COASTAL PELAGIC SPECIES FISHERY MANAGEMENT PLAN

SARDINE EXCERPTS

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1.2 Stocks in the Fishery Management Plan

1.2.1 Management Unit Species

Table 1-1 includes the fishery management unit species which are "in the fishery" and subject to provisions of the CPS FMP.

Table 1-1. Stocks managed under this FMP.

Common Name	Scientific Name
Pacific sardine	*Sardinops sagax*
Northern subpopulation	
Pacific (chub) mackerel	*Scomber japonicus*
Northern anchovy	*Engraulis mordax*
Central and northern subpopulations	
Market squid	*Doryteuthis opalescens*
Jack mackerel	*Trachurus symmetricus*
Krill or Euphausiids	*All Species in West Coast EEZ*
Including these eight dominant species.	*Euphausia pacifica*
First two species are common and are	*Thysanoessa spinifera*
most likely to be targeted by fishing	*Nyctiphanes simplex*
	Nematocelis difficilis
	T. gregaria
	E. recurva
	E. gibboides
	E. eximia

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

1.2.2 Ecosystem Component Species

Table 1-2. EC species under this FMP:

Common Name	Scientific Name
Pacific herring	*Clupea pallasii pallasii*
Jacksmelt	*Atherinopsis californiensis*

OFL	BIOMASS * F_{MSY} * DISTRIBUTION
ABC	BIOMASS * BUFFER * F_{MSY} * DISTRIBUTION

To some extent, the existing harvest control rules for some managed species merge scientific uncertainty and OY considerations thereby providing additional reductions from OFL levels, particularly during warm temperature regimes. Therefore, harvest control rules will be considered in conjunction with ABC control rules to prevent overfishing (see Section 4.6).

4.3 Definition of Overfishing

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

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

4.4 Definition of an Overfished Stock

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

4.5 Rebuilding Programs

Management of overfished CPS stocks must include a rebuilding program that can, on average, be expected to result in recovery of the stock to MSY levels in ten years. It is impossible to develop a rebuilding program that would be guaranteed to restore a stock to the MSY level in ten years, because CPS stocks may remain at low biomass levels for more than ten years even with no fishing. The focus for CPS is, therefore, on the average or expected time to recovery based on realistic projections. If the expected time to stock recovery is greater than ten years due to reasons outlined in the MSA at 50 CFR § 600.310(j)(3)(i), the Council and the Secretary may consider extending the time period.

Rebuilding programs for CPS may be an integral part of the harvest control rule or may be developed or refined further in the event that biomass of a CPS stock reaches the overfished level. If a stock is overfished, for the period between when it is determined to be overfished and the effective date of a rebuilding plan, the Council shall consider whether to allow any harvest of the overfished stock and what the appropriate interim harvest level should be.

4.5.1 Rebuilding Plan for Pacific Sardine

In July 2019, the National Marine Fisheries Service notified the Council that it had declared the Pacific

sardine stock overfished. The declaration came as a result of the 2019 Pacific sardine stock assessment indicating that the stock had declined below its MSST of 50,000 mt. A rebuilding plan was adopted by the Council in September 2020 and implemented as Amendment 18. The rebuilding plan was modified by the Council in November 2024. The rebuilding reference points for Pacific sardine are:

Tmin = 12 years

Tmax = 24 years

Ttarget = 17 years

Rebuilding target = 150,000 mt of age 1+ biomass

The OFL, ABC, and ACL will be set annually based on stock assessments, the control rules in the FMP and recommendations from the SSC regarding uncertainty in the assessment and OFL. Under the rebuilding plan, the ACL will be set as follows:

- When the age 1+ biomass is 50,000 mt or less; ACL = 2,200 mt or the ABC, whichever is lower
- When the age 1+ biomass is greater than 50,000 mt; ACL = 5 percent of the age 1+ biomass or the ABC, whichever is lower

The management measures under the Pacific sardine Rebuilding Plan include the following:

- The primary directed fishery for Pacific sardine will be closed until the biomass reaches or exceeds 150,000 mt (i.e., the Rebuilding target and CUTOFF in the HG control rule);
- Incidental limits in other primary directed CPS fisheries are restricted to no more than 20 percent Pacific sardine per landing until the biomass reaches or exceeds 50,000 mt (i.e., the MSST for Pacific sardine);
- The minor directed fisheries are limited to 1 mt of Pacific sardine per trip per day;
- Live bait harvest is not specifically constrained under the Rebuilding Plan but is subject to management measures that will be reviewed during the Council's annual specifications process; and
- Other management measures the Council may recommend (e.g., incidental catch limits in non-CPS fisheries)

The population dynamics of small coastal pelagic fish such as Pacific sardine are highly influenced by environmental conditions. Although fishing pressure can also impact the population dynamics of small pelagics, it is generally agreed that under current sardine management, harvest is a lesser factor in sardine population status than environmental factors. Historical analysis of marine sediment layers (Baumgartner et al, 1992) conclude that the sardine population is prone to long periods of decline even in the absence of fishing.

4.6 Harvest Control Rules

For CPS, a harvest control rule is defined to be a harvest strategy that provides biomass levels at least as high as the F_{MSY} approach while also providing relatively high and relatively consistent levels of catch. An MSY control rule is a harvest strategy which, if implemented, would be expected to result in a long-term average catch approximating MSY. Similarly, MSY stock size (Bmsy) (defined at 50 CFR 600.310(e)(1)(i)(C)) "means the long-term average size of the stock or stock complex, measured in terms

resource status and fishery dynamics.

OFL	*BIOMASS * F_{MSY} * DISTRIBUTION*
ABC	*BIOMASS * BUFFER * F_{MSY} * DISTRIBUTION*
ACL	*LESS THAN OR EQUAL TO ABC*
HG	*(BIOMASS - CUTOFF) * FRACTION * DISTRIBUTION.*
ACT	*EQUAL TO HG OR ACL, WHICHEVER VALUE IS LESS*

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

4.6.4 Harvest Control Rule for Pacific Sardine[2]

The Harvest Control Rule for Pacific sardine includes OY considerations and will be used to calculate an HG or ACT for the entire sardine stock, but cannot exceed ABC. The harvest control rule is based on an estimate of biomass for the whole sardine stock, a CUTOFF equal to 150,000 mt, a FRACTION[2] between five percent and 15 percent (depending on oceanographic conditions as described below), a U.S. DISTRIBUTION of 87 percent, and MAXCAT of 200,000 mt. The U.S. ABC is calculated from the target harvest for the whole stock by prorating the total ABC based on proportion of total biomass in U.S. waters.

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

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

where T is the average three season sea surface temperature at Scripps Pier, California during the three preceding seasons. The harvest control rule for sardine sets the control rule parameter FRACTION equal to F_{MSY} except that FRACTION is never allowed to be higher than 15 percent or lower than 5 percent. OFL and ABC calculations may be limited to a range of sea-surface temperatures dependent upon the recommendation of the SSC and based on the best available science. For example, under the analysis for Amendment 13, the CPSMT and the SSC recommended limiting OFL and ABC calculations by the interquartile range of SSTs, which span three-season averages from 1916-19 through 1994-97. The lower quartile SST for this period was 16.61 °C, with a corresponding F_{MSY} of 0.0200. The upper quartile SST

[2] In November 2014, the Council adopted a revised temperature-recruitment relationship, established a new temperature index, and adopted a revised FRACTION range. The new temperature-recruitment relationship is $E_{MSY} = -18.46452 + 3.25209(T) - 0.19723(T^2) + 0.0041863(T^3)$. The new temperature index is the California Cooperative Oceanic Fisheries Investigations (CalCOFI) time series, and the revised harvest FRACTION range is 5-20%. These are described in the November 2014 Council briefing book materials.

was 17.33 °C, with an F_{MSY} of 0.1985.

Although F_{MSY} may be greater or lesser, FRACTION can never be greater than 15 percent or less than 5 percent unless the harvest control rule for sardine is revised, because 5 percent and 15 percent are policy decisions taken by Council based on social, economic, and biological criteria. In contrast, relationships between FRACTION, $F_{MSY,}$ and environmental conditions are technical questions and estimates or approaches may be revised by technical teams to accommodate new ideas and data.

The temperature-dependent F_{MSY} for sardine is unique among F_{MSY} definitions for Council-managed species; to some extent, the existing sardine harvest control rule provides substantial reductions in harvest relative to $F_{MSY,}$ particularly during warm temperature regimes.

4.6.4.1 Definition for Overfished Stock for Sardine

An overfished sardine population is one with a 1+ stock biomass on July 1 of 50,000 mt or less. The Council is required to minimize fishing mortality on an overfished stock to the extent practicable and to undertake a rebuilding program which may be implicit to the harvest control rule or explicit. See Section 4.5 for the Pacific sardine rebuilding plan.

4.6.4.2 Allowable Harvest between the ABC and CUTOFF

The live bait fishery, the minor directed fishery, and other fisheries (e.g., exempted fishing permit) may be allowed to operate when estimated biomass falls below the CUTOFF but above the definition of an overfished stock directed fishing is precluded, and harvests are not expected to exceed the ACL or ABC. This does not prevent the Council from undertaking any measure authorized under this FMP, including a sector-specific ACL, that may be necessary to manage these fisheries and the sardine stock. The live bait and/or minor directed fishery could, for example, be managed by HG or quota, season, or gear restrictions at any point under the framework management process.

4.6.5 Harvest Control Rule for Pacific Mackerel

The harvest control rule for Pacific mackerel sets the CUTOFF and the definition of an overfished stock at 18,200 mt, FRACTION at 30 percent, and a U.S. DISTRIBUTION of 70 percent. Overfishing is defined as any fishing in excess of ABC calculated using the harvest control rule. No MAXCAT is defined because the U.S. fishery appears to be limited to about 40,000 mt per year by markets. The target harvest level is defined for the entire stock in Mexico, Canada, and U.S. waters (not just the U.S. portion), and the U.S. target harvest level is prorated based on relative abundance in U.S. waters.

4.6.6 Market Squid

The MSY Control Rule for market squid is founded generally on conventional spawning biomass "per recruit" model theory. Specifically, the MSY Control Rule for market squid is based on evaluating (throughout a fishing season) levels of egg escapement associated with the exploited population. The estimates of egg escapement are evaluated in the context of a "threshold" that is believed to represent a minimum level that is considered necessary to allow the population to maintain its level of abundance into the future (i.e., allow for "sustainable" reproduction year after year). In practical terms, the Egg Escapement approach can be used to evaluate the effects of fishing mortality (F) on the spawning potential of the stock, and in particular, to examine the relation between the stock's reproductive output and candidate proxies for the fishing mortality that results in MSY (F_{MSY}).

The fishing mortality (F_{MSY}) that results in a threshold level of egg escapement of at least 30 percent is used as a proxy for MSY. The level of egg escapement is reviewed on an intermittent basis in California as new information becomes available concerning the dynamics of the stock and fishery, to ensure that the proposed threshold meets its objective as a long-term, sustainable biological reference point for this marine