SCIENTIFIC AND STATISTICAL COMMITTEE REPORT ON PACIFIC SARDINE STOCK ASSESSMENT AND HARVEST GUIDELINE FOR 2004

Dr. Ramon Conser presented the results of the Pacific sardine stock assessment and the U.S. harvest guideline (HG) for 2004. The assessment considers Pacific sardine from Baja California to British Columbia, and estimates the biomass of animals aged one and older in this region. The assessment model and data analysis are similar to those used in previous years. The model is designed around indices of abundance for central and southern California and accounts for catches off Oregon, Washington, and Canada by allowing for migration from central and southern California to the northern areas. The analysis included the most recent fishery and survey data. The sardine stock biomass on July 1, 2003 was estimated to be approximately one million mt, and the recommended 2004 HG is 122,747 mt. This HG is higher than the 2003 HG of 110,908 mt because two of three 2003 indices are higher than those for 2002. The SSC endorses the use of this HG of 122,747 mt for the 2004 Pacific sardine fishery.

The catch by the U.S. is not likely to reach the harvest guideline in the short-term. However, if the U.S. catch increases, and Mexico and Canada continue to harvest at current levels, the total mortality on the stock may exceed that expected under the maximum sustainable yield (MSY) control rule.

A new sardine model and assessment are being developed. This revised assessment will consider landings and catch-at-age data as well as the results of fishery-independent surveys for Mexico, California, Oregon, Washington, and Canada. A stock assessment review (STAR) panel to review this model is currently planned for May 2004. However, the Coastal Pelagic Species Management Team (CPSMT) recommends that this STAR panel occur during the week of June 21, 2004. The SSC will participate in the STAR panel through its coastal pelagics species subcommittee according to the Terms of Reference for CPS STAR panels developed during 2003. Further, because the SSC CPS Subcomittee chairmanship is in transition, the SSC requests that the NMFS Southwest Fisheries Science Center provide assistance in providing reviewers and logistical support for this STAR panel meeting.

The SSC notes that a significant source of uncertainty in the Pacific sardine assessment is the sparseness of the data for Mexico and the Pacific northwest. In this regard, it strongly supports the increased collaboration among scientists and industry representatives from Mexico, the U.S., and Canada.

PFMC
11/05/03

Exhibit H.1
Situation Summary
November 2003

NATIONAL MARINE FISHERIES SERVICE REPORT ON COASTAL PELAGIC SPECIES MANAGEMENT

Situation: National Marine Fisheries Service will briefly report on recent developments in the coastal pelagic species fishery and other issues of relevance to the Council.

Council Task:

1. Council Discussion.

Reference Materials:

None.

Agenda Order:

a. Informational Update — Svein Fougner
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. Council Discussion

PFMC
10/17/03

Exhibit H.2
Attachment 1
November 2003

Stock Assessment of Pacific Sardine with Management Recommendations for 2004

Executive Summary

by

Ramon J. Conser[1], Kevin T. Hill[1], Paul R. Crone[1], Nancy C.H. Lo[1], and Darrin Bergen[2]

Submitted to:
Pacific Fishery Management Council
7700 NE Ambassador Place, Suite 200
Portland, OR 97220

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Addresses for authors:

[1] NOAA/NMFS
Southwest Fisheries Science Center
8604 La Jolla Shores Dr.
La Jolla, CA 92037

[2] California Department of Fish and Game
Southwest Fisheries Science Center
8604 La Jolla Shores Dr.
La Jolla, CA 92037

This document is available electronically at:
http://swfsc.nmfs.noaa.gov/frd/Coastal%20Pelagics/Sardine/sardine1.htm

Introduction

The following summary presents pertinent results and harvest recommendations from a stock assessment conducted on Pacific sardine (*Sardinops sagax*). It is an update to the stock assessment carried out last year (Conser et al. 2002), and is intended for use by the Pacific Fishery Management Council (PFMC) when developing management goals for the upcoming fishing season for sardine beginning January 2004.

The assessment results presented here are applicable to the sardine population off the North America Pacific coast from Baja California, Mexico to British Columbia, Canada. Research surveys (fishery-independent) have been conducted on an annual basis in the spawning areas off central and southern California. For most of the contemporary time series (1983-98), significant fishing for sardine occurred only off northern Mexico and California (Area 1 or *Inside* Area). As the sardine population rebuilt and expanded its range through the mid-1990's, sardine became more available seasonally off Oregon, Washington, and British Columbia. Subsequently, fisheries in these more northerly areas expanded with significant landings beginning in 2000. As in past assessments, research survey data (fishery-independent) are used to index the size of the sardine spawning biomass; and when coupled in a modelling framework with fishery-dependent data and structural information on sardine biology and migration, provide the stock size estimates and demographics needed by the PFMC to establish harvest guidelines for the USA fisheries.

Methods

An age-structured stock assessment model (CANSAR-TAM, **C**atch-at-age **AN**alysis for **SAR**dine - **T**wo **A**rea **M**odel, see Hill et al.1999) was applied to fishery-dependent and fishery-independent data to derive estimates of population abundance and age-specific fishing mortality rates. In 1998, the original CANSAR model (Deriso et al. 1996) was modified to account for the expansion of the population northward to waters off the Pacific northwest. The models are based on a 'forward-simulation' approach, whereby parameters (e.g., population sizes, recruitments, fishing mortality rates, gear selectivities, and catchability coefficients) are estimated after log transformation using the method of nonlinear least squares. The terms in the objective function (to be minimized) included the sum of squared differences in ($\log_e$) observed and ($\log_e$) predicted estimates from the catch-at-age and various sources of auxiliary data used for 'tuning' the model, e.g., indices of abundance from research survey data. Bootstrap procedures were used to calculate variance and bias (95% confidence intervals) of sardine biomass and recruitment estimates generated from the assessment model. The CANSAR-TAM model was based on two fisheries (California, USA and Ensenada, Mexico) and semesters within a year were used as time steps, with ages being incremented between semesters on July 1 and spawning that was assumed to occur on April 1 (middle of the first semester).

Fishery-dependent data from the California and Ensenada fisheries (García and Sánchez 2003) – 1983 to first semester 2003 – were used to develop the following time series: (1) catch (in mt)-

Table 1 and Figure-1; (2) catch-at-age in numbers of fish; and (3) estimates of weight-at-age. Fishery-independent data (time series) from research surveys included the following indices, which were developed from data collected from Area 1 (*Inside Area*, primarily waters off central and southern California) and used as relative abundance measures (Table 2): (1) index (proportion-positive stations) of sardine egg abundance from California Cooperative Oceanic and Fisheries Investigations (CalCOFI) survey data (*CalCOFI Index*)-Figure 2; (2) index of spawning biomass (mt) based on the Daily Egg Production Method (DEPM) survey data (*DEPM Index*)-Figure 3, see Lo et al. (1996); (3) index of spawning area (Nmi^2) from CalCOFI and DEPM survey data (*Spawning Area Index*)-Figure 4, see Barnes et al. (1997); and (4) index of pre-adult biomass (mt) from aerial spotter plane survey data (*Aerial Spotter Index*)-Figure 5, see Lo et al. (1992). Time series of sea-surface temperatures (Figure 6) recorded at Scripps Pier, La Jolla, California were used to determine appropriate harvest guidelines (*Sea-surface Temperature Index*), see Amendment 8 of the Coastal Pelagic Species Fishery Management Plan, Option J, Table 4.2.5-1, PFMC (1998). Further, the CANSAR-TAM model includes a modified Ricker (1975) spawner-recruit function that constrains recruitment estimates in the last few years. Following Jacobson and MacCall (1995), the modified model includes a term for sea-surface temperature, but the remaining spawner-recruit parameters are fixed per Jacobson and MacCall (1995).

Survey indices of relative abundance were re-estimated using generally similar techniques as was done in previous assessments (Hill et al. 1999; Conser et al. 2000; Conser et al. 2001; and Conser et al. 2002). The final model configuration was based on equally 'weighted' indices except for the CalCOFI index, which was downweighted to 0.7 (relative to 1.0 for the other indices). The relative weight used for the CalCOFI index (0.7) was consistent with previous assessments in which the proportion of the total spawning area covered by the CalCOFI surveys (~70%) was used to determine its relative weighting in the model. Further the CalCOFI Index has undergone considerable saturation in recent years due to the higher frequency of positive stations as the sardine stock expanded throughout and beyond the southern California Bight. As in the previous assessment, the CalCOFI index was fit with a non-unity exponent (0.3547) to allow for a nonlinear relationship between the index and sardine spawning biomass. This procedure produced a better fit to these data and a more acceptable residual pattern than assuming the classical linear relationship between the index of abundance and population size. As in the two previous assessments, the Aerial Spotter Index was assumed to primarily track pre-adult fish (ages 0 and 1 plus a portion of age 2 fish). All of the other fishery-independent indices were used as indices of the spawning stock biomass, which can be approximated by the biomass of ages 1+ sardine.

Recognizing that the geographical extent of the sardine population tends to increase as population size increases (inferred largely from tagging data and the expansion of the fishery in the 1930's), the CANSAR-TAM model uses explicit time-varying migration rates to `move' sardine from the well-sampled Area 1 (roughly Baja California through central California) to the larger, coastwide stock area. Internal consistency checks are done to ensure that reasonable numbers of sardine are present outside Area 1 to account for the catches of the developing fisheries in the Pacific Northwest. In conjunction with the previous assessment (Conser et al.

2002), a sensitivity run was carried out in which (i) the available catch-at-age from Oregon and Washington fisheries (mostly 2000 and 2001) were formally incorporated into the model and (ii) no structural assumptions regarding migration rates were imposed. The 2002 assessment results were fairly robust to the alternative structural assumptions of the sensitivity run. The sensitivity run was not repeated this year. However, as the time series of catch-at-age data from the Pacific Northwest fisheries accumulates and fishery-independent data become available from northern areas, the structure of this sensitivity run is likely to become the template for future sardine stock assessments.

Results

Pacific sardine landings estimate for the directed fisheries off California, USA and Ensenada, Mexico decreased from the relatively high level that was reached during 2002 (107,000 mt), with a total 2003 harvest of roughly 94,000 mt (Table 1, Figure 1); however, note that semester 2 landings in 2003 reflect projected estimates based on landing patterns observed in the fisheries during recent years (Table 1). California landings in 2003 are expected to decrease somewhat from the 2002 level, while the Ensenada landings are projected to remain at the 2002 level or slightly above. Currently, the USA fishery is regulated using a quota (harvest guideline) management scheme and the Mexico fishery (Ensenada landings) is essentially unregulated.

As has been the case in recent years, landings from the USA Pacific sardine fishery (California, Oregon, and Washington) are below the harvest guideline recommended for 2003 (111,000 mt), with roughly 65,000 mt landed through September 2003 and 86,000 mt projected landings for the entire year (the fishing year ends December 31, 2003).

Estimated stock biomass ($\geq$1-year old fish on July 1, 2003) from the assessment conducted this year indicated the sardine population has remained at a relatively high abundance level, with a bias-corrected estimate of nearly 1.1 million mt (Table 3 and Figure 7). Estimated recruitment (age-0 fish on July 1) has increased significantly – with year-to-year fluctuation – since the late 1980's (Table 3 and Figure 8). Recent recruitment levels are an order of magnitude larger than the low levels estimated during the 1980's. However, it should be noted that recent recruitment (5-37 billion recruits) is not well-estimated (Figure 8) – largely due to the lack of a recruitment index in recent years. Another 2-3 years of data may be needed to ascertain whether the sardine population biomass has reached a plateau at approximately the one million mt level (Figure 7).

Estimates of Pacific sardine biomass from the 1930's (Murphy 1966 and MacCall 1979) indicate that the sardine population may have been more than three times its current size prior to the population decline and eventual collapse in the 1960's (Figure 9). Considering the historical perspective, it would appear that the sardine population, under the right conditions, may still have growth potential beyond its present size. However, per capita recruitment estimates show a downward trend in recruits per spawner in recent years that may be indicative of a stock that has reached a plateau under current environmental conditions (Conser et al. 2001).

Harvest Guideline for 2004

The harvest guideline recommended for the USA (California, Oregon, and Washington) Pacific sardine fishery for 2004 is 122,747 mt. Statistics used to determine this harvest guideline are discussed below and presented in Table 4. To calculate the proposed harvest guideline for 2004, we used the maximum sustainable yield (MSY) control rule defined in Amendment 8 of the Coastal Pelagic Species-Fishery Management Plan, Option J, Table 4.2.5-1, PFMC (1998). This formula is intended to prevent Pacific sardine from being overfished and maintain relatively high and consistent catch levels over a long-term horizon. The Amendment 8 harvest formula for sardine is:

$$HG_{2004} = (\text{TOTAL STOCK BIOMASS}_{2003} - \text{CUTOFF}) \bullet \text{FRACTION} \bullet \text{USA DISTRIBUTION}$$

where HG_{2004} is the total USA (California, Oregon, and Washington) harvest guideline recommended for 2004, TOTAL STOCK BIOMASS_{2003} is the estimated stock biomass (ages 1+) from the current assessment conducted in 2003 (see above), CUTOFF is the lowest level of estimated biomass at which harvest is allowed, FRACTION is an environment-based percentage of biomass above the CUTOFF that can be harvested by the fisheries (see below), and USA DISTRIBUTION is the percentage of TOTAL STOCK BIOMASS_{2003} in USA waters.

The value for FRACTION in the MSY control rule for Pacific sardine is a proxy for F_{msy} (i.e., the fishing mortality rate that achieves equilibrium MSY). Given F_{msy} and the productivity of the sardine stock have been shown to increase when relatively warm-water ocean conditions persist, the following formula has been used to determine an appropriate (sustainable) FRACTION value:

$$\text{FRACTION or } F_{msy} = 0.248649805(T^2) - 8.190043975(T) + 67.4558326,$$

where T is the running average sea-surface temperature at Scripps Pier, La Jolla, California during the three preceding years. Ultimately, under Option J (PFMC 1998), F_{msy} is constrained and ranges between 5% and 15% (Figure 10).

Based on the T values observed throughout the period covered by this stock assessment (1983-2003), the appropriate F_{msy} exploitation fraction has consistently been 15% (see Figures 6 and 1); and this remains the case under current oceanic conditions (T_{2003} = 17.5 °C). However, it should be noted that the general decline in sea-surface temperature observed in recent years (1998-2003) may contribute to environmentally-based reductions in the exploitation fraction in the future years – with concomitant reductions in future harvest guidelines (see Figure 10).

The 2004 USA harvest guideline (122,747 mt) is 11% greater the 2003 harvest guideline (110,908 mt). Recent fishery practices and market conditions indicate that it may not be constraining with regard to USA fishery landings in 2004 (Figure 11). However, recent

recruitment levels are not well-estimated, resulting in a high degree of uncertainty with respect to recent recruitment. If the actual recruitment in recent years is less than that estimated in the model and/or should the general sea-surface temperature decline continue, it is likely that harvest guidelines in the out years will constrain USA fishery practices and removals.

Further when viewed on a stock-wide basis and considering the landings of Mexico and Canada as well as the USA, adherence to an implied 'stock-wide harvest guideline' may constrain fisheries even without recruitment and sea-surface temperature declines. Figure 12 compares recent international landings with the annual harvest guidelines that would have resulted from applying the PFMC CPS FMP harvest formula (above) absent the "USA Distribution" term. International landings have exceeded such calculated harvest guidelines during the past two years (2002 and 2003). Should Oregon and Washington landings continue to increase (at rates comparable to the past few years) and/or Mexican landings return to the levels reported during 1997-2000 (average landings of 56,500 – see Table 1), the implied stock-wide harvest guideline will be exceeded again in 2004 and perhaps beyond.

Acknowledgments

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Table 1. Pacific sardine time series of landings (mt) by semester (1 is January-June and 2 is July-December) in California and Baja California (Ensenada), 1983-2003. Semester 2 (2003) estimates are projections. Note that estimates in 2002 reflect updated values and differ from projected estimates used in the assessment conducted in 2002, see Conser et al. (2002). Ensenada fisheries data are from García and Sánchez (2003).

	CALIFORNIA			ENSENADA			
Year	Semester 1	Semester 2	Total	Semester 1	Semester 2	Total	Grand Total
83	245	244	489	150	124	274	762
84	188	187	375	<1	<1	0	375
85	330	335	665	3,174	548	3,722	4,388
86	804	483	1,287	99	143	243	1,529
87	1,625	1,296	2,921	975	1,457	2,432	5,352
88	2,516	1,611	4,128	620	1,415	2,035	6,163
89	2,161	1,561	3,722	461	5,763	6,224	9,947
90	2,272	1,033	3,305	5,900	5,475	11,375	14,681
91	5,680	3,354	9,034	9,271	22,121	31,392	40,426
92	8,021	13,216	21,238	3,327	31,242	34,568	55,806
93	12,953	4,889	17,842	18,649	13,396	32,045	49,887
94	9,040	5,010	14,050	5,712	15,165	20,877	34,927
95	29,565	13,925	43,490	18,227	17,169	35,396	78,886
96	17,896	18,161	36,057	15,666	23,399	39,065	75,121
97	11,865	34,331	46,196	13,499	54,941	68,439	114,636
98	21,841	19,215	41,055	20,239	27,573	47,812	88,868
99	31,791	24,956	56,747	34,760	23,810	58,569	115,316
00	35,174	22,761	57,935	25,800	25,373	51,173	109,108
01	30,118	24,785	54,903	9,307	12,939	22,246	77,149
02	28,195	35,248	63,444	16,497	26,940	43,437	106,881
03	25,268	25,114	50,382	15,097	28,596	43,693	94,075

Table 2. Pacific sardine time series of survey indices of relative abundance and sea-surface temperature, 1983-03.

Year	CalCOFI (% positive)	DEPM (mt)	Spawning area (Nmi^2)	Spotter plane (mt)	Sea-surface temperature (C)
83	na	na	40	na	17.25
84	4.9	na	480	na	17.58
85	3.8	na	760	na	17.80
86	1.9	7,659	1,260	22,049	17.87
87	4.0	15,704	2,120	11,498	17.71
88	7.9	13,526	3,120	55,882	17.55
89	7.2	na	3,720	32,929	17.24
90	3.7	na	1,760	21,144	17.19
91	16.7	na	5,550	40,571	17.35
92	8.8	na	9,697	49,065	17.61
93	6.1	na	7,685	84,070	17.84
94	17.8	127,102	24,539	211,293	17.97
95	13.4	na	23,816	188,924	18.04
96	28.0	83,175	25,890	119,731	18.06
97	27.3	409,579	40,591	66,943	18.06
98	24.3	313,985	33,446	118,492	18.44
99	16.7	282,248	55,171	40,506	18.04
00	7.8	1,063,837	32,784	48,373	17.73
01	12.5	790,925	31,663	na	17.24
02	7.1	206,333	61,753	na	17.31
03	14.2	485,121	41,702	na	17.50

Table 3. Pacific sardine time series of stock biomass (>age-1 fish in mt) and recruitment (age-0 fish in 1,000s) estimated at the beginning of semester 2 of each year. Stock biomass estimates are presented for Area 1 (Inside) and the Total Area of the stock. The 95% CIs for Total Area biomass and recruitment estimates are also presented.

	Stock Biomass				Recruitment		
Year	Area 1	Total Area	Lower CI	Upper CI	Total Area	Lower CI	Upper CI
83	4,721	4,721	2,716	9,937	146,767	89,767	274,267
84	12,848	12,909	8,917	22,888	222,886	140,886	392,886
85	21,212	21,703	15,534	35,991	214,411	145,411	368,911
86	29,752	31,372	23,751	49,516	859,821	606,321	1,355,821
87	73,047	76,635	59,716	114,284	842,804	602,804	1,257,804
88	106,233	115,909	94,590	160,815	1,476,516	1,026,516	2,326,516
89	162,390	181,563	149,812	252,778	1,173,843	809,343	1,973,843
90	177,666	211,270	173,169	296,546	4,872,561	3,227,561	8,432,561
91	228,789	266,211	202,708	414,083	5,924,857	3,754,857	10,474,857
92	356,801	425,957	325,258	657,290	4,064,304	2,594,304	7,459,304
93	334,681	447,278	350,663	684,962	9,205,937	6,225,937	15,365,937
94	491,775	652,113	532,364	955,568	10,277,379	7,227,379	16,477,379
95	504,856	722,777	586,245	1,026,232	6,512,311	4,652,311	10,662,311
96	525,105	783,985	659,246	1,081,543	5,664,403	4,164,403	8,899,403
97	479,680	766,702	657,839	1,025,251	10,089,643	7,324,643	15,619,643
98	479,942	802,487	678,202	1,075,551	12,123,733	8,853,733	18,523,733
99	553,811	919,974	782,081	1,233,861	8,634,180	6,134,180	14,014,180
00	554,554	945,892	798,927	1,275,202	8,578,695	5,338,695	15,448,695
01	474,799	864,672	708,635	1,227,548	14,792,684	8,887,684	27,542,684
02	604,893	1,034,764	785,740	1,618,994	9,275,313	4,690,313	20,365,313
03	633,102	1,090,587	777,606	1,810,895	12,586,415	5,036,415	36,886,415

Table 4. Proposed harvest guideline for Pacific sardine for the 2003 fishing season. See Harvest Guideline for 2004 section for methods used to derive harvest guideline.

Total stock biomass (mt)	Cutoff (mt)	Fraction (%)	U.S. Distribution (%)	Harvest guideline (mt)
1,090,587	150,000	15%	87%	**122,747**

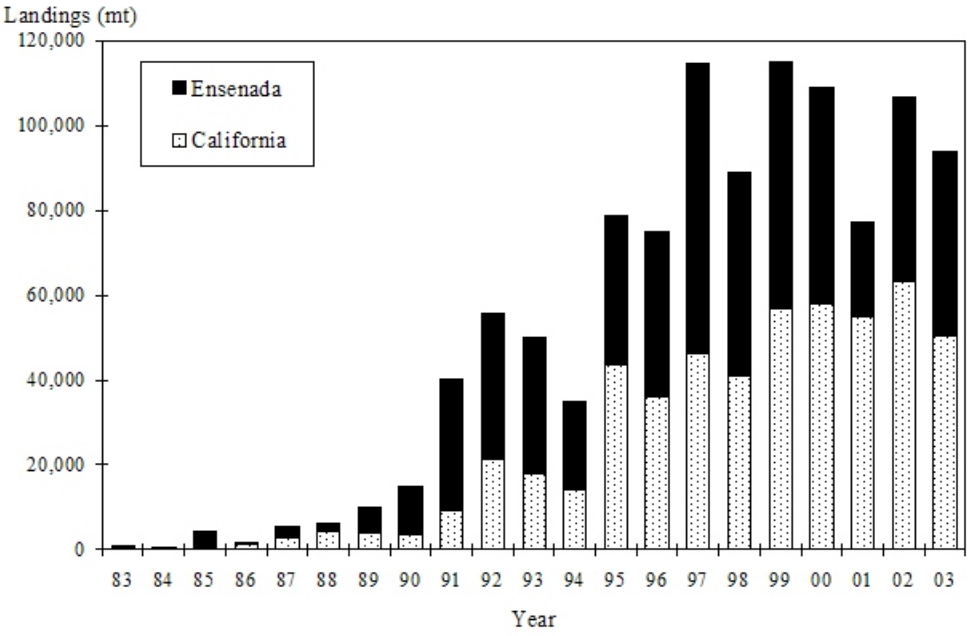

Figure 1. Pacific sardine landings (mt) in California and Baja California (Ensenada), 1983-03.

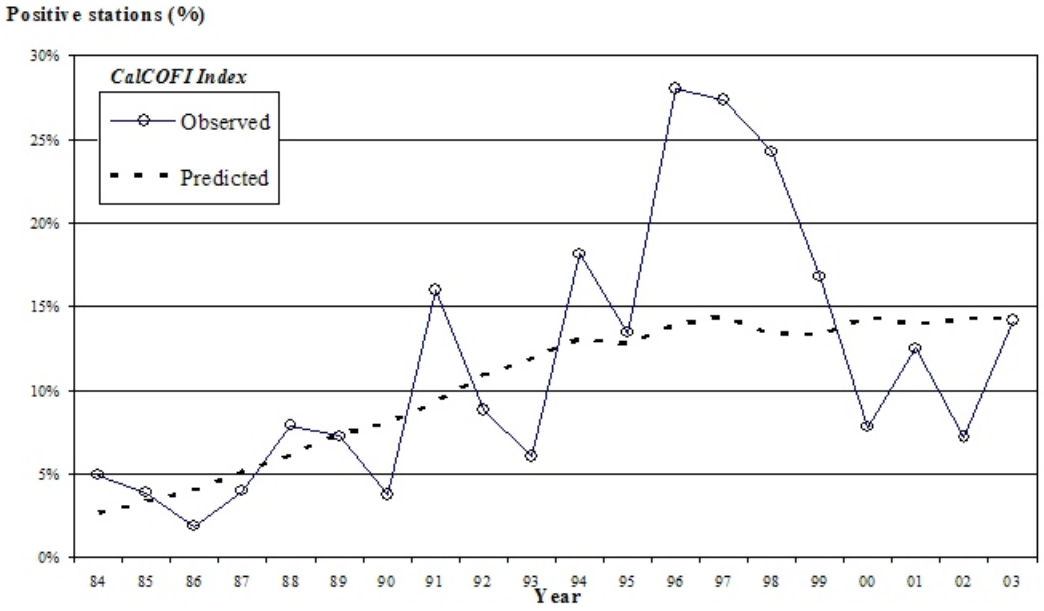

Figure 2. Index of relative abundance of Pacific sardine eggs (proportion-positive stations) off southern California based on CalCOFI bongo-net survey (1984-03).

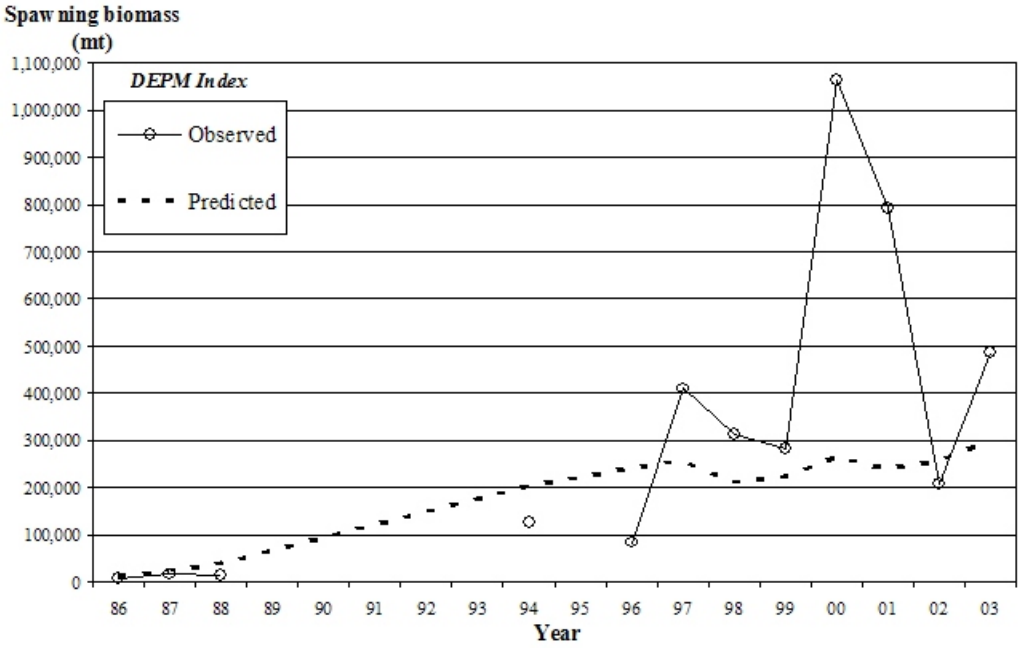

Figure 3. Index of relative abundance of Pacific sardine spawning biomass (mt) off California based on daily egg production method (DEPM) estimates from ichthyoplankton survey data (1986-03). Note that no sample data (Observed estimates) were available for years 1989-93 and 1995.

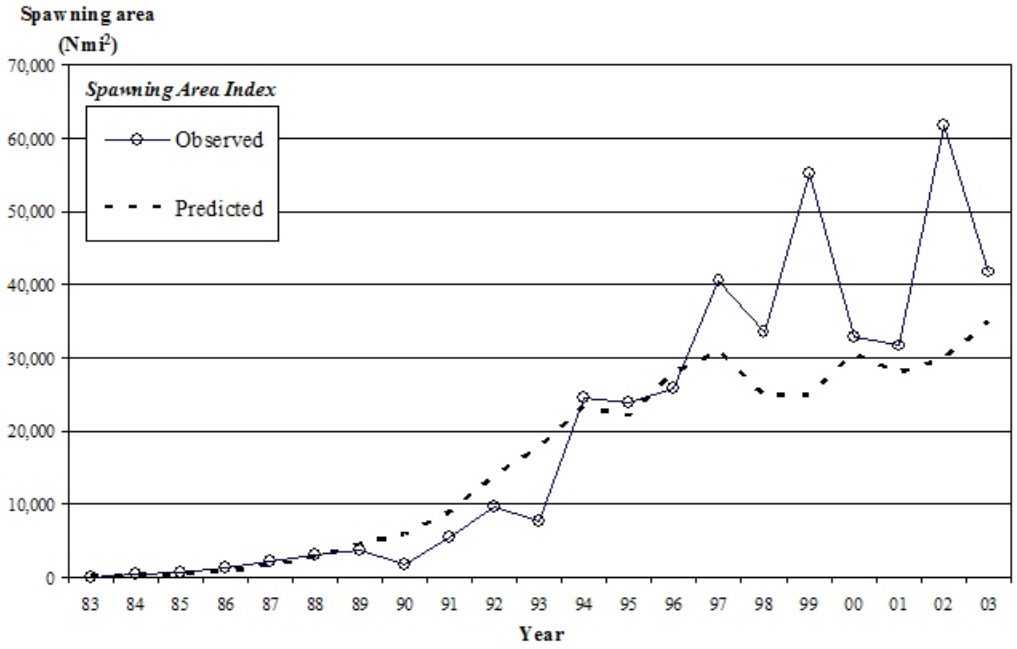

Figure 4. Index of relative abundance of Pacific sardine spawning stock size based on estimates of spawning area (Nmi2) calculated from CalCOFI and DEPM survey data (1983-03).

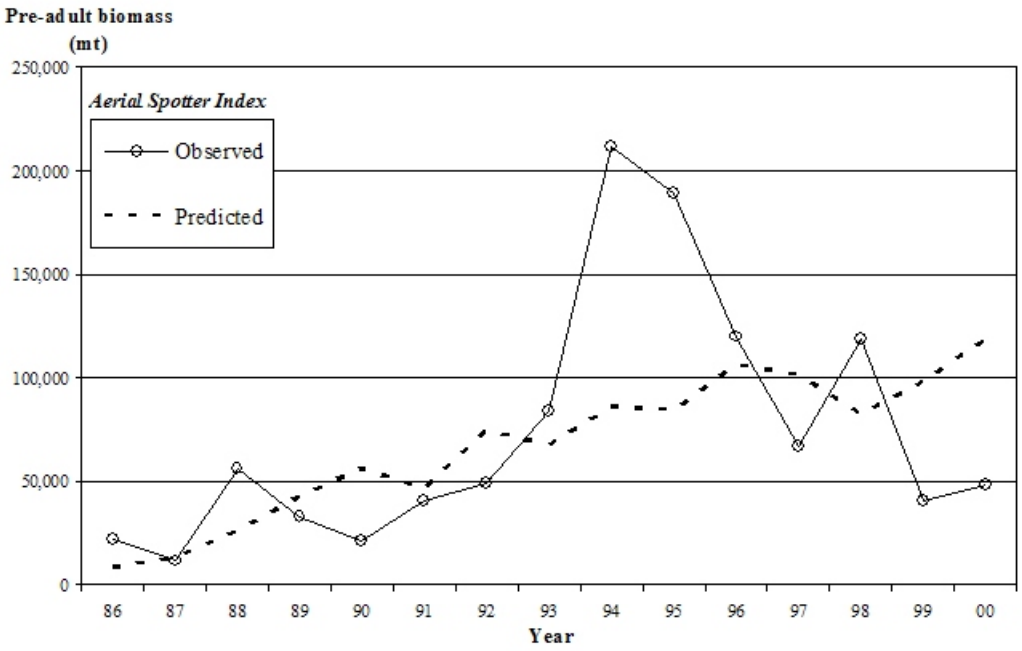

Figure 5. Index of relative abundance of Pacific sardine pre-adult biomass (primarily age 0-2 fish in mt) off California based on aerial spotter plane survey data (1986-00). Note that no sample data were available for 2001-03.

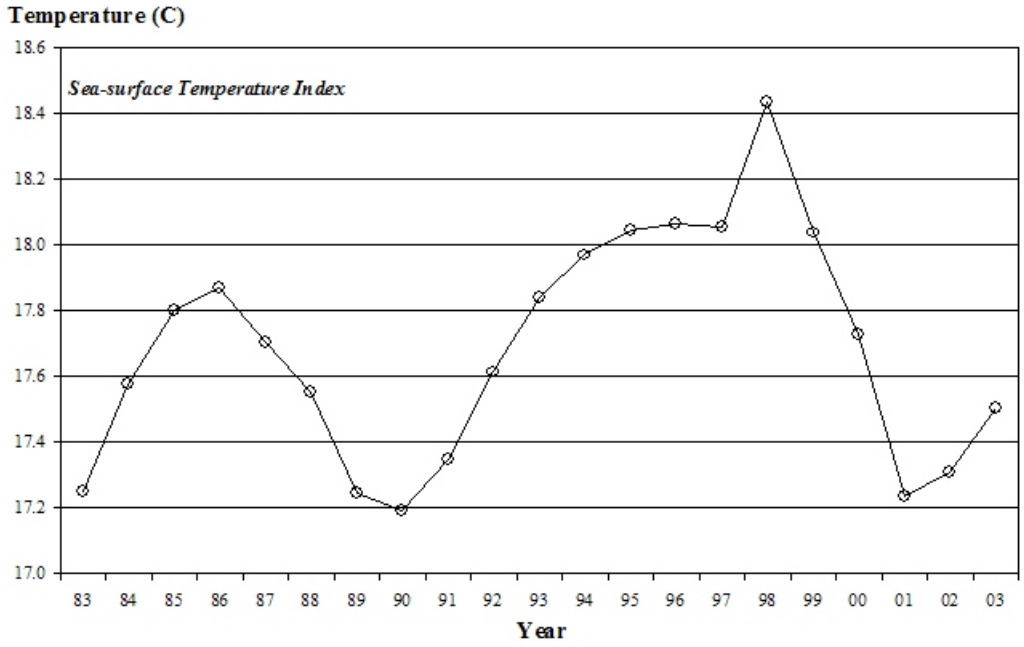

Figure 6. Time series of sea-surface temperature (C) recorded at Scripps Pier, La Jolla, CA (1983-03). Annual estimates reflect 3-year 'running' averages, see Jacobson and MacCall (1995).

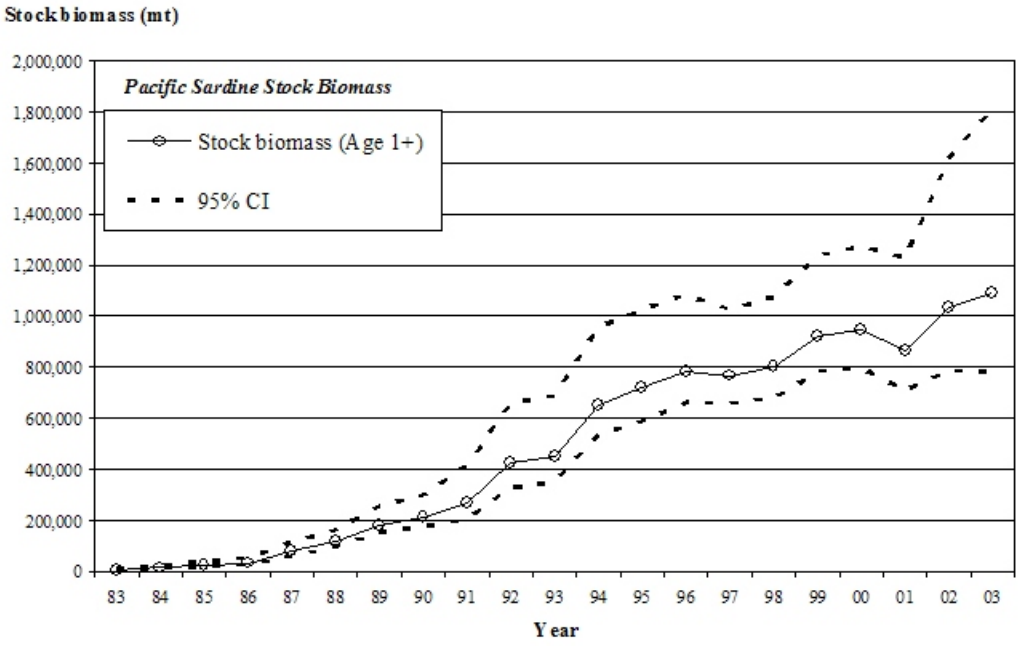

Figure 7. Time series (1983-03) of Pacific sardine stock biomass (>1-yr old fish on July 1 of each year in mt) estimated from an age-structured stock assessment model (CANSAR-TAM, see Hill et al. 1999).

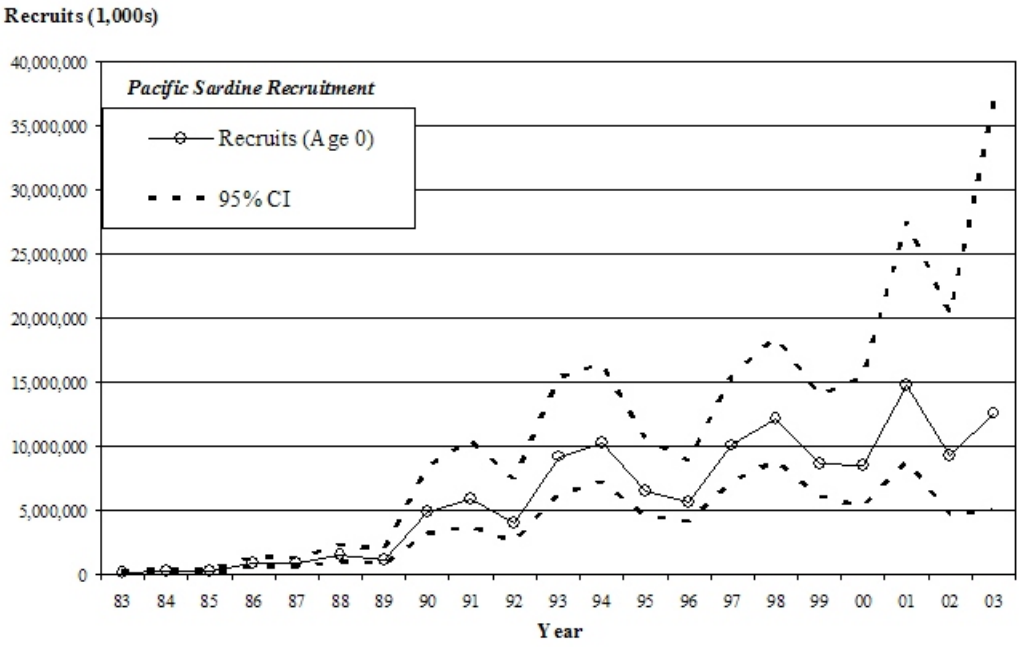

Figure 8. Time series (1983-03) of Pacific sardine recruitment (0-yr old fish on July 1 of each year in 1,000s) estimated from an age-structured stock assessment model (CANSAR-TAM, see Hill et al. 1999).

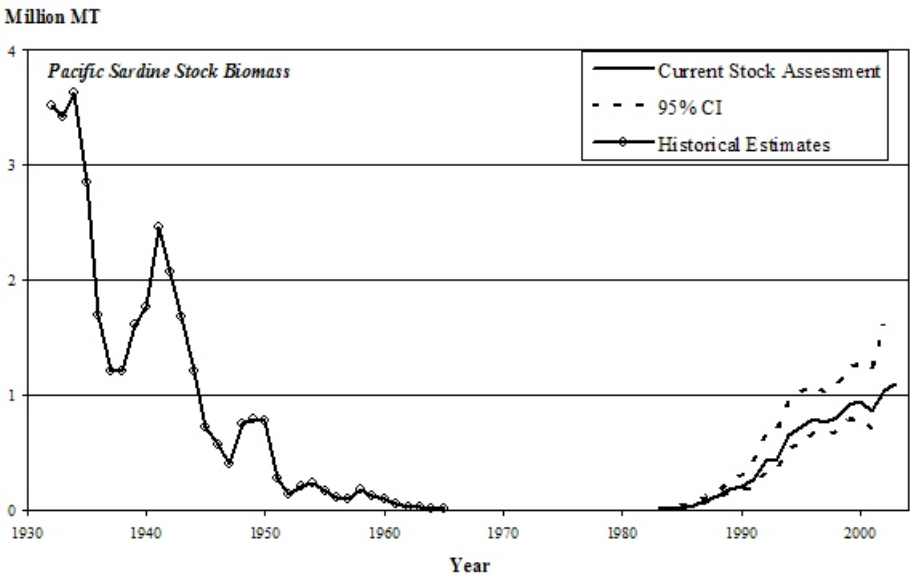

Figure 9. Time series (1983-2003) of Pacific sardine stock biomass (>age 1+ fish on July 1 of each year in million mt) and associated 95% confidence intervals estimated in the current stock assessment (cf. Figure 7); and historical stock biomass estimates (1932-65) from Murphy (1966). Confidence intervals or other measures of precision are not available for the historical estimates. No stock assessment-based estimates are available for the period 1966-82. The sardine fishery was closed during much of this period and biomass was at very low levels.

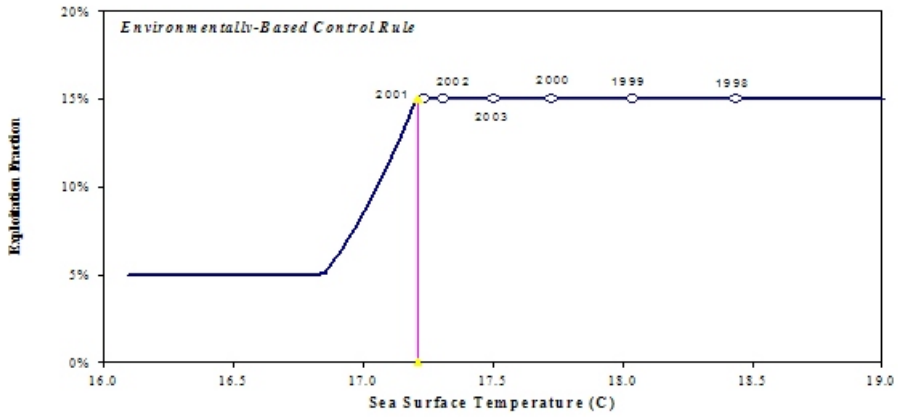

Figure 10. Environmentally-based harvest rate control rule for Pacific sardine as specified in the Coastal Pelagic Species Fishery Management Plan (PFMC 1998). For any given year, sea surface temperature (X-axis) is the running average sea surface temperature at Scripps Pier (La Jolla, CA) during the three preceding years. The exploitation fraction (Y-axis), which can range between 5-15%, is an explicit part of the algorithm used to determine the annual harvest guideline (quota) for the coastwide U.S. fishery – see Table 4. Open circles illustrate the sea surface temperature and exploitation fraction for recent years (1998-2003).

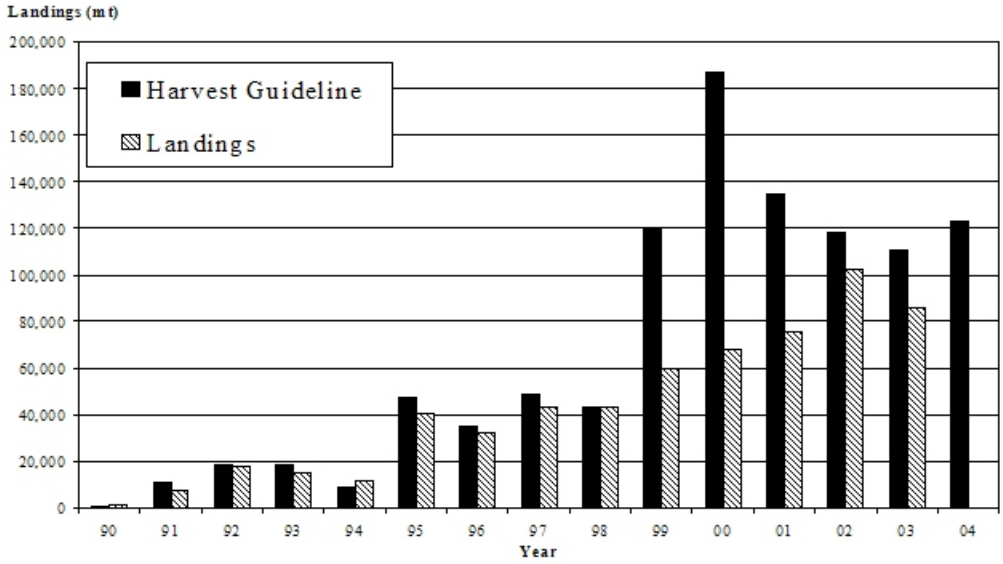

Figure 11. Time series (1990-03) of Pacific sardine harvest guidelines ('quotas') and actual landings (mt). State-based (California) regulations were in place for 1990-99, with federal-based (California, Oregon, and Washington) regulations beginning in 2000. Note that landings in 2003 represent a projected estimate and no landings thus far in 2004.

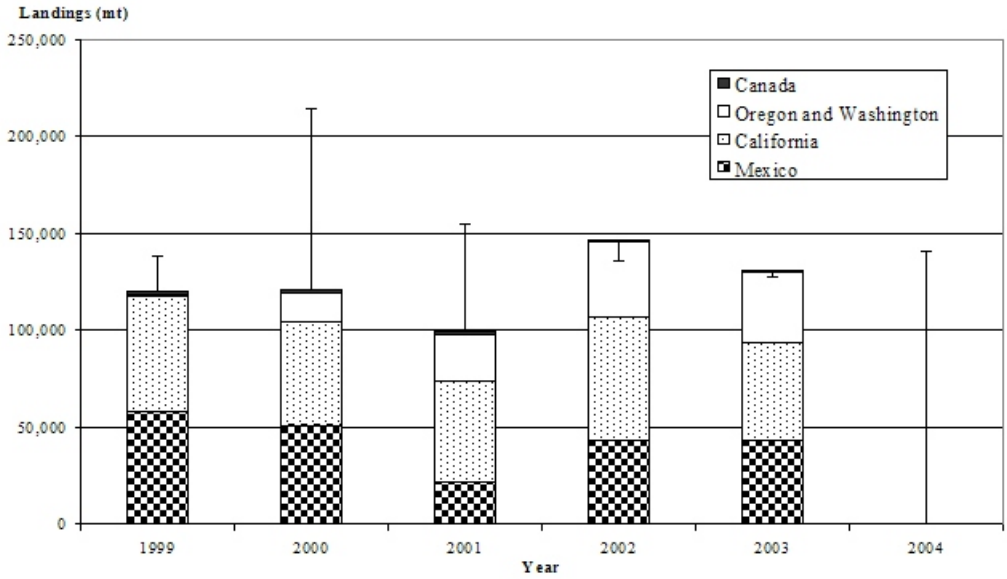

Figure 12. Pacific sardine landings (mt) from Mexico (Ensenda), California, Oregon and Washington, and Canada (1999-03). Landings shown for 2003 are estimates projected through the end of the calendar year. The thin bars illustrate the annual harvest guidelines that would have resulted from applying the PFMC CPS FMP harvest formula (see Table 4 and related text) on a stock-wide basis, i.e., applying the harvest guideline formula absent the 'U.S. Distribution' term.

PACIFIC SARDINE STOCK ASSESSMENT AND HARVEST GUIDELINE FOR 2004

Situation: Per the coastal pelagic species (CPS) fishery management plan (FMP) annual cycle, the Council is scheduled to review the Pacific sardine stock assessment and adopt a recommendation to the U.S. Secretary of Commerce for a harvest guideline for the 2004 Pacific sardine fishing season. The current harvest guideline (which expires December 31, 2003) is 110,908 mt (based on a biomass estimate of 999,871 mt). The most recent (2003) stock assessment and 2004 harvest guideline recommendation are summarized in Exhibit H.2, Attachment 1.

Per the revised allocation framework, the fishery opens on January 1 and the harvest guideline is initially allocated 33% to the northern subarea (Subarea A) and 66% to the southern subarea (Subarea B). On September 1, unharvested sardine is reallocated, 20% to Subarea A and 80% to Subarea B. All unharvested sardine that remain on December 1 are pooled and made available coast wide. The dividing line between the two areas is Point Arena, California (39° N latitude).

The Scientific and Statistical Committee (SSC), CPS Management Team (CPSMT), and the CPS Advisory Subpanel (CPSAS) have reviewed the assessment and the recommended harvest guideline. They will present their respective advice to the Council.

In setting the harvest guideline for 2004, the Council might consider including incidental catch allowances, which would provide for incidental landings of Pacific sardine in CPS fisheries. Incidental allowances could be necessary if a subarea were closed to directed fishing and sardine landings could potentially occur in another CPS fishery, e.g., Pacific mackerel. The FMP provides for incidental catch allowances up to 45% of landed weight.

Council Action:

1. Adopt Pacific Sardine Harvest Guideline for 2004.

Reference Materials:

1. Exhibit H.2, Attachment 1 – Status of the Pacific Sardine Resource and Fishery in 2003 with Management Recommendations for 2004.
2. Exhibit H.2.b, CPSMT Report.
3. Exhibit H.2.b, CPSAS Report.
4. Exhibit H.2.b, Supplemental SSC Report.

Agenda Order:

a. Agendum Overview — Dan Waldeck
b. Reports and Comments of Advisory Bodies
c. Public Comment
d. **Council Action:** Adopt Pacific Sardine Harvest Guideline for 2004

PFMC
10/21/03

Exhibit H.2.b
CPSAS Report
November 2003

COASTAL PELAGIC SPECIES ADVISORY SUBPANEL REPORT ON PACIFIC SARDINE STOCK ASSESSMENT AND HARVEST GUIDELINE FOR 2004

The Coastal Pelagic Species Advisory Subpanel (CPSAS) met October 14, 2003 in La Jolla, California. At the meeting, the CPSAS heard a presentation from Dr. Ray Conser reviewing the current Pacific sardine stock assessment and the recommended harvest guideline of 122,747 mt for the 2004 fishery. The CPSAS unanimously agrees the stock assessment is as complete as the best available science and the current model allows. The CPSAS supports the recommended harvest guideline, which is based on the formula defined in the Coastal Pelagic Species (CPS) Fishery Management Plan (FMP). The CPSAS is anxious to transition to the new model, which will more completely incorporate fishery dependent and fishery independent data from the Pacific Northwest fisheries. Furthermore, the CPSAS continues to support the need for coastwide surveys of the sardine resource. The CPSAS recommends the Council encourage National Marine Fisheries Service (NMFS) to continue to fund comprehensive CPS research, including the survey off the Pacific Northwest.

The CPSAS agrees with the CPSMT that coordinated international management of CPS fisheries is needed. Moreover, the CPSAS also agrees that inclusion of complete Mexican catch statistics is vital to the CPS assessment process. In April of 2003, the Council sent a letter to the U.S. Department of State (DOS) requesting attention to these matters, specifically for the initiation of formal discussions with the government of Mexico. The CPSAS is disappointed that the Council has not received a response from the DOS and by the apparent lack of attention to the Council request. The CPSAS recommends the Council request a response from the DOS, as well as NMFS, about this matter.

As described by the CPSMT, the Tri-National Sardine Forum has been a very positive experience. The CPSAS recommends the Council continue their involvement in the Sardine Forum. As noted by the CPSMT, the Sardine Forum provides a means for scientists from U.S. and Mexico to collaborate informally. However, the CPSAS continues to strongly recommend that formal cooperative management and data sharing arrangements are necessary. Thus, the CPSAS recommends the Council vigorously engage the DOS in seeking better cooperation from the Mexican government.

PFMC
10/21/03

COASTAL PELAGIC SPECIES MANAGEMENT TEAM REPORT ON PACIFIC SARDINE STOCK ASSESSMENT AND HARVEST GUIDELINE FOR 2004

The Coastal Pelagic Species Management Team (CPSMT) recently met with Dr. Ray Conser, National Marine Fisheries Service (NMFS) to review results from the latest Pacific sardine stock assessment, which will be used to set a harvest guideline for the 2004 season. The CPSMT concurs with the stock assessment team's analyses, and recommends the Council adopt a harvest guideline of 122,747 mt for the 2004 season.

The CPSMT discussed planning for a stock assessment review (STAR) Panel in Spring 2004. At the STAR Panel, the Pacific sardine and Pacific mackerel stock assessment data and models will be reviewed. The results would be available for management of the 2005 sardine fishery and the 2005-2006 Pacific mackerel fishery. Currently, the schedule calls for a May 2004 meeting. However, because of conflicting meetings during May, the CPSMT recommends the STAR Panel be held the week of June 21 in La Jolla, California at the NMFS-Southwest Fisheries Science Center facility. Pending Council approval of this recommendation, tentative arrangements have been made to secure meeting space the week of June 21.

While the CPSMT considers the current sardine assessment to be based on the best available information, more data on this species are clearly needed, particularly, regarding biology and distribution habits, both within year and year-to-year. That is, development of an improved, coastwide sardine assessment model will depend on gathering fishery-dependent and fishery-independent data for the offshore and northern portions of the stock. In this context, the initial phase of a proposed, long-term survey off the Pacific Northwest was completed in July 2003. This survey focuses on obtaining biological data from adult sardines and conducting exploratory evaluations of the northern extent of egg and larval distribution. Data from this research cruise will be summarized and presented at the upcoming STAR meeting in 2004. The information will facilitate model development, e.g., the stock structure assumptions used in the overall modeling work. The next phase of the research project is scheduled for February 2004. Continuation of such research and data collection initiatives is critical to the development of stock assessment models appropriate to Pacific sardine.

Fishery sampling by the states of Oregon and Washington is ongoing, but fishery-independent data for the Pacific Northwest region are sparse. More recently, budget constraints have limited the ability of Oregon Department of Fish and Wildlife to employ at-sea observers for the sardine fishery. While Washington Department of Fish and Wildlife continues to employ at-sea observers, budget limitations are also affecting their management programs. In California, budget constraints have severely impacted staffing levels and support of the fishery sampling program. The CPSMT recommends the Council urge state and federal management agencies and the fishing industry to actively pursue funding, which will be vital to improving the sardine assessment and future management of the coastwide sardine fishery.

Beyond U.S. waters, Mexican harvest of CPS has rapidly increased in recent years. To ensure fishery sustainability, this increased activity in Mexican CPS fisheries necessitates close coordination

of both fishery management and science. This should include, at the very least, the availability of complete Mexican catch statistics for inclusion in CPS assessment models. The CPSMT recommends the Council and NMFS continue to pursue cooperative arrangements with Mexican fishery management agencies.

One very positive example of collaboration among scientists and industry representatives from Mexico, the U.S., and Canada (British Columbia) has been the series of Tri-National Sardine Forum meetings. The next Sardine Forum is scheduled for December 4-5, 2003 in San Pedro, California. The Sardine Forum provides an opportunity for industry representatives and fishery scientists from the three nations to share information on the status of their respective fisheries, participate in workshops to improve scientific methods, and garner the perspective of the industry representatives about current fishery trends and the concerns of industry. The CPSMT recommends the Council continue their involvement in the Sardine Forum.

PFMC
10/21/03