biota to a moderately rich one in the immediate outfalls zone, with a very rich biota in the adjacent outer harbor area.

Soule and Oguri (1973, p. 15-16) reported that

> Nothing is known about the distance traveled by individual anchovies within the harbor, nor about the degree to which they move in and out of the harbor. Catches by the bait boats . . . indicate that there may be an area of inhibition in the immediate vicinity of the cannery outfalls . . . . There are indications that the anchovies move away from the area when the oxygen is low and also when it is excessively high, during plankton blooms. Weather conditions may exert influence

as well, for anchovies apparently disappeared from harbor catches prior to heavy winter storms and subsequent rainwater runoff. They also were not caught in the harbor near the end of the season when the Davidson Current brought warmer southerly waters into the area, but reappeared just after water temperatures dropped.

Turbid waters with high densities of edible fine particulate matter apparently made harbor waters an excellent habitat for larval and juvenile fishes. Fish productivity began to decrease, however, when dissolved air flotation treatment was installed in the cannery waste streams in 1975, even though esthetically the harbors waters were improved. The installation of secondary waste treatment at the Terminal Island Treatment Plant and the subsequent connecting of cannery waste streams to the treatment plant in 1977-1978 resulted in a dramatic decrease in harbor biota, and, in particular in anchovies (Soule and Oguri 1979, p. viii; 1980, p. 9). Benthic populations decreased three- to four-fold in the outer harbor between 1973 and 1978, and the fish populations, sampled by otter trawl, also dropped four-fold. Trawl catches of anchovy in the outer harbor decreased about ten-fold between 1973 and 1974 and continued to decrease at a slower rate through 1978 (Soule and Oguri 1980, p. 372). The offshore anchovy population increased from 1973 to 1974, then decreased about five-fold through 1978 and recovered in 1979 (Soule and Oguri 1980, p. 372).

The harbor anchovy population has not recovered since that time, regardless of whether the winter has been warm or cold, wet or dry. Anchovy and other fish have been attracted to the harbor during episodes when the treatment plant malfunctioned and released wastes with high biological oxygen demand, and when dredging created high levels of turbidity and resuspended edible particulates and microbiota.

A number of studies (Lasker 1975, 1978; Lasker and Smith 1977) suggest that larval habitat is critical to larval survival and therefore governs subsequent recruitment strength. Spawning occurs from January to May throughout the area inhabited by the central stock, with heaviest concentrations occurring inshore. Favorable larval habitat consists of dense plankton blooms of edible and nutritious organisms. Edibility is governed by size but nutrition is governed by species. Some organisms of the proper size, such as armored dinoflagellates, cannot be digested by the anchovy larvae. These plankton blooms characteristically form as thin layers often extending over large geographic areas.

3.1.3 Oil and Gas Development

Thirty-nine percent of the estimated 3.2 million mt of petroleum entering the marine environment each year is due to production and transportation of petroleum products (National Academy of Sciences 1985). Concerns about accidental or chronic release of oil from offshore oil and gas development center on potential biological and ecological impacts. Various studies have shown that low concentration of petroleum products can affect marine organisms, particularly larval and juvenile forms (National Academy of Sciences 1985). Detecting and measuring the strength of these effects on anchovy populations is difficult, however, because natural variability in factors such as growth, survival, reproductive success and abundance may mask effects due to the release of petroleum products. While studies support concerns about accidental and chronic discharge of oil in protected or enclosed coastal waters, there is almost no information available regarding long-term effects of petroleum discharges offshore (Owens 1973; Malins 1981). The effects of oil and gas development on abundance and distribution of anchovy are, therefore, largely unknown.

3.2. Programs and Policies

Federal programs and authorities concerned with protecting and conserving anchovy habitat include the U.S. Fish and Wildlife Service, NMFS, Minerals Management Service, Army Corp of Engineers, Coast Guard and Environmental Protection Agency. State of California programs and authorities concerned with protecting and conserving anchovy habitat include State Lands Commission, Department of Oil and Gas, Coastal Zone Commission, California Department of Fish and Game and State Water Quality Control Board.

It is the policy of the Council that there should be no net loss of productive capacity of any marine habitat that sustains anchovy. Guided by this policy, the Council will:

1. work with other agencies in decisions which directly or indirectly affect anchovy habitat and insure that anchovy receive appropriate weight in decisions that affect habitat quality;

2. work to resolve conflicts about uses of coastal and offshore areas that might affect anchovy habitat;

3. support diligent application and enforcement of regulations governing ocean oil exploration and development, waste management and pollution control;

4. encourage the best management practices available to protect anchovy habitat from adverse effects of contamination by oil and gas development, domestic wastes, industrial wastes, pesticides, dredged material disposal and radioactive wastes;

5. encourage users to seek legislative remedies to problems with habitat where existing authorities and regulation are inadequate; and

6. support and encourage efforts to determine the net economic value of preserving anchovy habitat.

4.0 DESCRIPTION OF FISHERY MANAGEMENT PLAN

4.1 History

The Council initiated the development of the FMP in January 1977. A final draft of the FMP was approved and submitted to the Secretary of Commerce in June 1978. Regulations implementing the FMP were published in the Federal Register on September 13, 1978. Subsequently, the Council has considered five amendments to the FMP.

4.1.1 Amendment 1

The first amendment changed the method of specifying the domestic annual harvest 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.

4.1.2 Amendment 2

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 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.

4.1.3 Amendment 3

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

4.1.4 Amendment 4

The fourth amendment, which had two clauses, was published in the Federal Register on August 2, 1983 and became effective on August 13, 1983. The first clause abolished the 5-inch size limit in the commercial fishery and established a minimum mesh size of 5/8 inch. 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 clause established a midseason quota evaluation that was simpler in design than the method proposed in Amendment 3. The annual quota was split in half. The first half would be allocated at the beginning of the season. The second half would be allocated unless available evidence indicated that its harvest would reduce the following year's spawning biomass below the level of one million short tons.

4.1.5 Amendment 5

The fifth amendment 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 has 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.

4.2 Current Management Regulations

4.2.1 Reduction Quota

The reduction quota from the central subpopulation of northern anchovies is equal to: (1) 0, 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.

4.2.2 U.S.-Mexico Optimum Yield Allocation

The OY in the U.S. EEZ is equal to 70 percent of the total OY.

4.2.3 Non-Reduction Allocation

There is no numeric limit on live-bait catch, and 7,000 mt are reserved for other non-reduction uses (e.g., dead bait and animal food).

4.2.4 Geographic Allocation of Reduction Quota

A portion of the U.S. reduction quota equal to the smaller of 9,072 mt or 10 percent of the quota is reserved for the fishery north of Point Buchon, but may be reallocated on June 1 if necessary.

4.2.5 Reduction Fishing Seasons

The seasons are August 1 through June 30 in the northern area and September 15 through June 30 in the southern area.

4.2.6 Area Closures

Certain portions of the EEZ are closed to anchovy reduction fishing (Figure 1).

4.2.7 Mesh Restrictions

Nets used in the reduction fishery must have a minimum wet mesh size of 5/8 inch.

4.3 Transboundary Considerations

An important consideration in establishing a management regime for northern anchovy is inclusion of all major fishing operations under one management program. In fact, the MFCMA requires that a fishery resource be managed as a unit stock throughout its range. At the present time, Mexico and the United States do not have an effective means of managing stocks, like anchovy, that are present in the coastal zones of both nations. Consequently, Mexico harvests northern anchovy from the central subpopulation independently of management regulations established in the U.S. under the MFCMA.

The current FMP addresses the issue of unilateral management of this transboundary stock by specifying OY for the stock as a whole, and then allocating 70 percent of it to the U.S. and 30 percent to Mexico. The allocation formula is based on the observation that 70 percent of anchovy larvae (and presumably, the spawning biomass) during 1951-1975 were found in U.S. waters (Council 1983, Section 4.1.2).

Mexican harvests have been significant in recent years and have exceeded U.S. catches in every year since 1977 (Table 4.3-1). In the absence of an agreement with Mexico, it is possible that the total catch by Mexico and the U.S. during some years will exceed OY. This may have the effect of decreasing the stock level and total OY in subsequent years.

5.0 HISTORY OF THE FISHERY

5.1 Early History: 1916-1964

Reliable records of U.S. landings of northern anchovy date from 1916 (Table 4.3-1). Anchovy landings during 1916-1921 averaged 458 mt per year and were used largely for reduction to meal and oil. In 1919 a law was passed prohibiting the reduction of whole fish except by permit. Landings fell after the law was passed and averaged only 144 mt per year during 1922-1938. During 1939-1946, landings averaged 1,319 mt per year.

Scarcity of Pacific sardine caused processors to begin canning anchovies in quantity during 1947, when landings increased to 8,591 mt. In order to lower the quantity of anchovies being reduced, the California Fish and Game Commission required each processor to can a large proportion of the harvest (40 to 60 percent depending on can size). Anchovy landings declined with the temporary resurgence of sardine landings through 1951. Following the collapse of the sardine fishery in 1952, anchovy landings increased to 38,935 mt in 1953. Anchovy landings declined to 5,263 mt by 1958, largely as a result of low consumer demand for canned anchovy and increased sardine landings. Landings remained below 3,500 mt per year through 1964.

Live bait catch is distinguished from other uses of anchovy by the fact that it is not landed. Transactions between buyers and sellers of live bait take place either at sea or from receivers that are tied up at dock. The anchovy live bait catch, which was 1,364 mt in 1939, dropped to 0 during World War II. It increased to 3,469 mt in 1950 and has ranged from 3,729 to 6,178 mt per year from 1951 to 1964 (Table 4.3-1).

During the early years of the fishery (1916-1964), anchovy was harvested almost exclusively by U.S. fishermen. Mexico did not begin harvesting anchovy until 1962 (Table 4.3-1).

5.2 Recent History: 1965-1989

Beginning in 1965, the California Fish and Game Commission managed the U.S. fishery on the basis of a reduction quota, and separate reduction and non-reduction landings statistics have been kept ever since. Although Table 4.3-1 describes landings on the basis of calendar years, it should be noted that both state and federal regulations established since 1965 have pertained to fishing seasons that extend from July 1 through June 30.

5.2.1 U.S. Reduction Fishery

In recent years, northern anchovy have been harvested for reduction by a fleet of approximately forty small purse seine vessels known collectively as the "wetfish" fleet. The fleet also fishes for Pacific mackerel (Scomber japonicus), jack mackerel (Trachurus symmetricus), Pacific bonito (Sarda chiliensis), bluefin tuna (Thunnus thynnus), market squid (Loligo opalescens) and Pacific sardine (Sardinops sagax). Market squid have been the dominant components of the wetfish catch in recent years, while landings of northern anchovy have been insignificant (Thomson etal., 1989, Table 1).

Reduction landings increased from 155 mt in 1965 to 24,810 mt in 1966. They ranged from 12,515 mt per year to 84,328 mt per year during 1966-1972. Landings increased to 118,432 mt in 1973 and ranged from 73,400 mt per year to 141,586 mt per year during 1973-1977. In response to decreases in fish meal prices, landings declined to an annual average of 46,500 mt during 1979-1982. Reduction landings have been extremely low since 1983, largely as a result of low ex-vessel prices rather than low anchovy abundance (Thomson etal. 1989).

5.2.2 U.S. Non-Reduction Fishery

The non-reduction fleet consists of approximately 18 boats that are distributed along the California coast to service the principal sportfishing markets conveniently. Sixteen of the boats operate in southern California (six in the San Diego area alone). Sixteen of the boats derive most of their revenue from live bait, although they may also fish anchovy for other non-reduction uses (largely dead bait and pet food). The remaining two boats fish largely for non-reduction uses other than live bait. Approximately six other vessels occasionally target on anchovies when their preferred target species is not available or land anchovies incidentally with other species. However, these vessels derive only a small proportion of their income from anchovies and are not considered to be part of the non-reduction fleet.

Two types of gear are used in the non-reduction fishery: (1) the lampara net, which is set in shallow waters and cannot be used effectively in deeper 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 anchovies. The drum seine is of more recent origin, and six boats in the non-reduction 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, comprise approximately 85 percent of the live bait catch. From 1965 to 1988, the anchovy live bait catch ranged from 3,572 to 6,978 mt per year and averaged 5,244 mt annually (Table 4.3-1).

Other anchovy non-reduction landings (which include harvests for non-reduction uses other than live bait) averaged about 1,973 mt per year from 1965 to 1988. Since 1985, non-reduction landings have exceeded reduction landings. This has been due to a dramatic decline in reduction landings rather than to any increase in non-reduction landings (which have actually been lower than average since 1985).

5.2.3 Mexican Reduction Fishery

Anchovy landed in Mexico are used primarily for reduction, although a small amount may be taken for use as bait. Table 4.3-1 describes landings by the Mexican fleet at Ensenada, Baja California. Ensenada is more than 60 miles north of Punta Baja, which is the northern boundary of the southern subpopulation. While the bulk of the Ensenada landings comes from the central subpopulation, a small but unknown proportion probably also comes from the southern subpopulation.

Mexico's harvesting and processing capacity increased significantly in the late 1970s, due to the addition of several large seiners to the fishing fleet and the construction of a large reduction plant in Ensenada. Mexican landings reached a high of 258,700 mt in 1981, fell to 178,000 mt in 1982, and have ranged from 79,000 mt to 124,000 mt per year since 1983 (Table 4.3-1). Mexican landings have surpassed U.S. landings in every year since 1977 and have comprised more than 90 percent of total landings since 1983.

6.0 VESSEL SAFETY REQUIREMENTS OF PUBLIC LAW 99-659

Regulations limiting access to a fishery (such as quotas, closed seasons and trip limits) can lead to highly competitive fisheries (so-called "derby fisheries") which provide incentives for vessel operators to fish in poor weather, overload their boats, and otherwise endanger personnel and equipment. The vessel safety provision of Public Law 99-659 requires that councils consider the need for "temporary adjustments" to regulations in order to avoid dangerous conditions in the fishery. These adjustments could, for example, specify a quota for vessels otherwise prevented from fishing because of adverse weather and ocean conditions.

6.1. Regulations Limiting Access to the Fishery

The Anchovy FMP regulates access to the reduction fishery by:

1. inseason closure of the fishery if and when the quota is exhausted;
2. closure of the fishery north of Point Buchon from July 1 through July 31 and south of Point Buchon from July 1 through September 14; and
3. closure of nearshore areas to reduction fishing throughout the season.

The live bait fishery is not subject to any regulatory restrictions. The FMP, however, does impose a 7,000 mton quota on non-reduction uses (other than live bait), and requires inseason closure of the non-reduction (other than live bait) fishery if and when the quota is exhausted.

Quotas for the reduction and non-reduction (other than live bait) fisheries are set to protect the long-term viability of the stock by limiting fishing mortality (Council 1983, Sections 9.1 and 9.3). The nearshore closure also serves a conservation purpose. Nearshore areas are the major habitat of more than half of all prespawning anchovies and closure of these areas to the reduction fleet reduces fishing mortality on young fish (Council 1983, Section 9.6).

The seasonal and nearshore closures of the reduction fishery also serve to reduce contact and potential conflict between reduction and other (particularly live bait and recreational) fishermen (Council 1983, Sections 9.5 and 9.6). Two-thirds of the live bait fleet use lampara nets to catch anchovy. This net does not purse at the bottom, so its use is limited to shallow waters where the sea bottom prevents fish from escaping under the net. Both the live bait fleet and the recreational fishery that it supports are concentrated in nearshore areas, where reduction fishing is not allowed. Recreational fishing activity peaks during the summer months, when the reduction fishery is closed.

6.2 Effect of Regulations on Vessel Safety

The Council has identified several scenarios in which current regulations could affect safety in the operation of the anchovy fisheries. The plausibility and impact of each of these scenarios on vessel revenues and safety are discussed below.

6.2.1 Scenario 1

Description. The reduction fleet takes extraordinary risks in competing for a quota before it is exhausted. This scenario may be more plausible for vessels in the Monterey area who are more likely to experience adverse winter/spring weather.

Analysis. The FMP allocates 10 percent of the domestic reduction quota or 9,072 mt, whichever is less, for the fishery north of Point Buchon. This geographic allocation precludes the larger-capacity southern fleet from exhausting the quota before the northern fleet has an adequate opportunity to fish. Although the geographic allocation was originally devised in the interest of equity (Council 1983, Section 9.4), it serves a vessel safety objective as well. Winter/spring weather and ocean conditions tend to be more severe in the north. The geographic allocation, therefore, reduces pressure on the northern fleet to fish during inclement weather.

Although geographic allocation of the reduction quota encourages safety in the fishery, it should be noted that highly competitive conditions that contribute to risk-taking behavior by vessels have not historically existed in the anchovy fishery. The allowable reduction harvest for the southern area has been reached only once, in the 1978/1979 season, when the quota was exhausted on June 8. The northern area quota has never been exhausted (Table 6.2-1).

6.2.2 Scenario 2

Description. The reduction fleet takes extraordinary risks during the winter months to make up for income foregone during the summer closure.

Analysis. Historical data provide no information regarding the effect of the summer closure on reduction revenues since the U.S. reduction fishery has always been closed during the summer by Federal (and previously State) management regulations. The large amounts of anchovy harvested by the Mexican fishing fleet during the summer (Table 6.2-2), however, suggest that the U.S. fleet incurs some losses as a result of the summer closure. These losses may be at least partially offset by revenues generated by fishing for other target species (e.g., Pacific and jack mackerel in southern California, squid in northern California) during the summer months. The season for Pacific mackerel opens on July 1 and landings are regulated by quotas set by the State of California. Jack mackerel and squid landings are not subject to quota restrictions. The ex-vessel prices of mackerel and squid have historically been three to four times higher than the ex-vessel prices paid for anchovy landed for reduction.

Even if significant economic losses can be attributed to the summer closure, adverse weather is not the only factor to discourage fishermen from targeting on anchovy during the winter/early spring. These months coincide with the peak spawning period for anchovy. Anchovy schools tend to break up into smaller aggregations when engaged in spawning activity, making them less available in commercial quantities to the fishermen (Council 1983, Section 4.1.1). Also the fish are less marketable during this time, since oil in the flesh (which is marketed as a by-product of the fishmeal production process) is reduced during the spawning period (Council 1983, Section 4.2.9). Finally, squid, which command a higher ex-vessel price than anchovy, are frequently available to the southern California fleet during the winter and early spring.

6.2.3 Scenario 3

Description. The nearshore closure exposes the reduction fleet to hazardous conditions offshore.

Analysis. The frequency with which the reduction fleet would operate in nearshore waters in the absence of regulation is unknown, since a nearshore closure has always been enforced under Federal (and previously State) management. Reduction vessels have occasionally been cited for fishing in illegal areas, suggesting that anchovy availability is sometimes better nearshore than offshore. Ocean conditions tend to be less severe nearshore than offshore, particularly during the winter/early spring. Activity in the reduction fishery, however, usually declines during winter/spring, for reasons discussed under Scenario 2.

Fishermen tend to characterize anchovies as "light" or "heavy", depending on how they behave when encircled in the net. Fish which are heavy tend to orient themselves downward to escape from the net. Even after the net is pursed, they may exert sufficient downward pressure to capsize a boat. Heavy fish occur largely in late spring after spawning, when the oil reserves in anchovies are depleted. One death and several capsizings in the 1970s have been linked with attempts to capture large schools of heavy fish.

It is difficult to determine whether the nearshore closure increases the risks associated with setting on heavy fish, since heavy fish may occur in nearshore waters as well and fishermen tend to avoid setting on large schools when heavy fish occur. The risk of capsizing when setting on heavy fish is minimal in shallow waters (less than 35 to 40 fathoms, which is the depth of the net), although damage to the net is more likely at these shallow depths. The areas closed to reduction fishing attain a maximum depth of approximately 200 fathoms.

6.2.4 Scenario 4

Description. Vessels participating in the non-reduction (other than live bait) fishery take extraordinary risks in competing for the quota.

Analysis. The U.S. quota for non-reduction uses other than live bait is 4,900 mt. The quota has not, however, historically constrained the fishery. Annual non-reduction landings averaged 1,973 mt over the period 1965-1988 and exceeded 4,900 mt in only two of these years (1979 and 1980) (Table 4.3-1). Moreover, landings of anchovy for dead bait decline considerably during the winter months, independent of weather conditions, due to a decline in recreational fishing.

6.3 Conclusions and Recommendations

Available evidence indicates that the FMP does not pose any extraordinary risks to vessel safety. The anchovy fisheries have historically not been competitive and the reduction and dead bait quotas have seldom been exhausted. Weather is only one of several factors limiting fishing activity in the winter/spring months. Availability and oil content of anchovy and the demand for bait by the recreational fishery tend to decline during those months when weather tends to be inclement. For these reasons, formal procedures for adjusting regulations to encourage vessel safety are not warranted at this time.

Procedures already in place for alerting the Council to safety concerns which may arise in the future as a result of changes in regulations or the fisheries are adequate. The Coast Guard representative on the Council participates in the Council's Enforcement Consultants group and has ample opportunity to raise or comment on safety issues. The Coast Guard's written comments regarding the FMP and amendments are part of the public record and are formally considered and reviewed by the Secretary of Commerce. Current procedures also provide the Anchovy Advisory Subpanel and other fishery users with ready access to the Council and opportunity to raise issues related to vessel safety. Both the Coast Guard representative and the Anchovy Advisory Subpanel concur with the conclusion that formal procedures for adjusting regulations to encourage vessel safety are not warranted at this time.

7.0 MANAGEMENT ALTERNATIVES

7.1 Reduction Quota at Low Levels of Spawning Biomass

7.1.1 Specification of Options

This section describes the three reduction quota options considered by the Council at its April 1990 meeting.

7.1.1.1 Status Quo (Option 1)

The status quo (Option 1) involves no modification to the current FMP and OY formulas. Under this option, the reduction OY is (1) 0 when the spawning biomass is less than or equal to 300,000 mt, and (2) the difference between the spawning biomass and 300,000 mt, up to a limit of 200,000 mt, when the spawning biomass is greater than 300,000 mt.

7.1.1.2 Unconditional Option (Option 2)

Option 2 is the unconditional option. Under this option, the reduction OY is (1) 7,000 mt when the spawning biomass is less than or equal to 307,000 mt, and (2) the difference between the spawning biomass and 300,000 mt when the spawning biomass is greater than 307,000 mt.

7.1.1.3 Conditional Option (Option 3)

Under the conditional option (Option 3), the reduction OY depends on the level of total biomass as well as spawning biomass. Under this option, when the total biomass is greater than or equal to 375,000 mt, the reduction OY is (1) 7,000 mt if the spawning biomass is less than or equal to 307,000 mt, and (2) the difference between the spawning biomass and 300,000 mt, up to a maximum of 200,000 mt, if the spawning biomass is greater than 307,000 mt. When the total biomass is less than 375,000 mt, the reduction OY is (1) 0 if the spawning biomass is less than or equal to 300,000 mt, and (2) the difference between the spawning biomass and 300,000 mt, up to a maximum of 200,000 mt, if the spawning biomass is greater than 300,000 mt.

7.1.2 Clarification of Options

The status quo (Option 1) closes the reduction fishery when the spawning biomass is less than or equal to 300,000 mt. However, use of a 300,000 mt cutoff level for the other options would have produced some anomalous results. For instance, specification of a 300,000 mt cutoff under the unconditional option (Option 2) would cause the reduction fishery to receive a 1,000 mt quota if the spawning biomass were 301,000 mt, but a 7,000 mt OY if the spawning biomass were 299,000 mt. By setting the cut-off at 307,000 mt for this option, the reduction fishery is allowed to take 7,000 mt at all spawning biomass levels less than or equal to 307,000 mt.

The rationale for selecting a total biomass cutoff level of 375,000 mt under the conditional option (Option 3) is that spawning biomass can be regarded as a poor measure of total biomass when the fraction spawning is less than 80 percent of the total (i.e., 375,000 mt x 0.80 = 300,000 mt, the original cutoff value). Note also that when total biomass is greater than or equal to 375,000 mt, reduction quotas under the conditional option depend on whether the spawning biomass falls above or below 307,000 mt. When total biomass is less than 375,000 mt, however, reduction quotas under this option depend on whether the spawning biomass falls above or below 300,000 mt. The reason for this asymmetry is that specification of a 307,000 mt spawning biomass threshold when total biomass falls below 375,000 mt would cause the conditional option to close the reduction fishery when the spawning biomass falls between 300,000 mt and 307,000 mt. This would restrict the reduction fishery more than the status quo, which allows a small fishery within this range of spawning biomass. In other words, it would cause the conditional option to be inconsistent with a major purpose of the amendment, which is to reduce restrictions on the reduction fishery.

The status quo (Option 1) closes the reduction fishery when the spawning biomass is less than or equal to 300,000 mt, while the unconditional option (Option 2) provides a 7,000 mt reduction OY when the spawning biomass is less than or equal to 307,000 mt. The conditional option (Option 3) specifies that when the total biomass is greater than or equal to 375,000 mt, the reduction OY is determined in the manner of the unconditional option. When the total biomass is less than 375,000 mt, the reduction OY is determined in the manner of the status quo. Thus, the conditional option is a hybrid version of the other two options. It is less restrictive than the status quo but more restrictive than the unconditional option.

7.2 Definition of Overfishing

Because the anchovy population is both a major forage stock and a commercial resource, the OY formula in the current FMP includes a threshold level of spawning biomass (300,000 mt) at or below which only fishing for live bait and other non-reduction uses are allowed. Live bait harvests are not regulated but are modest in amount, the average for the nine seasons beginning with 1979/1980 being 4,078 mt. Harvests for other non-reduction uses are limited to 7,000 mt per fishing season but have typically been much less than this, averaging 1,188 mt for the nine seasons beginning with 1979/1980 (Table 7.2-1).

The biological rationale for this threshold is to prevent depletion of the resource and to provide an adequate forage reserve for marine fishes, mammals, and birds. Implicit in this approach is the judgment that relatively small catches can be allowed when the spawning biomass is below 300,000 mt without significantly affecting the resource's long-term reproductive potential (Council 1983, Section 9.3.1).

In 1983, the Council considered and rejected cutoffs for all fishing at spawning biomass levels of 90,700 mt and 20,000 mt. An initial preference for the 20,000 mt minimum was reconsidered and rejected by the Council after discussions indicated that: (1) low levels of abundance are difficult to measure, (2) specification of incidental catch allowances in other fisheries would have become necessary, and 3) the stock has recovered from low levels in the mid-1950s (Table 2.1-1) despite a small fishery at the time (Council 1983, Section 10.2.2).

7.2.1 Specification of Options

In April 1990, the Council reconsidered the pros and cons of disallowing all harvests at low levels of spawning biomass, in view of the revised guidelines for National Standard 1 (see Section 2.2). At that time the Council considered the so-called no-lower-cutoff and lower-cutoff options for the definition of overfishing and adopted the former. After reviewing the proposed amendment, NMFS requested that Council reconsider its decision with respect to the definition of overfishing (see Section 2.3). In response, Council considered and adopted a third option called the two-year-lower-cutoff option. All three options are described below.

7.2.1.1 No-Lower-Cutoff Option

The no-lower-cutoff Option defines overfishing as any harvest in excess of OY, where OY is determined according to the harvest formula in the FMP. This definition is consistent with the view that the OY formula provides adequate protection against overfishing.

The effect of the no-lower-cutoff option on the reduction fishery at low levels of abundance will depend on which reduction OY option is chosen. If the status quo is chosen, the no-lower-cutoff option will disallow all reduction fishing when the spawning biomass is less than or equal to 300,000 mt. If the unconditional option is chosen, it will allow a 7,000 mt reduction harvest when the spawning biomass is less than or equal to 307,000 mt. If the conditional option is chosen, it will: (1) disallow all reduction fishing when the spawning biomass is less than or equal to 300,000 mt and total biomass is less than 375,000 mt, and (2) allow a 7,000 mt reduction harvest when the spawning biomass is less than or equal to 307,000 mt and total biomass is greater than or equal to 375,000 mt.

Regardless of which reduction OY option is chosen, the no-lower-cutoff option allows unlimited live bait harvest and a 7,000 mt quota for other non-reduction uses, independent of the level of spawning biomass. It should be noted that U.S. live bait and other non-reduction harvests are typically modest, averaging 4,078 mt and 1,188 mt respectively over the 9 seasons beginning with 1979/1980 (Table 7.2-1).

7.2.1.2 Lower-Cutoff Option

The lower-cutoff option defines overfishing as harvests of any kind during seasons when the spawning biomass falls below 50,000 mt. This option disallows all fishing (for reduction, live bait and other non-reduction uses) during seasons when the spawning biomass is less than 50,000 mt.

7.2.1.3 Two-Year-Lower-Cutoff Option

The two-year-lower-cutoff option defines overfishing as harvests of any kind when the spawning biomass during the current <u>and</u> preceding season was less than 50,000 mt. Under the two-year-lower-cutoff option, all fisheries (reduction, live bait and other non-reduction fisheries) are closed in the second season when the spawning biomass falls below 50,000 mt for two consecutive seasons. Closures continue in subsequent seasons until the spawning biomass equals or exceeds 50,000 mt.

The two-year-lower-cutoff option is more restrictive than the no-lower-cutoff option and less restrictive than the lower-cutoff option. The two-year-lower-cutoff option is similar to the lower-cutoff option except that closure is invoked after the spawning biomass falls below 50,000 mt for two consecutive seasons.

7.2.2 Consistency with Revised National Standard 1

All of the overfishing options are consistent with the revised guidelines for National Standard 1 in the following respects:

1. All options provide an objective and measurable standard for defining overfishing. For the no-lower-cutoff option, the standard takes the form of an objective and measurable threshold level of spawning biomass (300,000 mt under the current reduction OY formula, or 307,000 mt if the reduction OY formula is amended), at and below which only modest harvests are allowed. For the lower-cutoff option, this standard takes the form of an objective and measurable interval of spawning biomass (50,000 to 300,000 mt) within which modest harvests are allowed and a level of spawning biomass (50,000 mt) below which all harvests are disallowed. A similar standard is used for the two-year-lower-cutoff option, except that spawning biomass must be less than 50,000 mt for two consecutive seasons to warrant closure of all fisheries.

2. All options allow for the monitoring and evaluation of the stock relative to the threshold level on an annual basis.

3. The analysis of all options is based on modeling of long-term reproductive capability.

4. All options allow for a program to rebuild the stock when it becomes depleted. For the no-lower-cutoff option, the program involves restriction of U.S. harvests to modest levels when the spawning biomass is less than or equal to 300,000 mt. For the lower-cutoff option, the program involves restriction of U.S. harvests to modest specified levels when the spawning biomass falls in the interval 50,000 to 300,000 mt and disallowance of all U.S. harvests when the spawning biomass falls below 50,000 mt. A similar program is used for the two-year-lower-cutoff option, except that all U.S. harvests are disallowed if the spawning biomass falls below 50,000 mt in two consecutive seasons.

7.3 Combining Reduction Quota Options with Overfishing Options

7.3.1 Specification of Options

The three reduction quota options presented in Section 7.1.1 and the three overfishing options presented in Section 7.2.1 were combined to yield a total of nine options for consideration by the Council (Table 7.3-1).

Combinations of the reduction quota options with the no-lower-cutoff option were accomplished by allowing harvests when the spawning biomass falls below 50,000 mt according to the appropriate OY formula. These combined options are referred to as Options 1-3 in Table 7.3-1.

Combinations of the reduction quota options with the lower-cutoff option for overfishing were accomplished by eliminating all harvests when the spawning biomass falls below 50,000 mt. These combined options are referred to as Options 1L-3L in Table 7.3-1.

Combinations of the reduction quota options with the two-year-lower-cutoff option were accomplished by eliminating all harvests when the spawning biomass falls below 50,000 mt in two consecutive seasons. These combined options are referred to as Options 1L*-3L* in Table 7.3-1.

7.3.2 Consideration of Mexican Harvest

The Council has no influence on Mexican harvests in the absence of a bilateral agreement. Therefore, 70 percent of the reduction and non-reduction OY's specified under each of the options in Table 7.3-1 is allocated to U.S. fishermen. This is the same approach used in the current FMP (see Section 4.3).

8.0 ENVIRONMENTAL ASSESSMENT/REGULATORY IMPACT REVIEW/INITIAL REGULATORY FLEXIBILITY ANALYSIS

This section consists of an EA, RIR and IRFA. It was prepared in accordance with the requirements of Executive Order 12291, the National Environmental Policy Act, the Regulatory Flexibility Act, and the Paperwork Reduction Act. This analysis compares the management options summarized in Table 7.3-1 on the basis of the following criteria:

1. The biological impact on the northern anchovy population and brown pelican reproductive success.

2. Economic impacts on harvesters, processors and consumers of northern anchovy.

3. The costs incurred by the government in order to implement each option.

4. Monitoring and enforcement costs incurred by State governmental units that oversee compliance.

5. Compliance costs and recordkeeping requirements imposed on small businesses (i.e., vessel operators and fish processors).

8.0.1 The Simulation Model

The effects of each of the nine options on the anchovy stock and the reduction fishery were evaluated using a simulation model which is described in Jacobson and Thomson (1989). The model assumes that profits to fishermen depend on anchovy abundance (measured as catch-per-unit-effort in units of mt per hour), reduction and non-reduction harvests (mt), operating costs (dollars per hour), and ex-vessel prices for anchovy (dollars per mt). It was assumed that fishermen take the entire reduction quota if fishing is profitable and that no fishing takes place when fishing is not profitable. The reduction, live bait and other non-reduction fisheries were considered separately in the model.

Operating costs for the reduction, non-reduction and live bait fisheries were estimated to be $288.29 per hour. This figure was obtained by converting the figure for reduction fishery costs used in the current FMP (Council 1983, Section 6.4) to 1988 dollars by correcting for inflation. No data concerning operating costs in the live bait and non-reduction fisheries were available.

Ex-vessel prices for the live bait, non-reduction and reduction fisheries were estimated to be $681 per mt, $287 per mt and $79 per mt, respectively. The ex-vessel price for live bait was obtained by converting the figure used in the current FMP (Council 1983, Section 3.5.1.1) to 1988 dollars by correcting for inflation. The non-reduction ex-vessel price used in the model is the mean of ex-vessel prices (converted to 1988 dollars) paid during 1980-1988 (Table 8.0-1). The reduction fishery ex-vessel price used in the model is the price paid during 1981 (the most recent season in which U.S. reduction landings exceeded 50,000 mt), converted to 1988 dollars (Table 8.0-2). The value used ($79 per mt) is about 2.5 times greater than the price actually paid during 1988 ($32 per mt). This relatively high price was used in order to exaggerate the potential effects of the various options on harvest of the anchovy stock.

Live bait catches in the model were 4,078 mt per season and non-reduction landings were 1,188 mt per season. These values are the average of live bait and non-reduction harvests for the nine seasons beginning in 1979/1980 (Table 7.2-1).

Table 8.0-3 describes the simulation results for each of the nine options in terms of total biomass, reduction catch and profit, fishery closures, and reproductive success of the endangered California brown pelican. The relationship between brown pelican breeding success and anchovy abundance used in the simulation model is documented in Jacobson and Thomson (1989).

8.1 Biological Impacts

According to Table 8.0-3, the biological impacts, measured in terms of total biomass and brown pelican breeding success, are the same for all of the nine options considered. Mean total biomass is 840,000 mt and mean pelican breeding success is 0.99 fledglings per breeding pair per season for each option.

The apparently small biological impact of modest reduction and non-reduction harvests at low levels of abundance can be attributed to several factors:

1. Even if reduction harvests are allowed when the spawning biomass is less than or equal to 300,000 mt (as they are under Options 2 and 3 and, to a lesser extent, Options 2L, 2L*, 3L and 3L*), such harvests are not likely to occur. A simple economic analysis based on the model used in the simulations suggests that reduction fishing becomes unprofitable at low levels of biomass (i.e., that economic constraints tend to protect the stock from overfishing by the reduction fleet). This result is discussed in greater detail in Section 8.2.

2. Unlike the reduction fishery, the non-reduction fishery is likely to be active even at very low levels of abundance. The effect of non-reduction harvests at low levels of biomass is not well represented in the overall results, however, because spawning biomass levels below 50,000 mt occurred very infrequently in the course of the simulations (Table 8.0-3).

An alternative way to analyze the biological impact of non-reduction harvests is to compare the time required for the stock to recover from a low level of spawning biomass (e.g., 25,000 mt) to a higher level (e.g., 300,000 mt) when non-reduction harvests are and are not allowed. To accomplish this, a modified version of the simulation model was rerun for Options 1, 1L and 1L*. The spawning biomass at the beginning of each simulation was set at 25,000 mt. The number of years required for the stock to reach a spawning biomass of 300,000 mt (the "recovery time") was recorded. Five hundred thousand individual simulation runs were done for each of the three options. Mean time to recovery was 7.9 years for Options 1L and 1L* and 8.6 years for Option 1, a difference of 0.7 years. In other words, the mean recovery time with a cutoff (Options 1L or 1L*) was 0.7 years less, on average, than the mean recovery time without a cutoff (Option 1).

The simulation model suggests that the benefits of a cutoff for all fishing may be small and that the population may be quite resilient to the effects of modest fishing pressure at low levels of abundance. This result is supported by historical data, which indicate that the stock was able to rebound from low levels of abundance in the mid-1950s (Table 2.1-1), despite annual harvests of 25,000 to 30,000 mt (Table 4.3-1).

It should be noted, however, that the parameters in the simulation model were estimated from data for 1964-1985, which were medium to high biomass years (Jacobson and Thomson 1989). Thus, the estimates of mean recovery times from low levels of spawning biomass are extrapolations and possibly unreliable. The true difference in mean recovery times with and without a 50,000 mt cutoff may be larger.

8.2 Socioeconomic Impacts

8.2.1 U.S. Reduction Fishery

A very small fraction of the fishmeal supply in the U.S. is derived from northern anchovy (Table 8.2-1). Even in 1975, when anchovy meal production peaked at 25,100 mt, anchovy comprised only 10 percent of total U.S. production and 7 percent of total U.S. supply. Given the modest market position of anchovy meal relative to other fishmeals and the very small changes in reduction harvest proposed in this amendment, none of the options considered in this amendment is expected to have a significant effect on domestic fishmeal prices and availability. All further discussion of reduction fishery impacts will focus on California harvesters and processors.

The simulation results in Table 8.0-3 indicate that there are no differences among options in terms of catch or profit for local harvesters. Mean annual catch is 150,000 mt and mean annual profit is $3.7 million for all options. It should be noted that these catch and profit estimates are much higher than the values historically experienced in the reduction fishery. The reason for this disparity is that the simulation model incorporates two unrealistic assumptions in order to exaggerate the effect of the fishery on the stock: 1) that the fishermen take the entire OY when fishing is profitable, and 2) that the ex-vessel reduction price is $79 per mt.

In actuality, anchovy is only one of several species targeted by the U.S. reduction fleet (see Section 5.2.1). Because anchovy commands a lower ex-vessel price than any of these other species, the fleet is more likely to target on other species and is unlikely to exhaust the reduction quota in most years (Thomson etal. 1989). Table 8.0-3 also describes the frequency and duration of no-fishing intervals under each of the options. According to the simulation model, reduction fishing would cease completely in 15 percent of all years under Options 1/1L/1L* and 11 percent of all years under Options 2/2L/2L* and 3/3L/3L*. Reduction fishing closures of one or more years in duration would occur about nine times every hundred years under Options 1/1L/1L* and about six times every hundred years under Options 2/2L/2L* and 3/3L/3L*. The mean length of closures would be about two years for all options.

An important distinction is whether cessation of fishing occurs as a result of FMP-mandated closures at low levels of spawning biomass or because prevailing ex-vessel prices and costs make fishing unprofitable. According to the simulation model, FMP-mandated closures would occur in 13 percent of all years under

Options 1/1L/1L*, 0 percent of all years under Options 2/2L/2L*, and 9 percent of all years under Options 3/3L/3L* (Table 8.0-3). However, fishing would be unprofitable in 11 percent of all years under each of the options. These results suggest that the reduction fleet generally would not find it profitable to fish at low levels of spawning biomass even if fishing were allowed by the FMP. Lack of profit appears to be a more binding constraint on reduction fishing than FMP-mandated closures.

Figure 2 illustrates this point by describing the "breakeven" price associated with different levels of total biomass. The breakeven price is the ex-vessel price that reduction fishermen would have to receive in order to cover their operating costs at a specified level of total biomass and catch-per-unit of fishing effort. At the $79 ex-vessel price assumed in the simulation model, fishing is profitable at total biomass levels of 350,000 mt and higher. In recent years ex-vessel prices have been much lower than $79 per mt and landings have also been low (Table 8.0-2). The relationship depicted in Figure 2 reinforces the common perception that the low reduction landings in recent years have been due to low ex-vessel prices rather than availability of anchovy.

The general picture that emerges from this analysis is that economic factors tend to protect the stock from overfishing by the reduction fleet. It should be remembered, however, that the results obtained here depend on the biological and economic structure of the model. In particular, the results depend heavily on assumptions about reduction ex-vessel prices, the relationship between fishing costs and anchovy abundance, and the behavior of the Mexican fleet. The probability that Options 2 and 3 for the reduction fishery quota could contribute to stock depletion would increase if ex-vessel prices should exceed historical levels, if fishing costs do not increase as anchovy abundance decreases, and/or if the combined U.S.-Mexican harvest should exceed OY.

8.2.2 U.S. Non-Reduction Fishery

The non-reduction fishing fleet described in Section 5.2.2 supplies live and dead bait to an economically significant recreational fishery in California. According to results from the Marine Recreational Fishery Statistics Survey, about eight million marine recreational fishing trips are made in California each year (Table 8.2-2). This figure underestimates the true level of fishing activity, since it does not include 1) trips targeted at salmon or striped bass, and 2) partyboat and private boat trips that originate in the U.S. but fish in Mexican waters. About 93 percent of all trips in the recreational fishery are undertaken by California residents. For this reason, all further discussion concerning impacts on the non-reduction fishery will be limited to impacts within California.

Unlike Options 1-3, Options 1L-3L disallow all non-reduction harvests when the spawning biomass falls below 50,000 mt and Options 1L*-3L* disallow all harvests when the spawning biomass is less than 50,000 mt in two consecutive seasons. Spawning biomass levels this low have occurred rarely (only twice since 1954, according to Table 2.1-1). However, the impact on the non-reduction fleet and on the recreational fishery of closing the non-reduction fishery at low levels of spawning biomass is potentially significant.

Juvenile anchovies tend to concentrate in shallow shelf areas and bays. Because they are likely to be accessible to the bait boats and because demand and ex-vessel prices for bait are likely to be strong, the non-reduction fleet (unlike the reduction fleet) may find it profitable to harvest anchovies even when abundance is low.

Most of the major species targeted by recreational anglers (kelp/sand bass, rockfishes, bonito, barracuda, yellowtail, and tunas) feed on a variety of species, such as squid, jack mackerel and sardines, as well as anchovies. Because of the presence of these other sources of food, it is likely that species targeted by the recreational fishery will continue to be available when anchovy biomass is low. Therefore, the demand for bait cannot be expected to diminish significantly in years of low anchovy abundance.

Live anchovies are generally the bait of choice for anglers targeting on kelp/sand bass, white seabass, bonito, barracuda, yellowtail, and tunas. Live/dead anchovies are the principal bait for rockfish anglers. These target species comprise approximately 75 percent-90 percent of total partyboat landings (Table 8.2-3) and probably an equally large proportion of private boat landings. Given this heavy reliance on anchovy for bait, closure of the anchovy non-reduction fishery could have a very significant impact on bait fleet revenues and on the recreational fishery. Some of this potential impact may be mitigated, however, depending on availability and acceptability of bait substitutes.

For partyboat and private anglers who target on rockfish and for shore-based anglers in general, baits such as live/dead squid and frozen herring could be substituted for anchovy. Substitution of other baits could result in a decline in participation by rockfish anglers, however, because rockfish catch rates tend to be higher with live anchovy than with other baits. Substitution possibilities are more limited for anglers targeting on the pelagic species. Live squid is a viable bait substitute for some target species; squid, however, are available during December-April but not during the peak summer fishing season. Live sardines are a good substitute, but their availability is very limited at this time.

On the basis of information indicating that the spawning biomass of Pacific sardines had exceeded 20,000 short tons, the State of California lifted its 18-year moratorium on Pacific sardine catches in 1986. During each of the years 1986-1990, the State has allowed an annual sardine quota for directed fishing of 1,000 short tons. The State also allows an annual live bait quota of 318 mt (350 short tons) and a dead bait quota of 227 mt (250 short tons). By comparison, anchovy live bait catch has averaged 4,078 mt and dead bait catch has averaged 1,188 mt over the nine seasons beginning in 1979/80 (Table 7.2-1). Whether the sardine live and dead bait quotas would be sufficiently high to meet the demand for bait in years of low anchovy abundance is unknown, since the extent and timetable for sardine recovery is highly uncertain at this time.

Implementation of the lower-cutoff options or two-year-lower-cutoff options (Options 1L-3L and 1L*-3L*) will require specification of an incidental catch allowance for anchovy with other bait species when the anchovy fisheries are closed. Given that some co-mingling of anchovies with sardines can be expected, a 0 percent allowable incidental take of anchovies would likely preclude substitution of sardines for anchovies as live bait. Substitution possibilities are likely to increase at higher allowable levels of incidental take.

To summarize, the economic impacts of Options 1-3 (no cutoff on all fishing) versus Options 1L-3L and 1L*-3L* (cutoffs for all fishing) are expected to be similar, except in those (occasional) years when the spawning biomass falls below 50,000 mt. In low biomass years, Options 1L-3L and 1L*-3L* are expected to have an adverse economic impact on the bait fleet and on the recreational fishery that it supports. Although not apparent from the results of the simulation runs, the short term adverse effects of options involving a one year cutoff (Options 1L-3L) should be greater than the short term adverse effects of options involving a two year cutoff (Options 1L*-3L*). This impact may be lessened, depending on: (1) the allowable incidental take of anchovies with other species, and (2) the availability of sardines and other species as bait substitutes. The timetable for recovery of the sardine population, however, is highly uncertain at this time.

8.3 Implementation Costs

In order to be implemented, each of the nine options being considered requires that spawning biomass (and total biomass, in the case of Options 3, 3L and 3L*) be estimated on an annual basis. Currently, biomass is estimated by the EPM (Lasker 1985) or an equivalent technique, such as the Stock Synthesis Model (Methot 1989). The last EPM survey was done in 1985. Since that time, estimates of abundance have been obtained using the Stock Synthesis Model calibrated to the 1985 EPM estimate, as well as egg production data from annual surveys and age composition data from the Mexican reduction fishery. Beginning in 1990, aerial survey data have also be used (Lo and Jacobson, in prep.).

The choice between an EPM estimate and a Stock Synthesis estimate involves a trade-off between cost and precision. Precision of EPM estimates (as measured by the coefficient of variation) averages 19 percent when spawning biomass levels are moderately high (Fiedler etal. 1986). Recent experience suggests that there may be considerable uncertainty associated with Stock Synthesis estimates of spawning biomass, particularly when recent EPM estimates of spawning biomass are not available (Jacobson and Lo 1989, 1990). Both EPM and Stock Synthesis estimates are expected to be imprecise at low levels of spawning biomass.

The cost of obtaining an EPM estimate is approximately $600,000. This includes vessel operation, equipment aboard ship and in laboratories, computer time, labor for data collection, data management and analysis. A Stock Synthesis estimate provides lower precision than an EPM estimate but can be obtained for less than $10,000. A Stock Synthesis estimate does not require dedicated vessel time, since the samples can be obtained at an insignificant marginal cost during regularly scheduled ocean surveys sponsored by CalCOFI. It also requires much less laboratory time, data management and analysis than an EPM estimate. No EPM estimate has been conducted since 1985 because of: (1) the near absence of a reduction fishery in the U.S. in recent years due to lack of profitability and (2) the need to divert limited funds to assessment of other managed species.

Implementation costs, as reflected in the frequency of EPM estimation relative to Stock Synthesis estimation, are not expected to vary significantly among the options, for the following reasons:

1. As indicated by the simulation results in Table 8.0-3, lack of profitability is expected to close the reduction fishery in about 11 percent of all years for each of the nine options being considered. Thus, to the extent that lack of profitability impacts the frequency of EPM estimates, no difference among options should be expected.

2. Fishery managers and the fishing industry will likely be especially aware of the need to monitor the stock when abundance is low. The conservation rationale for frequent EPM estimates at low levels of abundance may be particularly compelling under Options 1-3, which allow some harvests even at very low levels of abundance. On the other hand, there may be a compelling economic rationale for frequent EPM estimates at low levels of abundance under Options 1L-3L and 1L*-3L*, since even a small change in spawning biomass from below to above 50,000 mt could have a major economic impact on the non-reduction fishery and on the recreational fishery that it supports. Thus the frequency and cost of EPM spawning biomass estimates would probably be similar under any of the proposed options.

8.4 Monitoring and Enforcement Costs

8.4.1 Reduction and Non-Reduction Fisheries (Other Than Live Bait)

Monitoring of reduction landings under the current FMP involves two activities: (1) tracking the amount of anchovy landed when the fishery is open, and (2) ensuring that no fishing takes place during periods of fishery closure. The State of California requires that processors report landings of all commercially harvested species to the CDFG. The State imposes a "use tax" on all landings on the basis of receipts provided by the canneries. These same landings receipts are used to monitor anchovy reduction landings. CDFG also conducts dockside surveillance to ensure that no fishing occurs when the reduction fishery is closed. This surveillance is conducted as an adjunct to other CDFG activities (e.g., sampling of other species) which take place at the cannery docks.

The current FMP also requires monitoring of landings for non-reduction uses (other than live bait). Compliance with the non-reduction quota is monitored in the same manner as compliance with the reduction quota (i.e., via landings receipts).

All of the other options being considered impose limits on reduction and non-reduction landings similar to the status quo. Therefore, monitoring and enforcement costs for the reduction and non-reduction fisheries (other than live bait) are likely to be the same, regardless of which option is chosen.

8.4.2 Live Bait Fishery

Because the status quo (Option 1) imposes no restrictions on live bait catch, no monitoring of the live bait fishery is required. The same would be true for Options 2 and 3. However, Options 1L-3L and 1L*-3L* impose additional responsibilities with regard to monitoring live bait catch when the live bait fishery is closed.

Unlike catches that are intended for other uses, live bait catches cannot be monitored via landings receipts because they are not landed. Live bait boats typically contract with partyboats to supply bait for a fraction of passenger fee revenues. Direct at-sea transactions between bait boats and partyboats sometimes occur as the partyboats are enroute to the fishing grounds. Live bait that is not sold in this manner is transferred to receivers that are tied up at dock. Bait contained in the receivers is sold to partyboats and also to anglers on privately owned boats.

Monitoring of live bait catches at low levels of spawning biomass could theoretically be accomplished by:

1. expanding the scope of current patrol boat activity by state wardens to monitor the contents of bait receivers and at-sea transactions between bait boats and partyboats; or

2. placing observers aboard live bait boats to monitor catches.

The operational feasibility of monitoring live bait catches is questionable, regardless of which approach is taken. As indicated in Section 5.2.2, there is likely to be considerable co-mingling of anchovies with other species in the nearshore areas fished by the bait fleet. If one of Options 1L-3L and 1L*-3L* is adopted, it may be necessary to specify incidental catch allowances for anchovy taken during fishing for other species when the anchovy fisheries are closed due to low abundance. Monitoring and enforcing incidental take allowances for the live bait fishery would be difficult, since it would require sampling of catches that are alive and highly motile. Accurate estimation of incidental take may not be possible without causing some mortality to the fish in baitwells and receivers (C. Cooney, California Department of Fish and Game, pers. comm.). Options 1L*-3L* provide a practical advantage relative to Options 1L-3L in that a spawning biomass estimate less than 50,000 mt in the first season could be used to trigger preparations (e.g., analyses used to specify incidental catch allowances) for possible closure in the second season.

8.5 Compliance Costs and Record-Keeping Requirements

California state law requires processors and fishing vessels to obtain permits (free of charge) in order to engage in reduction fishing activities. Vessels that fish for reduction and non-reduction (other than live bait) purposes are required to provide processors with landings-related information, which is recorded on landings receipts for submission to CDFG. This recordkeeping requirement would continue, even in the absence of the FMP, in order to satisfy ongoing state requirements for information about commercial landings.

The live bait fleet currently provides records on catch to the CDFG on a voluntary basis. None of the options considered in this amendment relies on these logbooks for any purpose, nor do they impose any other compliance or recordkeeping requirements on the live bait fishery.

9.0 RECOMMENDED OPTIONS

9.0.1 Reduction OY Formula

The Council has deferred the final decision on this issue until the U.S. Fish and Wildlife Service issues a revised opinion, pursuant to formal consultation with NMFS under Section 7 of the Endangered Species Act, as to how the unconditional option (i.e., 7,000 mt reduction OY when the spawning biomass is less than 300,000 mt) would affect brown pelicans (see Section 2.3). In the interim, the Council recommends no modification to the existing OY formula (i.e., the status quo option). Under the status quo option, reduction OY is (a) 0 when the spawning biomass is less than or equal to 300,000 mt and (b) the difference between the spawning biomass and 300,000 mt, up to a limit of 200,000 mt, when the spawning biomass is greater than 300,000 mt. The status quo is the most conservative of the options considered and provides ample protection for the anchovy stock and brown pelicans.

9.0.2 Definition of Overfishing

The preponderance of evidence from the simulation model and from historical data suggests that the least restrictive no-lower-cutoff option for the definition of overfishing is sufficiently conservative to protect the stock from overfishing. The basis for this conclusion is that: (1) low levels of spawning biomass are unlikely to occur, (2) harvests by the reduction and non-reduction fisheries (including live bait) are expected to be modest when spawning biomass levels are low, and (3) modest levels of harvest at low levels of spawning biomass are not expected to significantly affect the stock's ability to recover from low levels of biomass.

Under the least restrictive option for amending the reduction OY formula (the unconditional option), the no-lower-cutoff option for the definition of overfishing would allow only a modest reduction harvest (7,000 mt) at low levels of spawning biomass. Moreover, even this level of harvest may not occur since reduction fishing is not expected to be profitable at low levels of abundance (see Section 8.2.1). Records on live bait catch (going back to 1939) and on other non-reduction harvests (going back to 1965) indicate that non-reduction harvests have historically been modest, even in the absence of regulation (Table 4.3-1).

The modest reduction and non-reduction harvests that occur at low levels of spawning biomass are not expected to significantly affect the stock's ability to rebound from low levels of abundance. Results from the simulation model indicate that time to recovery will not be significantly affected, regardless of whether or not a lower cutoff is imposed (see Section 8.1). This conclusion is supported by historical data, which indicate that the stock was able to rebound from low levels of abundance in the mid-1950s (Table 2.1-1), despite annual harvests of 25,000 mt to 30,000 mt (Table 4.3-1).

The Council, however, is aware that: (1) the simulation model was parameterized with data from medium- to high-biomass years so results for low biomass years may be unreliable, and (2) the ability of the stock to rebound from low levels in the 1950s may have been partially due to favorable environmental conditions that may not exist in the future. Thus modest harvests by the reduction, live bait, and other non-reduction fisheries when biomass levels are low may, despite the results of analyses described above, have adverse effects on the long-term productivity of the stock. In view of these uncertainties, Council recognizes the desirability of a definition of overfishing that curtails all fishing at low levels of spawning biomass.

The Council also recognizes (1) the relative imprecision with which spawning biomass in the most recent season is estimated in the absence of an EPM measurement and/or when spawning biomass is low (Jacobson and Lo 1989, 1990)(see Section 8.3), (2) enforcement problems and adverse economic effects associated with curtailing the live-bait fishery for anchovy (see Sections 8.2.2 and 8.4.2), and (3) similarity in the expected biological and economic effects of the lower-cutoff and two-year-lower-cutoff options (see Sections 8.1-8.2).

An advantage of the two-year-lower-cutoff option is that a spawning biomass estimate less than 50,000 mt in the first season could be used to: (1) trigger preparations (e.g., analyses used to specify incidental catch allowances, see Section 8.4.2) for possible closure in the second season and (2) improve data collection and spawning biomass estimation procedures prior to making the spawning biomass estimate that might result in closure during the second season. Another advantage of the two-year-lower-cutoff option relative to the lower-cutoff option is reduced likelihood that the fishery would be closed due to a single erroneous or imprecise spawning biomass estimate.

Given the desirability of a cutoff, the enforcement and economic problems associated with a cutoff, apparent similarity of the lower-cutoff and two-year-lower-cutoff options, and other advantages, Council recommends adoption of the two-year-lower-cutoff for the definition of overfishing.

10.0 RECOMMENDATIONS FOR FUTURE AMENDMENTS

The Council recommends that the anchovy FMP be reviewed when any of the following situations occur:

1. A bilateral management agreement is reached with Mexico.

2. Fisheries develop or management plans are adopted for other California pelagic species which significantly affect the operation of, or value of, the anchovy fishery.

3. A substantial anchovy fishery develops for human consumption.

4. Scientifically documented information becomes available regarding:

   a. adverse impact of the anchovy fishery on other species of animal or plant life, especially those listed as endangered or threatened;

   b. adverse impact of the commercial fishery on the abundance and/or availability of live bait and predator fish;

   c. change in the anchovy population response to exploitation.

5. An opinion issued by the U.S. Fish and Wildlife Service indicates that a small increase in reduction OY at low levels of spawning biomass would have no deleterious effects on brown pelicans.

11.0 TABLES AND FIGURES

Table 2.1-1. Total and spawning biomass of northern anchovy estimated with the stock synthesis model during 1954-1989 (mt).

	Biomass on Feb. 15	
Year	Total	Spawning
1954	63,570	54,760
1955	53,610	37,920
1956	45,990	25,420
1957	153,920	141,160
1958	213,410	213,150
1959	182,370	182,160
1960	118,580	118,470
1961	170,820	160,900
1962	357,500	214,170
1963	563,040	520,210
1964	645,000	639,000
1965	723,000	528,000
1966	556,000	541,000
1967	385,000	368,000
1968	358,000	340,000
1969	357,000	335,000
1970	350,000	273,000
1971	628,000	264,000
1972	932,000	523,000
1973	1,362,000	1,335,000
1974	1,648,000	1,094,000
1975	1,400,000	1,204,000
1976	983,000	947,000
1977	787,000	786,000
1978	429,000	429,000
1979	828,000	544,000
1980	764,000	757,000
1981	772,000	736,000
1982	464,000	419,000
1983	550,000	533,000
1984	377,000	371,000
1985	681,000	532,000
1986	607,000	601,000
1987	594,000	583,000
1988	369,000	336,000
1989	1,008,000	237,000

Source: Data for 1954-1963 from Methot, R.D. 1989. Synthetic estimates of historical abundance and mortality for northern anchovy. In E. Vetter and B. Megrey, eds. Mathematical analysis of fish stock dynamics: reviews, evaluations and current applications. Am. Fish. Soc. Symp. Ser. No. 6. American Fisheries Society, Bethesda, MD.

Data for 1964-1988 from L. Jacobson, pers. comm. See also Jacobson, L.D. and N.C.H. Lo. 1989. Spawning biomass of the northern anchovy in 1989. NMFS, SWFC Admin. Rep. LJ-89-17, Figure 2.

Table 4.3-1. Northern anchovy landings in California and Mexico during 1916-1988 (mt). California landings constitute virtually all of the landings in the United States.*

	California Landings						
Year	Reductn	Non Red**	Total	Calif. Live Bait	Total Calif.	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
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

* Separate statistics on reduction and non-reduction landings in California are available beginning in 1965, when a separate reduction quota was first established.

** Includes anchovy used for canning, consumption as fresh fish, freezing and dead bait.

Sources:

1. Data for 1962-1974 Mexican landings from Chavez, H. et.al. 1977. The fishery for northern anchovy, *Engraulis mordax*, off California and Baja California in 1975. CalCOFI Rept. 19: 147-165.
2. Data for 1975-1988 Mexican landings from Larry Jacobson, pers. comm.
3. Data for 1916-1964 California reduction landings and 1939-1964 live bait catches from Council. 1983. Northern Anchovy Fishery Management, Tables 3.2-1 and 3.2-2.
4. Data for 1965-1988 California reduction, non-reduction and live bait harvests from Thomson, C. et.al. 1989. Status of the California Coastal Pelagic Fisheries in 1988. NMFS, SWFC Admin. Rep. LJ-89-14. Also previous issues of the same report.

Table 6.2-1. Anchovy reduction landings and quota (mt), by season and area

	Southern Area		Northern Area		Total	
Season	Landings	Quota	Landings	Quota	Landings	Quota
1978/79	47,698	47,627	1,065	5,292	48,763	52,919
1979/80	30,023	96,253	2,114	9,072	32,137	105,325
1980/81	56,266	141,885	4,297	9,072	60,563	150,957
1981/82	43,509	361,154	4,493	9,072	48,002	370,226
1982/83	4,482	203,846	1,222	9,072	5,704	212,918
1983/84	79	95,709	1,601	9,072	1,680	104,781
1984/85	71	10,080	0	1,120	71	11,200
1985/86	0	130,928	1,371	9,072	1,371	140,000
1986/87	0	130,928	38	9,072	38	140,000
1987/88	0	130,928	111	9,072	111	140,000
1988/89	0	130,928	234	9,072	234	140,000

Source: Thomson, C. et.al. 1990. Status of the California Coastal Pelagic Fisheries in 1989. NMFS, SWFC Admin. Rep. LJ-89-13. Also previous issues of the same report.

Table 6.2-2. Mexican reduction landings by month during 1988-1989 (mt)

Month	1989	1988
Jan	--	--
Feb	20	--
Mar	60	--
Apr	4,730	401
May	6,989	3,262
Jun	13,378	14,383
Jul	18,826	36,541
Aug	9,342	9,092
Sep	15,761	10,195
Oct	11,718	4,707
Nov	--	649
Dec	--	--
Total	80,823.1	79,230.0

Source: Jacobson, L.D., and N.C.H. Lo. 1989. Spawning biomass of the northern anchovy in 1989. NMFS, SWFC Admin. Rep. LJ-89-17.

Jacobson, L.D. and N.C.H. Lo. 1990. Spawning biomass of the northern anchovy in 1990. NMFS, SWFC Admin. Rep. LJ-90-20.

Table 7.2-1. Northern anchovy non-reduction catch in California, by season and disposition of catch (mt).*

Season	Live Bait	Other	Total
1979/80	4,036	1,241	5,277
1980/81	4,364	892	5,256
1981/82	4,629	866	5,495
1982/83	3,711	1,363	5,074
1983/84	4,487	1,493	5,980
1984/85	3,838	839	4,677
1985/86	4,180	1,521	5,701
1986/87	3,175	967	4,142
1987/88	4,283	1,511	5,794
1988/89	2,967**	647**	3,614

* Catches are reported to the California Department of Fish and Game via mandatory fish logs. Figures do not reflect actual catches to date because of some delinquent logs.

** Preliminary estimates reflecting catches through April 1989.

Source: Thomson, C. et.al. 1989. Status of the California Coastal Pelagic Fisheries in 1988. NMFS, SWFC Admin. Rep. LJ-89-14. Also previous issues of the same report.

Table 7.3-1. Summary of options. The maximum reduction OY for all options is 200,000 mt. All figures expressed in mt. Abbreviations "SB" used for spawning biomass, "TB" for total biomass and "K" for thousands.[1]

		Optimum Yield		
Option	Conditions	Reduction	Live Bait	Other Non-Red
Reduction quota options combined with No-Lower-Cutoff Option for the definition of overfishing:				
1. Status Quo	SB≤300K	0	Unlim	7K
	SB>300K	SB-300K	Unlim	7K
2. Unconditional	SB≤307K	7K	Unlim	7K
	SB>307K	SB-300K	Unlim	7K
3. Conditional	TB≥375K and			
	SB≤307K	7K	Unlim	7K
	SB>307K	SB-300K	Unlim	7K
	TB<375K and			
	SB≤300K	0	Unlim	7K
	SB>300K	SB-300K	Unlim	7K
Reduction quota options combined with Lower-Cutoff Option for the definition of overfishing:				
1L. Status Quo	SB<50K	0	0	0
	50K≤SB≤300K	0	Unlim	7K
	SB>300K	SB-300K	Unlim	7K
2L. Unconditional	SB<50K	0	0	0
	50K≤SB≤307K	7K	Unlim	7K
	SB>307K	SB-300K	Unlim	7K
3L. Conditional	TB≥375K and			
	SB<50K	0	0	0
	50K≤SB≤307K	7K	Unlim	7K
	SB>307K	SB-300K	Unlim	7K
	TB<375K and			
	SB<50K	0	0	0
	50K≤SB≤300K	0	Unlim	7K
	SB>300K	SB-300K	Unlim	7K

Table 7.3-1 (Continued)

		Optimum Yield		
Option	Conditions	Reduction	Live Bait	Other Non-Red
Reduction quota options combined with Two-Year-Lower-Cutoff Option for the definition of overfishing:				
1L*. Status Quo	SB<50K (2nd season)	0	0	0
	SB<50K (1st season)	0	Unlim	7K
	50K≤SB≤300K	0	Unlim	7K
	SB>300K	SB-300K	Unlim	7K
2L*. Unconditional	SB<50K (2nd season)	0	0	0
	SB<50K (1st season)	7K	Unlim	7K
	50K≤SB≤307K	7K	Unlim	7K
	SB>307K	SB-300K	Unlim	7K
3L*. Conditional	TB≥375K and			
	SB<50K (2nd season)	0	0	0
	SB<50K (1st season)	7K	Unlim	7K
	50K≤SB≤307K	7K	Unlim	7K
	SB>307K	SB-300K	Unlim	7K
	TB<375K and			
	SB<50K (2nd season)	0	0	0
	SB<50K (1st season)	0	Unlim	7K
	50K≤SB≤300K	0	Unlim	7K
	SB>300K	SB-300K	Unlim	7K

[1] Reduction and non-reduction quotas for U.S. fishermen are 70 percent of the figures shown for "Reduction" and "Other Non-Red" fishing.

Table 8.0-1. Ex-vessel prices (1988 $'s/mt) for anchovy taken by the U.S. non-reduction (excluding live bait) fishery during 1980-1988.

Year	Price
1980	$ 296
1981	97
1982	313
1983	246
1984	450
1985	518
1986	187
1987	184
1988	292

Source: Thomson, C. et.al. 1989. Status of the California Coastal Pelagic Fisheries in 1988. NMFS, SWFC Admin. Rep. LJ-89-14. Also previous issues of the same report.

Table 8.0-2. U.S. reduction landings (mt) and ex-vessel prices (1988 $'s/mt) for northern anchovy during 1974-1989

Year	U.S. Reduction Landings	Price
1974	73,401	$99
1975	141,586	68
1976	112,270	76
1977	99,674	92
1978	10,339	87
1979	47,408	77
1980	43,699	79
1981	51,290	79
1982	43,742	51
1983	2,854	46
1984	1,722	37
1985	825	33
1986	546	29
1987	149	28
1988	234	32

Source: Thomson, C. et.al. 1989. Status of the California Coastal Pelagic Fisheries in 1988. NMFS, SWFC Admin. Rep. LJ-89-14. Also previous issues of the same report.

Table 8.0-3. Results of simulation analyses.

	Options		
	1,1L,1L* StatQuo	2,2L,2L* Uncond	3,3L,3L* Cond
Total biomass (million mt)			
Mean	0.84	0.84	0.84
Standard deviation	0.46	0.46	0.46
Coefficient of variation	54%	54%	54%
Reduction catch (million mt)			
Mean	0.15	0.15	0.15
Standard deviation	0.077	0.077	0.077
Coefficient of variation	51%	51%	51%
Reduction profit (million $)			
Mean	3.7	3.7	3.7
Standard deviation	2.6	2.6	2.6
Coefficient of variation	70%	70%	70%
Brown pelican breeding success (fledglings/pair)			
Mean	0.99	0.99	0.99
Standard deviation	0.14	0.14	0.14
Coefficient of variation	15%	15%	15%
Intervals with no reduction landings			
% of years	15%	11%	11%
Mean number per 100 years	9.2	5.9	6.1
Mean length of intervals	1.7	1.9	1.9
Intervals with no reduction landings due to no quota			
% of years	13%	0%	9%
Mean number per 100 years	8.3	0.0	5.0
Mean length of intervals	1.6	0.0	1.8
Intervals with no reduction landings due to no potential profit			
% of years	11%	11%	11%
Mean number per 100 years	5.9	5.9	5.9
Mean length of intervals	1.9	1.9	1.9
Percent of years when spawning biomass ≤ criteria levels			
Criteria level			
300K mt	13.0%	13.0%	13.0%
200K mt	4.3%	4.3%	4.3%
100K mt	0.5%	0.5%	0.5%
90K mt	0.4%	0.4%	0.4%
80K mt	0.2%	0.2%	0.2%
70K mt	0.1%	0.1%	0.1%
60K mt	0.0%	0.0%	0.0%

Table 8.2-1. Production, imports, exports and total supply of fishmeal in the U.S. during 1960-1988 (thousands of mt).

	Domestic Production					
Year	Anchovy	Other*	Total	Imports	Exports	Supply
1960	0.0	263.2	263.2	119.7	---	382.9
1961	0.0	282.4	282.4	197.6	---	480.0
1962	0.0	283.3	283.3	228.9	---	512.2
1963	0.0	232.2	232.2	341.4	---	573.5
1964	0.0	213.5	213.5	398.3	---	611.8
1965	0.0	230.5	230.5	245.6	---	476.1
1966	4.1	199.3	203.4	406.2	---	609.6
1967	5.1	186.5	191.6	591.0	---	782.6
1968	2.5	210.8	213.3	233.1	---	446.3
1969	10.3	218.9	229.2	143.3	---	372.6
1970	14.7	229.5	244.2	105.1	4.3	345.1
1971	7.0	258.6	265.6	256.9	9.2	513.4
1972	10.1	248.9	259.0	355.6	9.4	605.2
1973	20.0	233.2	253.2	62.1	33.3	282.0
1974	12.8	251.8	264.6	62.0	50.3	276.2
1975	25.1	228.3	253.4	107.4	10.7	350.1
1976	20.1	251.2	271.3	127.4	30.0	368.6
1977	17.3	231.1	248.4	73.9	32.7	289.6
1978	1.9	319.0	320.9	39.8	46.0	314.7
1979	9.0	320.2	329.2	81.3	14.2	396.3
1980	7.1	315.2	322.3	44.9	77.4	289.8
1981	9.3	272.0	281.3	53.9	42.6	292.6
1982	7.3	323.1	330.4	76.5	16.2	390.6
1983	0.5	338.5	339.0	61.6	70.2	330.4
1984	0.0	334.7	334.7	75.7	18.3	392.0
1985	0.0	319.6	319.6	231.6	31.4	519.8
1986	0.0	308.1	308.1	168.1	34.9	441.3
1987	0.0	349.6	349.6	178.6	46.9	481.4
1988	0.0	283.5	283.5	120.4	111.8	292.1

* Consists largely of menhaden meal produced on the Atlantic and Gulf coasts and modest amounts of tuna-mackerel meal.

Source: Bureau of Commercial Fisheries. 1960-1970. Fishery statistics of the United States.

National Marine Fisheries Service. 1971-1988. Fisheries of the United States.

Table 8.2-2. Estimated number of recreational fishing trips in California by fishing mode (thousands of trips) and percentage by out-of-state residents during 1981-1987.*

Year	Shore	Party/ Charter	Private/ Rental	Total	% by Out-of-State Residents
1981	3,748	1,429	2,775	7,952	6.8%
1982	3,483	2,274	2,546	8,302	8.1%
1983	3,613	1,629	2,893	8,135	7.4%
1984	3,742	1,349	3,199	8,292	6.9%
1985	3,438	1,378	2,989	7,804	7.2%
1986	3,539	1,538	3,801	8,876	7.0%
1987**	2,835	1,073	3,695	7,604	6.0%

* Excludes trips targeted on salmon and striped bass and all boat trips that originated in the U.S. but fished in Mexican waters.

** Preliminary estimates.

Source: National Marine Fisheries Service. 1981-1986. Marine Recreational Fishery Statistics Survey, Pacific coast. Current Fishery Statistics 8323, 8325, 8328, 8393.

J. Witzig, National Marine Fisheries Service, Washington, D.C., pers. comm. for 1987 estimates.

Table 8.2-3. Reported catch by California commercial passenger fishing vessels by species group during 1970-1988 (thousands of fish)*

Year	Bass	Bonito & Barracuda	Tuna	Rockfish	Other	Total
1970	927	1,026	99	2,726	853	5,631
1971	953	203	45	2,286	1,117	4,604
1972	847	457	147	3,159	852	5,462
1973	663	565	236	3,651	808	5,923
1974	622	197	140	4,125	607	5,691
1975	503	107	105	4,005	634	5,354
1976	658	305	116	3,678	392	5,149
1977	400	211	106	3,263	869	4,849
1978	477	389	149	3,021	1,220	5,256
1979	463	606	87	3,789	1,705	6,647
1980	586	588	81	3,412	1,741	6,408
1981	740	724	121	3,381	1,348	6,315
1982	587	292	77	3,139	1,275	5,371
1983	463	430	417	2,377	938	4,625
1984	360	465	349	2,040	959	4,172
1985	572	196	227	2,064	1,090	4,150
1986	702	429	78	1,828	1,038	4,075
1987	735	675	90	1,742	861	4,103
1988	773	399	91	1,959	1,104	4,326

* "Bass" includes kelp/sand bass and white sea bass.
"Tuna" includes albacore/bluefin/skipjack/yellowfin tuna and yellowtail.
"Rockfish" includes rockfish and lingcod.

Source: California Department of Fish and Game. 1970-1988. Report of fish caught by the California commercial passenger fishing vessel fleet.

ANCHOVY FISHERY

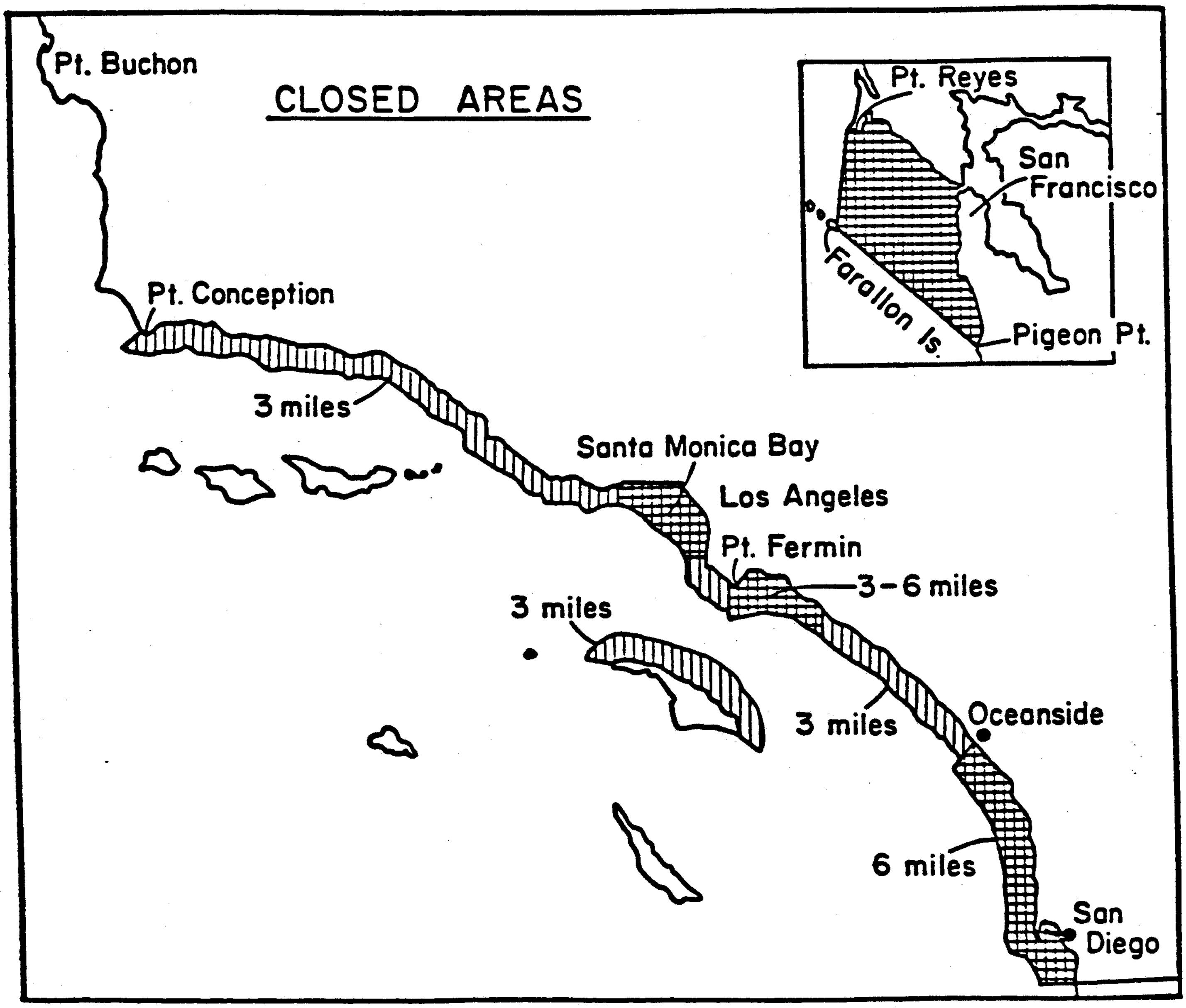

FIGURE 1. AREAS CLOSED TO ANCHOVY REDUCTION FISHING

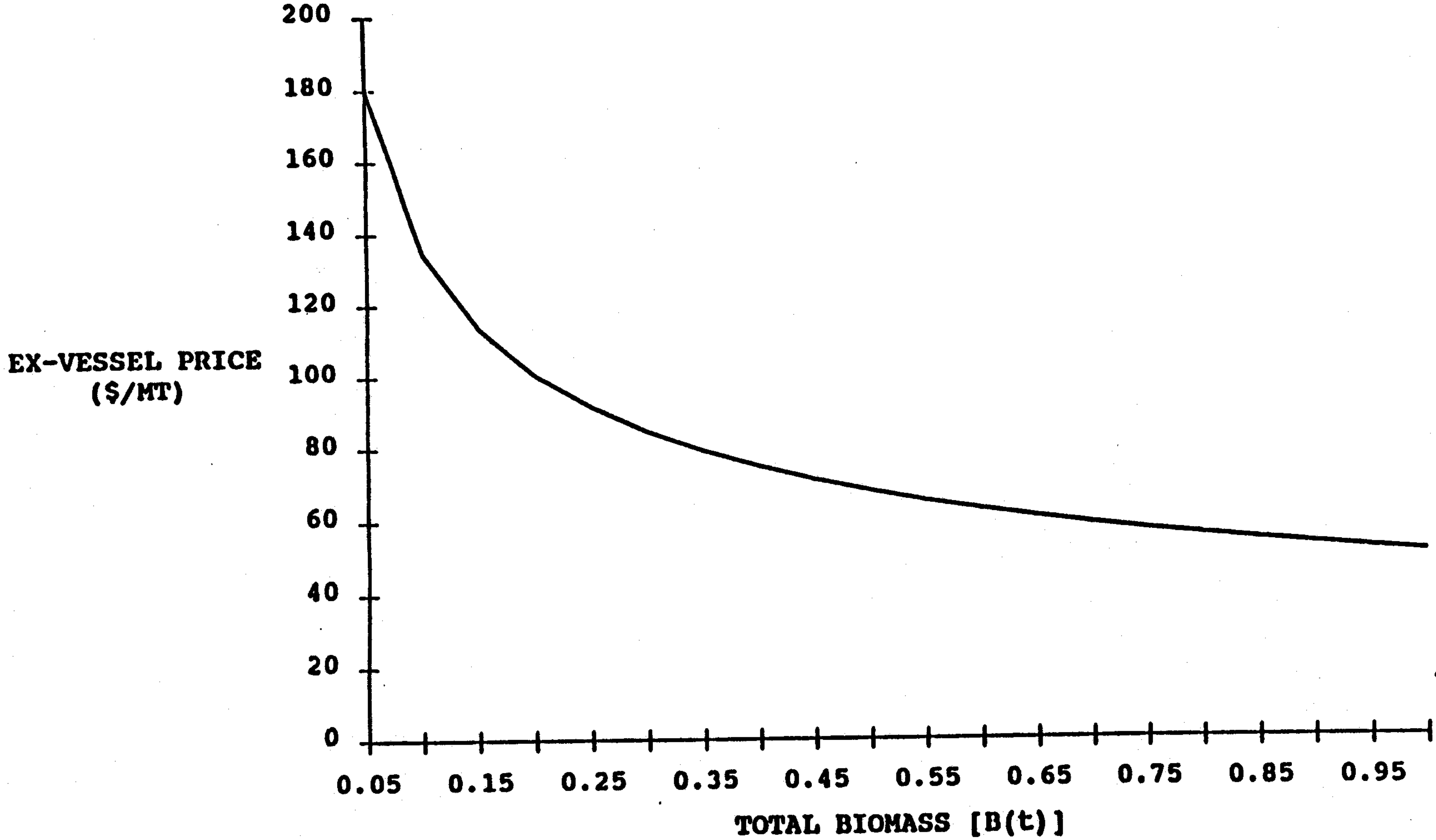

FIGURE 2. RELATIONSHIP BETWEEN BREAKEVEN EX-VESSEL PRICE AND TOTAL BIOMASS

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October 14, 1986 F/M11:DAH

To: Distribution*

From: F/M11 - Austin R. Magill

Subject: Structurally Complete Review of Amendment 7 to the "Fishery Management Plan for Commercial and Recreational Salmon Fisheries Off the Coasts of Washington, Oregon, and California Commencing in 1978."

Please review the attached amendment and associated documents for structural completeness and provide your findings to Davis Hays by C.O.B., Thursday, October 16, 1986 (673-5272).

Attachments

Distribution*

F/M11-Magill, Hays, Surdi
F/M12 - Haynes
F/S2 - Holliday
GCF - Cooney
F/M5 - Pallozzi
F/M1 - Fricke
GCEL - Frailey

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Joe Easley

EXECUTIVE DIRECTOR
Joseph C. Greenley

October 9, 1986

Mr. Rolland Schmitten, Director
Northwest Region
National Marine Fisheries Service
7600 Sand Point Way, NE.
BIN C15700
Seattle, WA 98115

Dear Rollie:

Enclosed is the "Seventh Amendment to the Fishery Management Plan for Commercial and Recreational Salmon Fisheries Off the Coasts of Washington, Oregon, and California Commencing in 1978." The three issues in this amendment package were identified in a "scoping" session on July 11, 1985 and, after development and several Council revisions, were sent to public hearing on August 27 and 28, 1986. The Council selected preferred options and adopted the amendment on September 18, 1986. This letter requests your formal review and approval of the three proposed amendment issues for implementation in the 1987 ocean salmon fishery season.

The three Council preferred amendment issue options propose to (1) provide a formula for deviating from the maximum sustained yield spawning escapement goal for Oregon coastal natural (OCN) coho when the OCN stock size is below 400,000 returning adults, (2) increase the flexibility in making inseason management changes beyond simply adding two new specific optional measures, and (3) provide for a new harvest allocation schedule for coho salmon south of Cape Falcon which increases the share for the recreational fishery while allowing for a "roll-over" provision to redistribute any excess allocation inseason. The Council believes its perferred option for each of the three issues will improve the effectiveness and efficiency of the management process under the framework plan, is necessary for the conservation and management of the salmon fishery, and is consistent with the Magnuson Fishery Conservation and Management Act and other applicable law.

The Council's amendment package contains a discussion of the alternatives for each amendment issue which includes an analysis of potential environmental impacts. Appendix A contains an environmental assessment which cross references and consolidates the information from the more detailed issue discussions and the regulatory impact review/initial regulatory flexibility analysis (RIR/IRFA). The Council concluded that there will be no significant impact on the environment as a result of this amendment.

Appendix B contains the RIR/IRFA. The coastal zone consistency statement is contained in Appendix C, and consistency with other applicable law is reviewed in Appendix D. Council staff have reviewed draft regulations prepared by the National Marine Fisheries Service and they appear to accurately reflect the Council's amendment recommendations.

Thank you for consideration of this important salmon fishery management plan amendment.

Sincerely,

for Joseph C. Greenley
Executive Director

JCC:rcb
Enclosure
cc: SW Region
NMFS-DC