Exhibit G.1
Situation Summary
June 2001

EXEMPTED FISHING PERMIT APPLICATIONS

Situation: The Coastal Pelagic Species (CPS) Fishery Management Plan (FMP) authorizes issuance of exempted fishing permits (EFPs) for exempted fishing consistent with the goals and objectives of the FMP.

In part, Section 2.2.8 states:

> "Exempted fishing" is defined to be fishing... not allowed under the FMP. Under this FMP... NMFS... may authorize... harvest of CPS for experimental or exploratory fishing that would otherwise be prohibited. NMFS... may restrict the number of EFPs by total catch, time, or area. NMFS... may also require any level of industry-funded observer coverage for these EFPs.
>
> Exempted fisheries are expected to be of limited size and duration and must be authorized by an EFP issued for the participating vessel in accordance with the criteria and procedures specified in 50 CFR §600.745. The duration of EFPs will ordinarily be one year. Permits will not be renewed automatically. An application must be submitted to the Regional Administrator for each year. A fee sufficient to cover administrative expenses may be charged for EFPs. An applicant for an EFP need not be the owner or operator of the vessel(s) for which the EFP is requested as long as the proposed activity is compatible with limited entry and other management measures in the FMP.
>
> This FMP authorizes mandatory data reporting and mandatory on-board observers with exempted fishing permits. Installation of vessel monitoring units aboard vessels with exempted fishing permits may be required.

National Marine Fisheries Service (NMFS) will report on application(s) for exempted fishing permits.

Council Action:

1. If necessary, review and comment on EFP application(s).

Reference Materials: None.

PFMC
05/08/01

Exhibit G.2.b
CPSMT Report
June 2001

PACIFIC MACKEREL HARVEST GUIDELINE AND OTHER SPECIFICATIONS FOR 2001-2002

The Coastal Pelagic Species Management Team (CPSMT) met with the Coastal Pelagic Species Advisory Subpanel (CPSAS) to review results from the latest Pacific mackerel stock assessment, which will be used to set a harvest guideline (HG) for the 2001-2002 season. The CPSMT concurs with the stock assessment team's analyses and recommends the Council adopt a harvest guideline of 13,837 mt for the upcoming season.

The CPSMT and CPSAS discussed problems in the current mackerel fishery and possible scenarios for conducting the upcoming season. The southern California fishery experienced high mackerel availability at the opening of the 2000-2001 season. Cumulative catch by the end of October was anomalously high compared to recent years, and 95% of the total harvest guideline was taken by the end of October, only three months into the season. The National Marine Fisheries Service (NMFS) closed the directed fishery on October 27, 2001, after which a 20% incidental catch allowance was implemented. The harvest guideline was met at the end of March, and the CPS fishery has been under a 1 mt per trip allowance since the beginning of April. Incidental mackerel catch in the sardine fishery has been a common occurrence for the past several months, and this has created an apparent problem for the fishery. The CPSMT and CPSAS heard testimony from several sardine fishermen at the meeting, who claimed having difficultly in accurately assessing percentage of mixed loads at sea. They also expressed concern over high discard mortality from loads released at sea. Biologists from CDFG's coastal pelagic species unit in Los Alamitos, California were also present at the joint meeting. They presented dockside observer data on the frequency and percentage of Pacific mackerel mixed in sardine loads. The CPSMT used these data to estimate total incidental take of mackerel, and estimated approximately 2,000 mt per year taken by the sardine fishery in 1999 and 2000.

The CPSMT outlined three possible scenarios for the upcoming season:

1) Close the directed fishery after a substantial fraction of the HG has been landed and switch to restrictive incidental allowance levels for the remainder of the season.

2) Close the directed fishery after a smaller portion of the HG is landed and switch to a less restrictive incidental tolerance for the remainder of the season.

3) Close the directed fishery after a smaller portion of the HG is landed, switch to a less restrictive incidental tolerance through the mid-season period, and reopen a directed "mop-up" fishery during the last two months of the season (e.g. May-June 2002).

Option 1 would result in status quo for the fishery, resulting in the same restrictive measures realized during the current season. The CPSMT prefers not to repeat the current situation.

The CPSAS proposed, and the CPSMT endorses, the following guidelines for prosecuting the mackerel fishery in 2001-2002: 1) open the season with a HG 13,837 mt; 2) close the directed fishery when 6,000 mt of the HG has been landed; 3) switch to incidental tolerance of up to 45% mackerel in other CPS fisheries, or up to 1 mt of mackerel at any percentage (i.e. pure loads); 4) CPSMT will closely monitor directed and incidental HG landed as the season progresses, reporting to Council at the March and April meetings; 5) reopen the directed fishery for a "mop-up" fishery in May and/or June if a significant portion of the HG still remains.

PFMC
05/29/01

COASTAL PELAGIC SPECIES ADVISORY SUBPANEL COMMENTS ON PACIFIC MACKEREL HARVEST GUIDELINE AND OTHER SPECIFICATIONS FOR 2001

The Coastal Pelagic Species Advisory Subpanel (CPSAS) held a joint meeting with the Coastal Pelagic Species Management Team (CPSMT) on May 11, 2001 to discuss the Pacific mackerel harvest guideline for the 2001-2002 season. This statement reflects decisions and recommendations for two issues regarding pacific mackerel: 1) the CPSMT recommended harvest guideline, and 2) allocation of the guideline.

2001-2001 Pacific Mackerel Harvest Guideline

The CPSAS and CPSMT had a lengthy discussion regarding the recommended harvest guideline of 13,837 mt for the 2001-2002 season. Most of the CPSAS members were surprised at the estimated decrease in biomass and resulting 33% decrease in the harvest guideline. The CPSAS was not privy to assessment results prior to the joint meeting so many of the subpanel members were shocked at the perceived decline in mackerel abundance. The majority of the CPSAS were not prepared to simply endorse the CPSMT's recommendation and proceed. The CPSAS agreed that while the maximum sustainable yield control rule for mackerel is set out in the fishery management plan, the mackerel assessment itself is limited in scope and is lacking additional data due to monetary constraints. The missing data include recruitment data and age composition data for the Ensenada, Mexico fishery. The CPSMT "guesstimated" that the results of the mackerel assessment have a +/- 40% accuracy. The CPSAS found this very troubling, especially following a season where the harvest guideline had been cut by over 50%, resulting in combined cuts of just under 70% in the last two years. Anecdotal evidence suggests mackerel are abundant and available to the traditional fishery. Fishery-dependant data also suggests mackerel are abundant and available to the traditional fishery as the fishery was closed on March 27th after having reached the 20,740 mt harvest guideline.

The CPSAS recommends the Council consider setting the 2001-2002 harvest guideline at a level consistent with the 2000-2001 season of 20,740 mt. There was hardship caused as a result of the 50% decrease in the 2000-2001 season. There will be increased hardships if a decrease of another 33% is enacted. The majority of the CPSAS does not believe there is adequate science to justify this additional cut. While the CPSAS understands the CPSMT has done the best they can with the information available to them, we would like the Council to consider the situation as outlined above and use their discretion when setting the 2001-2002 harvest guideline. Another approach would be to set the harvest guideline somewhere in between the CPSMT's recommendation and the previous year's quota so as to allocate the declines less drastically.

Allocation of 2001-2002 Harvest Guideline

The CPSMT and CPSAS spent the main part of their meeting discussing how to allocate the recommended harvest guideline. While the subpanel does not support the team's recommendation of 13,837 mt, it seemed most appropriate that the allocation discussion revolve around this potential number. During the 2000-2001 season there was no specific set aside allocated for incidental catch of mackerel. Mackerel is caught frequently as incidental catch in the sardine fishery. Due to the lack of foresight, after the directed mackerel fishery closed in March, fishers were allowed to only land up to 1 mt of incidentally caught mackerel with their sardine catch. This can and has created a serious problem as the sardine fishery can be severely curtailed due to the lack of incidental mackerel catch set-aside. For the 2001-2002 season the CPSAS would recommend that the allocation be set prior to the season to include a set-aside for incidental catch of mackerel in the sardine fishery. The recommendation by the CPSAS would hold true for either the CPSMT's recommended harvest guideline of 13,837 mt or a larger harvest guideline similar to the 2000-2001 season.

If the Council chooses to adopt a harvest guideline of 13,837 mt for the 2001-2002 season, then the CPSAS recommends allowing a directed fishery for 6,000 mt beginning in July. This leaves a set-aside of 7,837 mt to be caught incidentally throughout the season at a rate of up to 45% per directed landing of sardine. The landings should be monitored closely, and if it appears a large number of fish could be potentially left on the table, the CPSMT and CPSAS could recommend to the Council at their April meeting that they establish a directed fishery or mop-up fishery for the remaining mackerel at the end of the 2001-2002 season.

PFMC
06/14/01

Exhibit G.2.b
Supplemental SSC Report
June 2001

SCIENTIFIC AND STATISTICAL COMMITTEE
PACIFIC MACKEREL HARVEST GUIDELINE AND OTHER SPECIFICATIONS FOR 2002

Dr. Kevin Hill discussed the 2001-2002 Pacific mackerel harvest guideline (HG) with the Scientific and Statistical Committee (SSC). The recommended HG is 13,837 mt. The Coastal Pelagic Species Management Team (CPSMT) recommends closing the directed fishery after 6,000 mt is landed, then switching to an incidental tolerance of 45% of mackerel in other coastal pelagic species fisheries. If a significant portion of the HG remains, a directed fishery would re-open toward the end of the season.

The SSC notes that the HG is based on the same stock assessment methodology used in 2000, with the addition of one new data point. This methodology is scheduled to be reviewed by a stock assessment review panel in 2002.

PFMC
06/13/01

STOCK ASSESSMENT OF PACIFIC MACKEREL WITH RECOMMENDATIONS FOR THE 2001-2002 MANAGEMENT SEASON

EXECUTIVE SUMMARY

May 17, 2001

by

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Submitted to

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INTRODUCTION

The following summarizes stock assessment results and harvest guideline recommendations for Pacific mackerel (*Scomber japonicus*) developed for the Pacific Fishery Management Council's (PFMC) management season of July 1, 2001 to June 30, 2002. This Executive Summary will be included in the PFMC's Stock Assessment and Fishery Evaluation (SAFE) report for coastal pelagic species (CPS), which will be distributed prior to the June 2001 PFMC meeting. A full stock assessment report will not be developed until 2002 when the first formal stock assessment review (STAR) for this species will be conducted.

METHODS

We used a modified virtual population analysis (VPA) stock assessment model ('ADEPT', Jacobson 1993), based on Gavaris' (1988) procedure, to estimate biomass of Pacific mackerel that employs both fishery-dependent and fishery-independent data to estimate abundance. ADEPT adjusts or "tunes" biomass estimates using the fishery-independent indices of relative abundance. ADEPT has been used to assess Pacific mackerel for the past seven years. A conventional VPA back-calculates age-structured biomass estimates utilizing catch-at-age data, weight-at-age data, natural mortality estimates, and fishing mortality (F) estimates for the most recent year (referred to as 'terminal F'). ADEPT improves upon a conventional VPA by choosing terminal F and other parameters to obtain the best statistical fit (lowest log-scale sums of squares) between VPA output and survey indices of relative abundance, including spotter pilot sightings, CalCOFI larval data from southern California, recreational fishery catch-per-unit-effort, power plant impingement rates, and triennial trawl survey data. The crux of the estimate lies in the models' ability to estimate terminal F based upon the survey indices, essentially using them to adjust the conventional VPA output.

The assessment model is based on an annual time increment and now incorporates 72 years (1929 to 2000) of fishery data, including landings (Table 1, Figure 1), age composition (Figure 2), and mean weights-at-age (Figure 3). Abundance estimates are adjusted by the model to better match the fishery-independent (survey) indices of relative abundance, including aerial spotter sightings (Lo et al. 1992; Figure 4), CalCOFI larval data (Figure 5), recreational fishery catch-per-unit-effort (Figures 6 & 7), triennial shelf survey, and power plant impingement rates. As in past assessments, component likelihoods for most surveys were weighted equally to a value of 1.0. The power plant impingement index (age-0 Pacific mackerel caught in cooling water at San Onofre Nuclear Generating Station) represents a relatively small portion of the coastline and was therefore down-weighted to 0.1. ADEPT also has the ability to weight influence of annual survey observations using the coefficient of variation (CV; a measure of relative variation in any sample). As per Hill et al. (1999) and Hill (2000), we calculated CVs for each survey and re-scaled the CVs to the median value. Re-scaling CVs of each survey to a value of 1.0 had the effect of maintaining equal weighting among surveys while down-weighting annual observations within surveys for poorly-sampled or highly-variable years.

We used ADEPT to calculate biomass estimates through the end of 2000 (calendar year), and then projected an estimate of biomass for July 1, 2001, based upon: 1) the number of Pacific mackerel estimated to comprise each year class at the beginning of 2000; 2) the modeled estimates of fishing mortality during 2000; 3) the assumptions for natural mortality (M=0.5) and F through the first half of 2001; and 4) estimates of age-specific growth.

RESULTS

The coast-wide harvest of Pacific mackerel increased in calendar year 2000 from relatively low levels in 1999. The combined directed fisheries off California and Ensenada (northern Baja California, Mexico) yielded 30,387 mt, compared to 19,697 mt in 1999 (Table 1, Figure 1). California landings for the calendar year 2000 totaled 23,205 mt - over twice the 1999 yield. The Ensenada fishery experienced a 29% decrease in yield, from 10,168 mt in 1999 to 7,182 mt in 2000 (Table 1). The U.S. commercial fishery was allocated a 20,740 mt harvest guideline for the 2000-2001 (July-June) season based on a July 1, 2000 biomass estimate of 116,967 mt (Hill 2000). High local availability of young mackerel led to a dramatic increase in southern California landings during the first several months of the 2000-2001 season. As of October 31, 2000, the U.S. fishery (based primarily in San Pedro, CA) had landed approximately 19,776 mt, or 95% of the harvest guideline, with less than 1,100 mt remaining. The National Marine Fisheries Service closed the directed fishery on October

27, 2000. An incidental allowance guideline was implemented, permitting up to 20% by weight Pacific mackerel in landings in other CPS fisheries. The incidental allowance was amended in February 2001 to include a trip limit of up to one metric ton of 'pure' Pacific mackerel to be landed by both limited entry and non-CPS fishermen. NMFS closed the Pacific mackerel season on March 27, 2001, eliminating the 20% incidental catch, however, the 1 mt allowance remains in effect.

ADEPT recalculates biomass for all years in the 72-year time series. Differences in biomass estimates between assessment years can be caused by interannual variation in landings, shifts in fishery age composition, and changes in relative abundance as measured by fishery-independent surveys. As is true for all age-structured population models, abundance-at-age estimates are the least certain for the most recent years when the youngest year classes have not yet become fully vulnerable to, or utilized by, the fishery. Compounding this uncertainty is the general lack of fishery or survey data for Pacific mackerel outside the Southern California Bight. Catch-at-age and weight-at-age data have not been made available from the Ensenada fishery, which is comparable in volume to the California fishery.

Biomass trends for the current assessment were similar to those estimated during the 2000 stock assessment (Hill 2000; Table 2, Figure 8). Biomasses for the current assessment were slightly higher over the most recent decade (average of 7% higher), however, the most recent two years (1999 & 2000) dropped below estimates from the 2000 assessment (Hill 2000). The current estimate of July 1, 1999 biomass is estimated to be 17.5% lower than last years' estimate, and the 2000 biomass is 24.9% lower than last year's projection. The more precipitous decline in biomass can be attributed in part to a weak 1998 year class combined with high fishing mortality during the 1998 fishery. The 1998 fishery was the second largest on record (71,355 mt), but 71% of these landings were made by the Ensenada fleet (Table 1).

The July 1, 2000 biomass projection was based on ADEPT results and certain assumptions about recruitment in January, 2000, and fishing mortality during the first half of 2001 (Table 3). ADEPT's estimates of recruitment are unreliable for the most recent year, so recruitment was forecast based on recent trends in reproductive success. Recruits per spawning biomass was high during the late 1970s and early 1980s, but has remained relatively low since 1982 (Figure 9). The relationship between spawning biomass in July and number of recruits (age-0) in the following January was regressed for the period 1982/83 to 1998/99 (Figure 10). Based on this regression, we estimated approximately 249 million age-zero fish in January 2000. Based on this recruitment value and an estimate of fishing mortality during the first half of 2001, we estimate the July 1, 2001, age 1+ biomass will be approximately 84,090 mt (Table 3).

HARVEST GUIDELINE FOR 2001-2002

In Amendment 8 (PFMC 1998), the recommended maximum sustainable yield control rule for Pacific mackerel was:

HARVEST = (BIOMASS-CUTOFF) x FRACTION x STOCK DISTRIBUTION

where HARVEST is the U.S. harvest guideline, CUTOFF (18,200 mt) is the lowest level of estimated biomass at which harvest is allowed, FRACTION (30%) is the fraction of biomass above CUTOFF that can be taken by fisheries, and STOCK DISTRIBUTION (70%) is the average fraction of total BIOMASS in U.S. waters. BIOMASS (84,090 mt) is the estimated biomass of fish age 1 and over for the whole stock as of July 1, 2001. **Based on this formula, the 2001-2002 season harvest guideline should be 13,837 mt** (Table 4, Figure 11). This harvest guideline is 33% lower than the 2000-2001 season, but similar to the average yield (14,053 mt) realized by the fishery since the 1992-1993 season (Table 4).

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Table 1. Commercial and recreational landings (metric tons) of Pacific mackerel in California and Ensenada (northern Baja California, Mexico), for calendar years 1929 to 2000.

Year	CA Com.	MX Com.	CA Rec.	Total	Year	CA Com.	MX Com.	CA Rec.	Total
1929	26,297	0	134	26,431	1965	3,198	7,615	365	11,177
1930	7,499	0	134	7,633	1966	2,100	5,290	493	7,883
1931	6,466	0	134	6,600	1967	530	949	260	1,739
1932	5,658	0	134	5,792	1968	1,422	107	190	1,718
1933	31,576	0	134	31,711	1969	1,070	201	288	1,559
1934	51,641	0	134	51,776	1970	282	0	311	593
1935	66,419	0	135	66,554	1971	71	0	538	609
1936	45,605	0	43	45,648	1972	49	0	590	639
1937	27,641	0	85	27,726	1973	25	0	478	503
1938	36,218	0	119	36,337	1974	61	0	246	307
1939	36,700	0	234	36,934	1975	131	0	312	443
1940	54,660	0	196	54,856	1976	298	0	123	421
1941	35,456	0	112	35,569	1977	9,220	0	1,163	10,383
1942	23,838	0	112	23,950	1978	21,520	0	2,256	23,776
1943	34,117	0	112	34,229	1979	35,823	0	3,053	38,876
1944	37,947	0	112	38,058	1980	38,188	0	2,612	40,800
1945	24,366	0	112	24,478	1981	42,450	0	1,368	43,818
1946	24,438	852	112	25,401	1982	35,019	0	1,559	36,578
1947	21,082	1,263	345	22,690	1983	35,454	135	1,541	37,130
1948	17,865	515	479	18,859	1984	45,572	128	1,609	47,309
1949	22,576	1,352	225	24,153	1985	40,514	2,581	1,113	44,208
1950	14,810	2,029	142	16,981	1986	46,557	4,882	880	52,318
1951	15,204	1,321	99	16,624	1987	41,212	2,081	1,433	44,727
1952	9,347	1,052	148	10,547	1988	43,991	4,882	797	49,670
1953	3,403	1,178	118	4,698	1989	38,637	13,383	691	52,711
1954	11,519	5,681	700	17,900	1990	39,850	35,757	1,126	76,732
1955	10,573	9,799	338	20,710	1991	32,162	17,445	1,190	50,798
1956	22,686	10,725	259	33,669	1992	19699	24,338	778	44,815
1957	28,143	2,035	365	30,542	1993	12,680	7,739	726	21,145
1958	12,541	449	327	13,317	1994	10,043	13,318	1,060	24,421
1959	17,056	495	213	17,764	1995	8,667	4,821	885	14,373
1960	16,697	2,982	191	19,869	1996	10,287	5,604	691	16,582
1961	20,008	5,965	274	26,247	1997	20,615	12,477	943	34,034
1962	22,036	3,231	280	25,547	1998	20,073	50,726	555	71,355
1963	18,254	7,966	352	26,572	1999	9,527	10,168	221	19,916
1964	12,169	8618	243	21030	2000	23206	7182	236	30624

Figure 1. Pacific mackerel landings, 1929 to 2000.

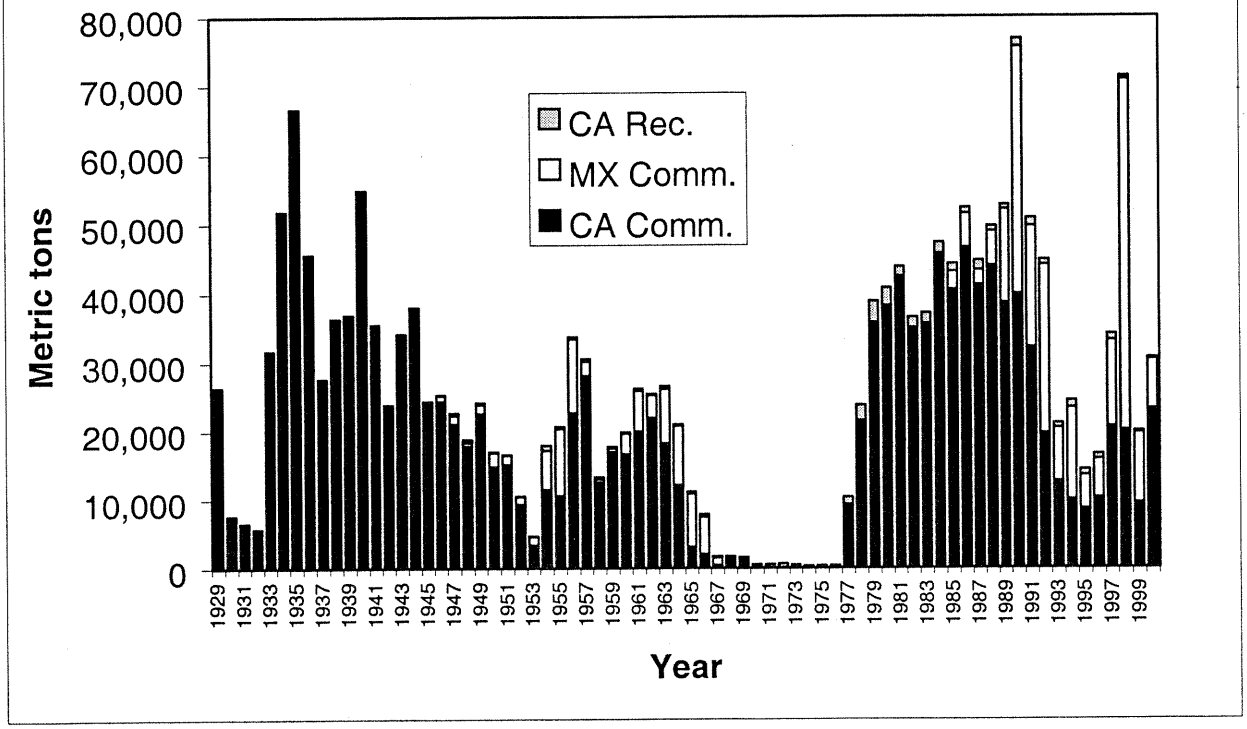

Figure 2. Proportional catch-at-age
California commercial fishery

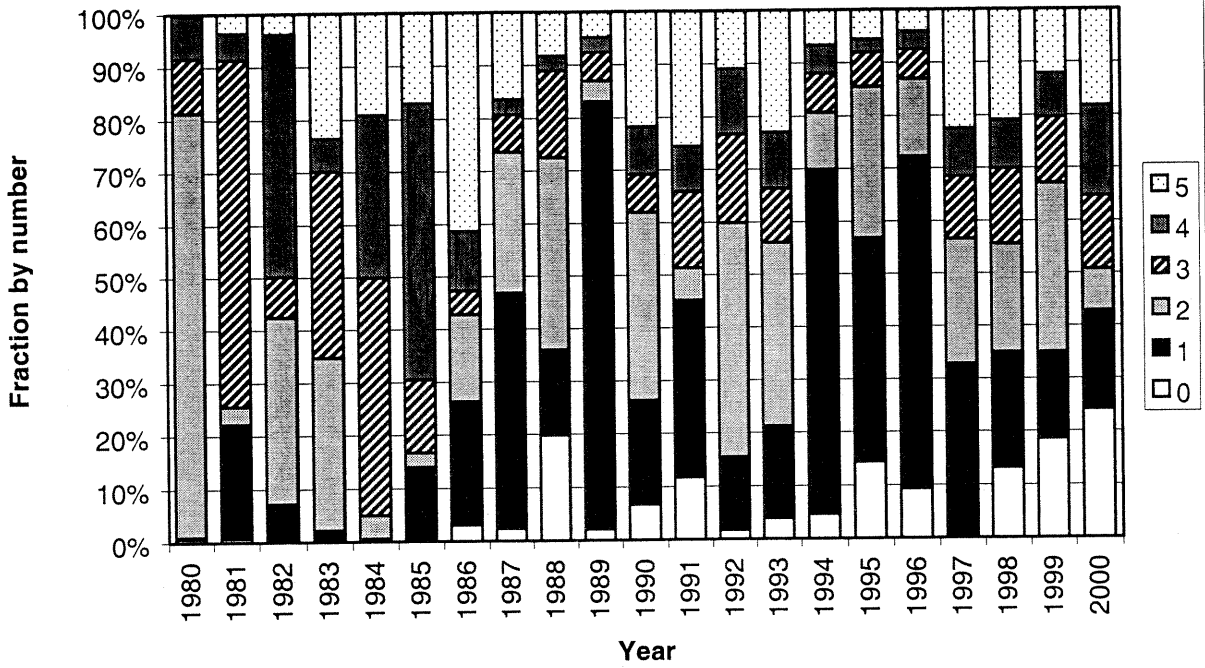

Figure 3. Mean weight-at-age
California Commercial Fishery

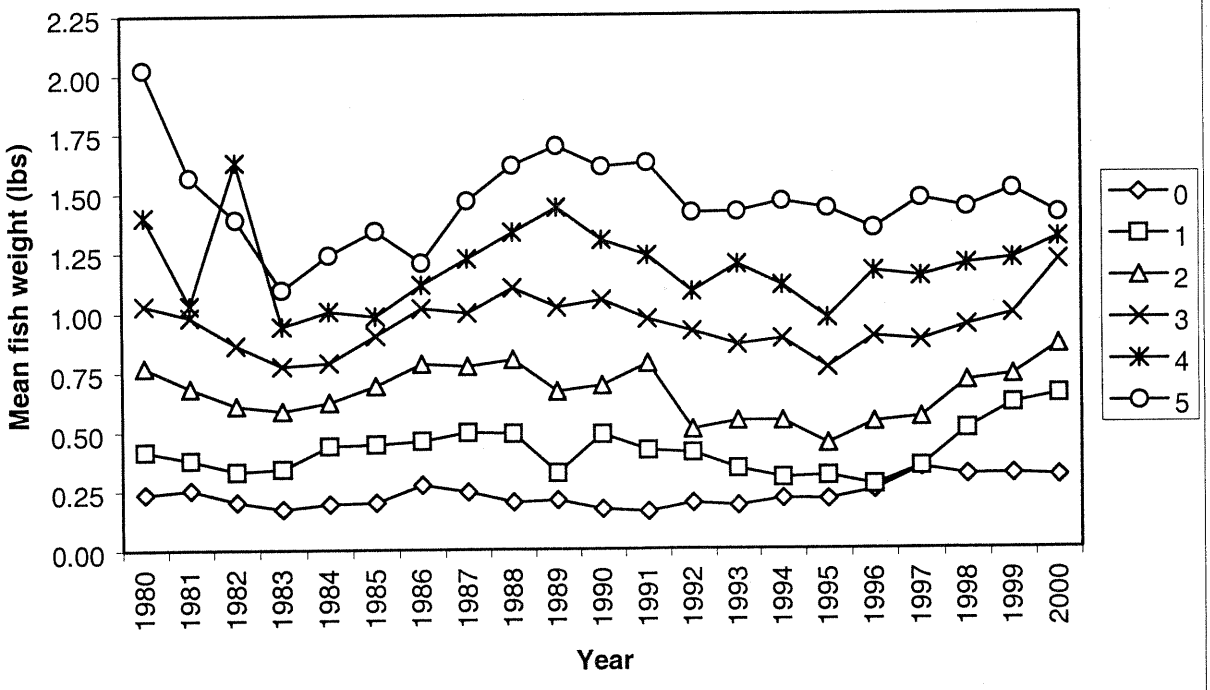

Figure 4. Aerial Spotter Index

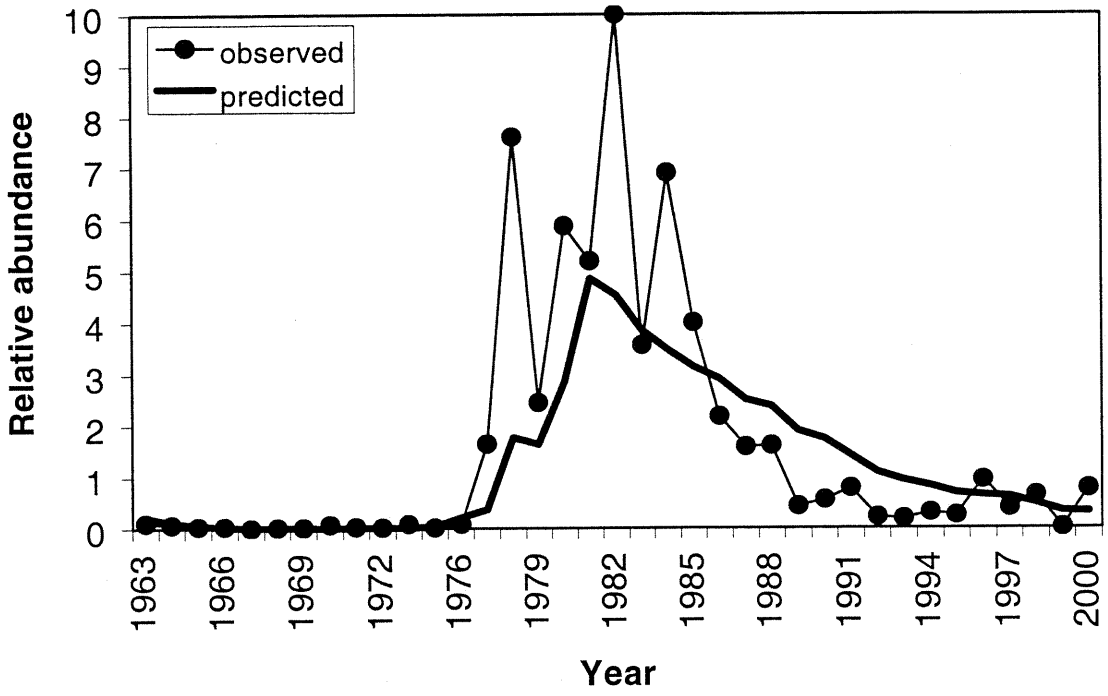

Figure 5. CalCOFI Larval Index

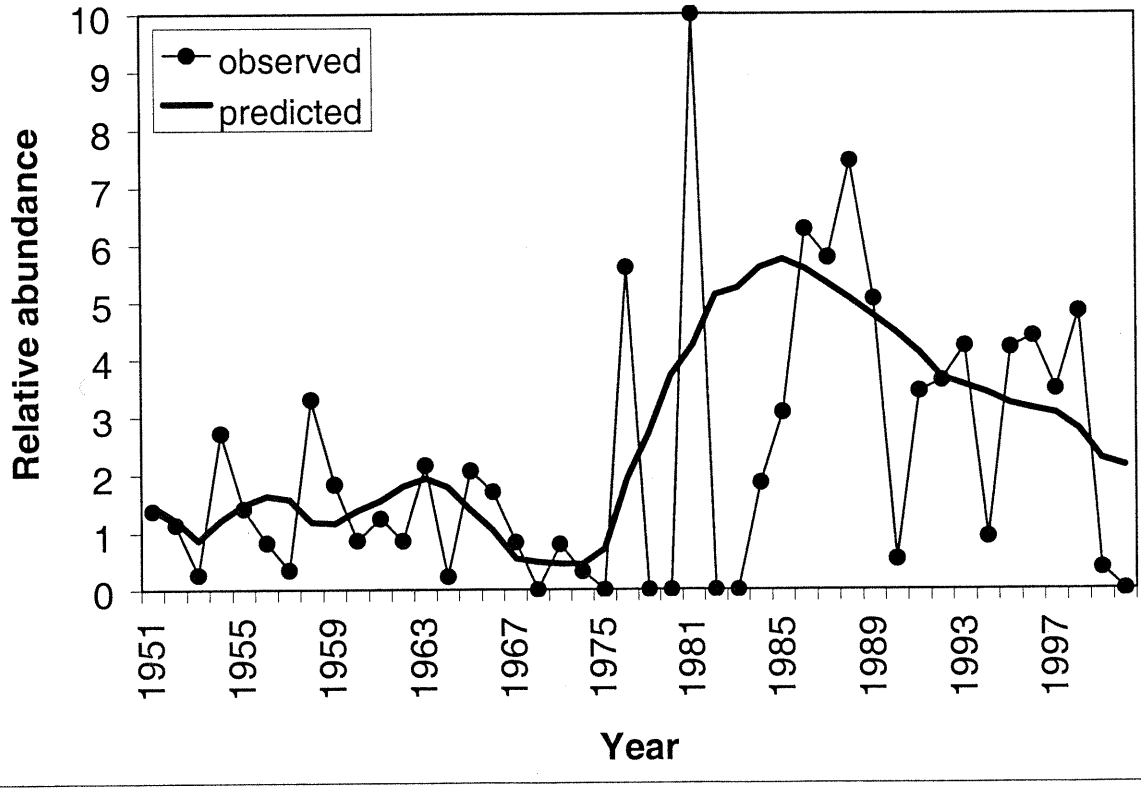

Figure 6. So. Calif. CPFV Index

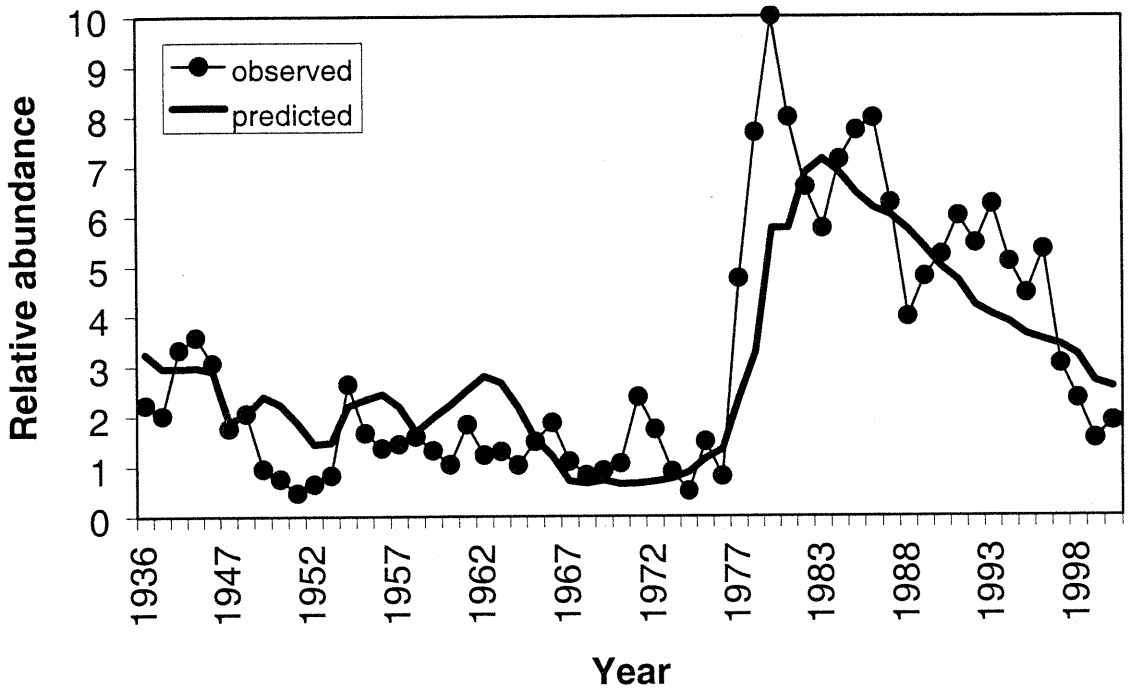

Figure 7. No. Calif. CPFV Index

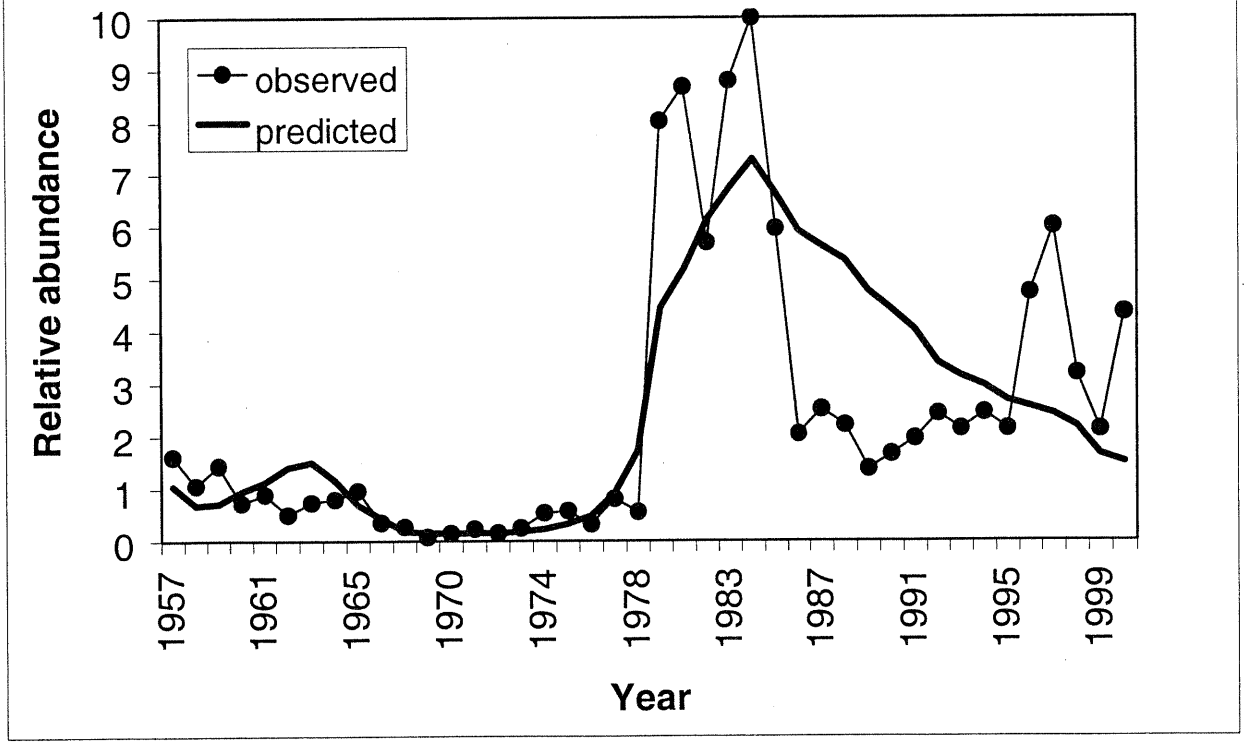

Table 2. Historical estimates of Pacific mackerel biomass (age 1+, metric tons) and recruitment (age 0, number $1x10^6$) estimated using the ADEPT model. The July 1, 2001 biomass was projected based on estimates in Table 3.

YEAR	Age 1+ Biomass (metric tons)	Recruits (millions)		YEAR	Age 1+ Biomass (metric tons)	Recruits (millions)
1929	155,896	1,020		1965	13,080	26
1930	223,033	1,392		1966	4,765	6
1931	296,408	1,552		1967	1,876	10
1932	365,252	1,106		1968	1,696	15
1933	350,660	373		1969	2,127	6
1934	289,642	167		1970	1,602	7
1935	192,454	187		1971	1,763	9
1936	127,778	399		1972	2,072	13
1937	114,806	319		1973	2,894	21
1938	105,650	549		1974	4,834	52
1939	116,944	363		1975	11,067	32
1940	91,214	312		1976	13,932	737
1941	86,466	635		1977	94,141	490
1942	114,291	233		1978	164,761	4,654
1943	105,889	210		1979	539,726	673
1944	84,429	217		1980	716,136	3,021
1945	65,560	68		1981	838,298	7,831
1946	41,260	57		1982	1,475,490	1,664
1947	20,911	582		1983	1,331,845	756
1948	57,101	311		1984	1,158,493	1,084
1949	60,937	35		1985	1,003,484	1,479
1950	42,660	15		1986	909,398	1,128
1951	22,102	10		1987	844,204	621
1952	8,371	199		1988	708,052	1,722
1953	26,419	497		1989	623,981	712
1954	61,973	193		1990	540,751	998
1955	55,240	328		1991	477,128	545
1956	62,799	66		1992	335,265	712
1957	33,036	98		1993	306,084	534
1958	21,457	332		1994	268,426	395
1959	44,194	282		1995	216,950	452
1960	51,912	473		1996	200,788	394
1961	81,419	266		1997	180,591	261
1962	97,143	41		1998	137,993	107
1963	70,707	25		1999	92,390	215
1964	36,733	10		2000	87,868	---
			FORECAST:	2001	***84,090***	

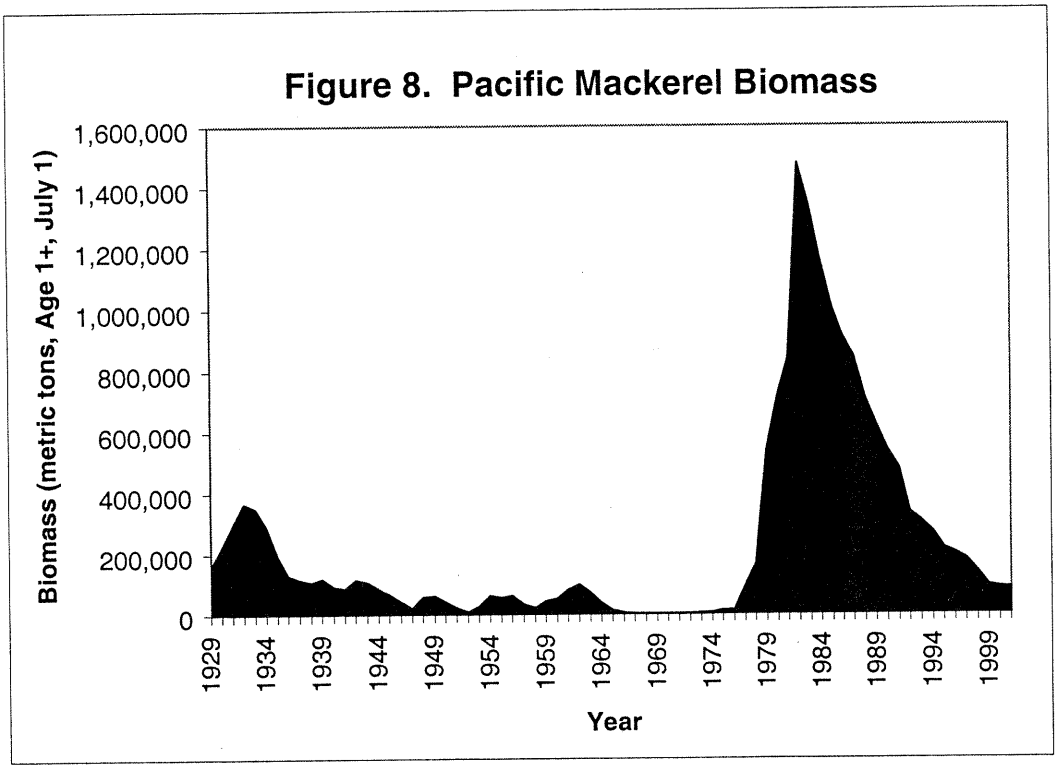

Figure 9. Recruits/Spawning Biomass

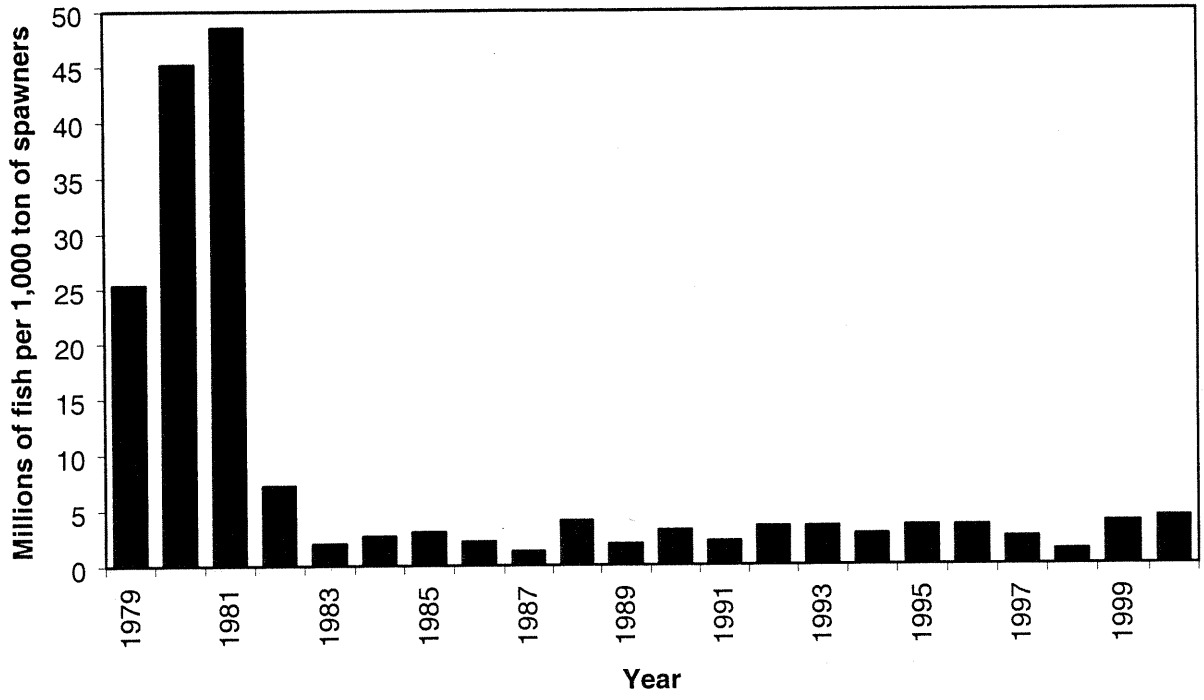

Figure 10. Recruitment Forecast for Biomass Projection

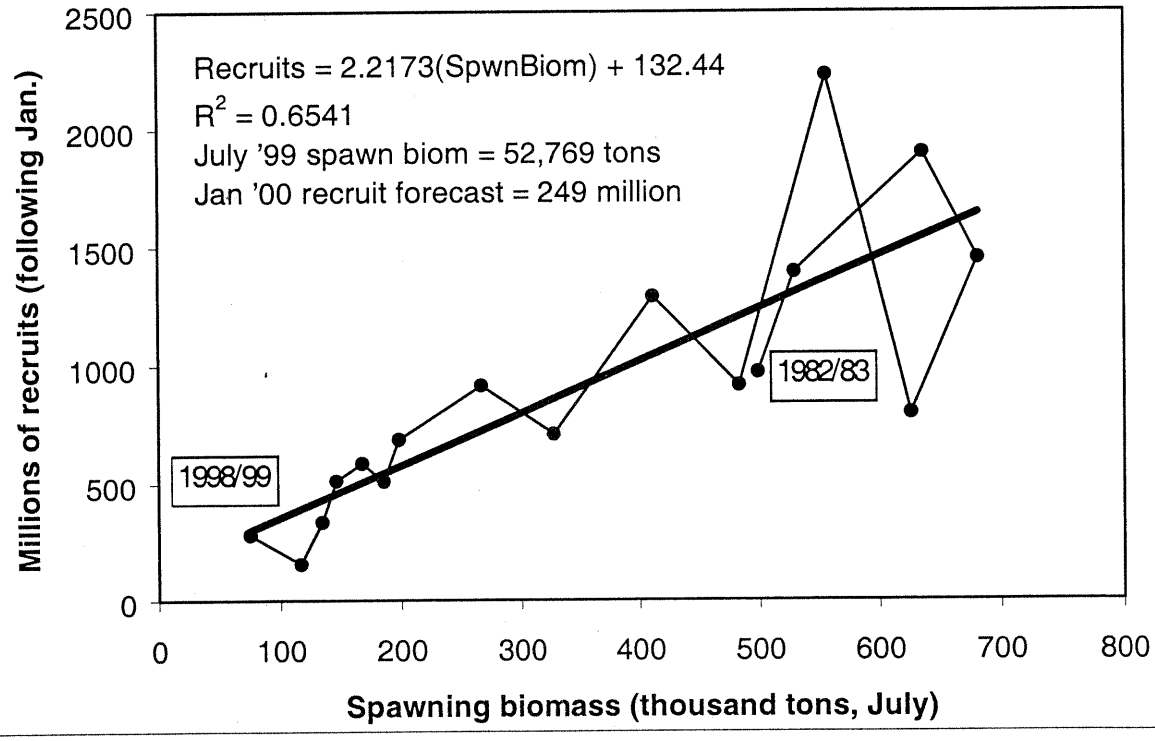

Table 3. Projected Pacific mackerel biomass and calculated harvest guideline for the 2001/2002 management season.

Age	#Fish (10^6) Jan 2000	F Mort 2000	#Fish (10^6) Jan 2001	Selectivity 2001	F Mort* 2001	#Fish (10^6) July 2001	Wt-at-Age (lbs/fish)	Projected Biomass (mt) July 2001
0	249	0.107						
1	163	0.114	136	0.200	0.026	104	0.649	30,779
2	38	0.213	88	0.373	0.048	67	0.857	26,061
3	42	0.366	19	0.642	0.083	14	1.209	7,636
4	36	0.570	18	1.000	0.129	13	1.305	7,639
5+	39	0.570	26	1.000	0.129	19	1.405	11,974
							TOTAL (mt)=	**84,090**

*Annual F in 2001 = 0.1294 <----- adjusted to match projected catch of 3,350 mt for Jan-Jun, 2001.

HARVEST GUIDELINE = (BIOMASS - CUTOFF) x FRACTION x STOCK DISTRIBUTION
where: BIOMASS=84,090; CUTOFF=18,200 mt; FRACTION=30%; STOCK DISTRIBUTION=70%

HARVEST GUIDELINE for 2001-2002 = 13,837 mt

Table 4. Commercial landings (California directed fishery) and quotas (92/93 to 98/99) or harvest guidelines (99/00 to present) for Pacific mackerel. See also Figure 11 below.

Season	Landings (mt)	Quota/HG (mt)
92/93	18,307	34010
93/94	10,793	23147
94/95	9,372	14706
95/96	7,615	9798
96/97	9,788	8709
97/98	23,413	22045
98/99	19,578	30572
99/00	6,732	42,819
36891	20,882	20740
01/02	-------	**13837**

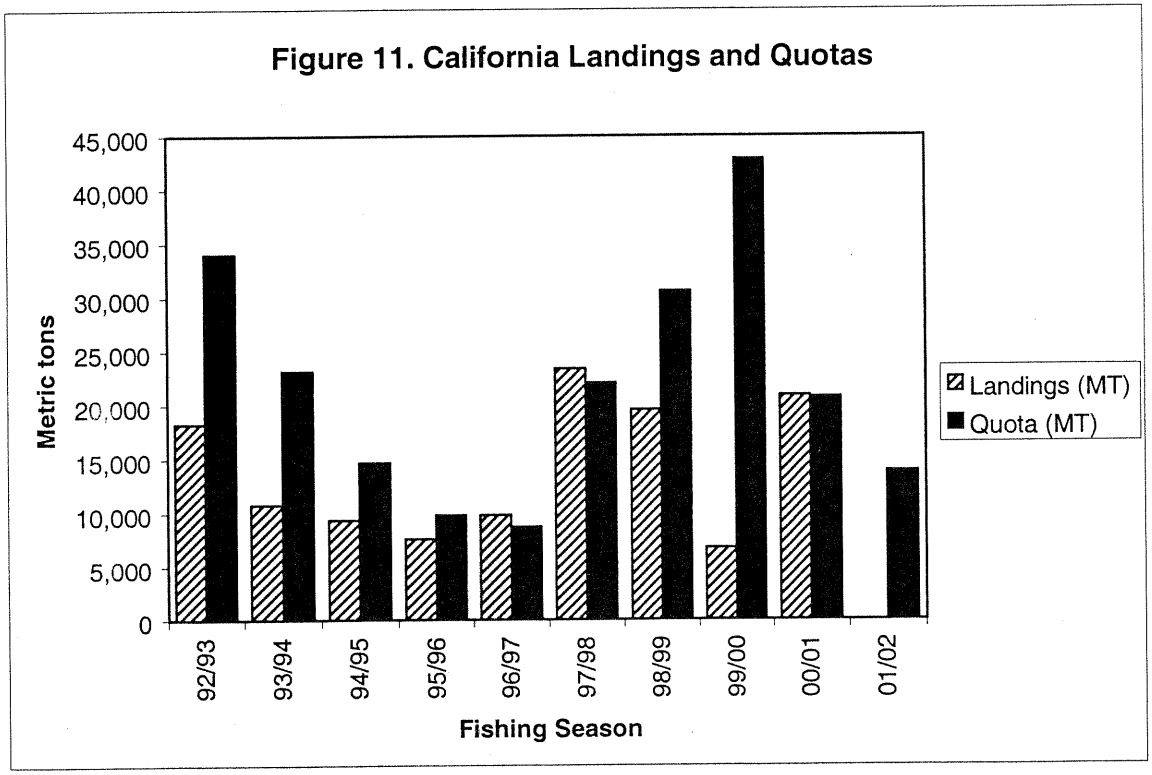

Exhibit G.2
Attachment 2
June 2001

STATUS OF THE PACIFIC COAST COASTAL PELAGIC SPECIES FISHERY THROUGH 2001 AND RECOMMENDED ACCEPTABLE BIOLOGICAL CATCHES FOR 2002

STOCK ASSESSMENT AND FISHERY EVALUATION

Pacific Fishery Management Council
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June 2001

ACKNOWLEDGMENTS

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A report of the Pacific Fishery Management Council pursuant to National Oceanic and Atmospheric Administration Award Number NA07FC0026.

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LIST OF ACRONYMS AND ABBREVIATIONS

ABC	acceptable biological catch
CalCOFI	California Cooperative Oceanic Fisheries Investigations
CANSAR-TAM	Catch-at-age Analysis for Sardine - Two Area Model
CDFG	California Department of Fish and Game
Council	Pacific Fishery Management Council
CPS	Coastal Pelagic Species
CPSMT	Coastal Pelagic Species Management Team
CPSPDT	Coastal Pelagic Species Plan Development Team
CV	coefficient of variation
DEPM	daily egg production method
EEZ	exclusive economic zone
FMP	fishery management plan
GIS	Geographic Information System
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MSY	maximum sustainable yield
NMFS	National Marine Fisheries Service
OY	optimum yield
RecFIN	Recreation Fishery Information Network
SAFE	stock assessment fishery evaluation
SSC	Scientific and Statistical Committee
VPA	virtual population analysis

1.0 Introduction

The Guidelines for Fishery Management Plans published by the National Marine Fisheries Service (NMFS) require that a stock assessment and fishery evaluation (SAFE) report be prepared and reviewed annually for each fishery management plan (FMP). SAFE reports are intended to summarize the best available scientific information concerning the past, present, and possible future condition of the stocks, marine ecosystems, and fisheries being managed under Federal regulation. Councils use this information to determine annual harvest levels for each stock; document significant trends or changes in the resources, marine ecosystems, and fishery over time; and assess the relative success of existing state and federal fishery management programs.

This is the second *Status of the Pacific Coast Coastal Pelagic Species (CPS) Fishery* SAFE document prepared for the Pacific Fishery Management Council (Council). Following NMFS guidelines, the purpose of this report is to briefly summarize the development of the FMP and to describe the history of the fishery and its management. Species managed under this FMP include: Pacific sardine (*Sardinops sagax*), Pacific mackerel (*Scomber japonicus*), Northern anchovy (*Engraulis mordax*), jack mackerel (*Trachurus symmetricus*), and market squid (*Loligo opalescens*).

The SAFE report for Pacific Coast CPS fisheries was compiled by the Council's Coastal Pelagic Species Management Team (CPSMT) from information contributed by scientists at NMFS, Southwest Fisheries Science Center, California Department of Fish and Game (CDFG), Oregon Department of Fish and Wildlife (ODFW), and Washington Department of Fish and Wildlife (WDFW). Included in this report are a description of landings, fishing patterns, estimates of the status of stocks (including stocks assessments for Pacific mackerel and Pacific sardine), and acceptable biological catches (ABC) for 1999 through 2001, as well as those proposed for 2002.

The ABC recommendations, together with social and economic factors, are considered by the Council in determining annual harvest guidelines for actively managed species (i.e., Pacific mackerel and Pacific sardine) and other measures used to manage the fisheries.

Members of the CPS Management Team are: Dr. Kevin Hill, Chair (CDFG); Dr. Paul Crone (NMFS); Mr. Brian Culver (Washington Department of Fish and Wildlife); Dr. Sam Herrick (NMFS); Ms. Jean Mc Crae (Oregon Department of Fish and Wildlife); Dr. Paul Smith (NMFS), and Ms. Marci Yaremko (CDFG). Mr. Jim Morgan (NMFS), Mr. Dan Waldeck (PFMC staff), Mr. Darrin Bergen (CDFG), and Ms. Michele Robinson (WDFW) also provided information for this report.

2.0 The CPS Fishery

2.1 Recent Management

The CPS FMP is an outgrowth of the *Northern Anchovy Fishery Management Plan*, which was implemented in September 1978. The Council began consideration of expanding the scope of the Northern anchovy FMP in 1990, with development of the seventh amendment to the FMP. The intent was to develop a greatly modified FMP, which included a wider range of coastal pelagic finfish and market squid. A complete draft was finished in November of 1993, but the Council suspended further work because NMFS withdrew support due to budget constraints. In July of 1994, the Council decided to proceed with the FMP through the public comment period. NMFS agreed with the decision on the condition that the Council also consider the options of dropping or amending the anchovy FMP. Thus, four principal options were considered for managing CPS:

1. Drop the anchovy FMP (which would have resulted in no Federal or Council involvement in CPS).
2. Continue with the existing FMP for anchovy (status quo).
3. Amend the FMP for northern anchovy.
4. Implement an FMP for the entire CPS fishery.

In March 1995, after considering the four options, the Council decided to proceed with option four, developing an FMP for the entire CPS fishery. Final action was postponed until June 1995 when the Council adopted a draft plan that had been revised to address comments provided by NMFS and the Scientific and Statistical

Committee (SSC). Amendment 7 was submitted to the U.S. Secretary of Commerce, but rejected by NMFS Southwest Region as being inconsistent with National Standard 7. NMFS announced its intention to drop the FMP for Northern anchovy (in addition to FMPs for other species) in the *Federal Register* on March 26, 1996, but the action was never completed.

Development of Amendment 8 began during June 1997 when the Council directed the Coastal Pelagic Species Plan Development Team (CPSPDT) to amend the FMP for Northern anchovy to conform to the recently revised Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) and to expand the scope of the FMP to include the entire CPS fishery.

In June 1999, NMFS partially approved the CPS FMP. The optimum yield (OY) designation for market squid was disapproved because there was no estimate of maximum sustainable yield (MSY). Bycatch provisions were disapproved because there was no standardized reporting methodology to assess the amount and type of bycatch, and because there was no explanation of whether additional management measures to minimize bycatch and the mortality of unavoidable bycatch are practicable at this time.

On December 15, 1999, final regulations implementing the CPS FMP were published in the *Federal Register* (64 *FR* 69888). Provisions pertaining to the issue of limited entry permits were effective immediately, other provisions, such as harvest guidelines, were effective on January 1, 2000.

During 1999 and 2000, the CPSMT developed Amendment 9 to the CPS FMP. Amendment 9 addressed the disapproved provisions of the FMP, bycatch and market squid MSY. In addition, the amendment included provisions to ensure that Indian fishing rights are implemented according to treaties between the U.S. and the specific tribes. Since implementation of the FMP, the CPS fishery has expanded to Oregon and Washington. As a result, the FMP must discuss Indian fishing rights in these areas. These rights were not included in the FMP; and the Council decided to address this issue in Amendment 9.

The Council distributed Amendment 9 for public review on July 27, 2000. At its September 2000 meeting, the Council reviewed written comments, received comments from its advisory bodies, and heard public comments, and decided to submit only two provisions for Secretarial review. Based on testimony concerning MSY for squid, the Council decided to include in Amendment 9 only the provisions for bycatch and Indian fishing rights. The Council decided to conduct further analysis of the squid resource and will prepare a separate amendment that addresses OY and MSY for squid.

The Secretary of Commerce (Secretary) approved Amendment 9 on March 22, 2001.

On September 11, 2000, NMFS announced the annual harvest guideline for Pacific mackerel in the exclusive economic zone off the Pacific coast. Based on the estimated biomass of 116,967 mt and the formula in the FMP, a harvest guideline of 20,740 mt was calculated for the fishery July 1, 2000, through June 30, 2001.

On December 27, 2000, NMFS announced the annual harvest guideline for Pacific sardine in the exclusive economic zone off the Pacific coast for the January 1, 2001, through December 31, 2001, fishing season. Based on the estimated biomass of 1,182,465 mt and the formula in the FMP, a harvest guideline of 134,737 mt was calculated for the fishery beginning January 1, 2001. The harvest guideline was allocated one-third for Subarea A, north of 35° 40' N latitude (Pt. Piedras Blancas) to the Canadian border, and two-thirds for Subarea B, south of 35° 40' N latitude to the Mexican border. Accordingly, the northern allocation was 44,912 mt; the southern allocation was 89,825 mt.

In April 2001, the Council adopted a capacity goal for the CPS limited entry finfish fishery and asked the CPSMT to begin work on a 10th amendment to the FMP. Amendment 10 will include the capacity goal, provisions for permit transferability, a process for monitoring fleet capacity relative to the goal, and a framework for modifying transferability provisions as warranted by increases or decreases in fleet capacity. The amendment will also address determination of OY and MSY for market squid.

For a complete listing of formal Council actions and NMFS regulatory actions since implementation of the CPS FMP see Tables 1 and 2, respectively.

2.2 The CPS Fleet

During the 1940s and 1950s, approximately 200 vessels participated in the Pacific sardine fishery. Some present day CPS vessels are remnants of that fleet. CPS finfish landed by the roundhaul fleet (fishing primarily with purse seine or lampara nets) are sold as relatively high volume/low value products (e.g., Pacific mackerel canned for pet food, Pacific sardine frozen and shipped to Australia to feed penned tuna, and Northern anchovy reduced to meal and oil). In addition to fishing for CPS finfish, many of these vessels fish for market squid, Pacific bonito, bluefin tuna, and Pacific herring.

Other vessels target CPS finfish in small quantities, typically selling their landings to specialty markets for relatively high prices. During the period 1993 through 1997, these included:

1. Approximately 18 live bait vessels in southern California and two vessels in Oregon and Washington that landed about 2,000 mt per year of CPS finfish (mostly Northern anchovy and Pacific sardine) for sale to recreational anglers.

2. Roundhaul vessels that take a maximum of 1,000 mt to 3,000 mt per year of Northern anchovy that are sold as dead bait to recreational anglers.

3. Roundhaul and other mostly small vessels that target CPS finfish (particularly Pacific mackerel and Pacific sardine) for sale in local fresh fish markets or canneries.

2.3 Aspects of the Limited Entry Fishery

NMFS is responsible for reviewing limited entry permit applications and issuing permits. The window period for CPS permit transferability closed on 31 December, 2000. The fleet now consists of 65 vessels. Forty-five of these vessels initially qualified under the window period and the other 20 vessels were permit transfers. Fifty-five of these boats currently hold permits to fish for market squid in California waters, and at least four vessels have been active in the CPS live-bait fishery since 1996. The vessels range in age from 4 to 64 years old, with an average age of 30 years (Table 2.3.1). Of the 65 permitted vessels, 36 are 4-25 years old, 15 are 26-45 years old, and 14 are 46-64 years old. Sixteen vessels are wooden.

Calculated gross registered tonnage (GRT) incorporates a vessel's length, breadth and depth, which are consistent measures across vessel registration and Coast Guard documentation lists. As described in 46CFR69.209, **GRT is defined:**

$$GRT=(2/3*length*breadth*depth)/100.$$

CPS limited entry vessel dimension data were obtained from the Coast Guard database. Gross tonnage for the current fleet ranges from 23.8 to 224.7 metric tons, with an average of 87.2 tons (Table 2.3.1). Three general tonnage classes are present in the fleet, with modes at 61-70 tons, 121-130 tons, and three vessels over 200 tons. Total fleet GRT increased from 4,635.9 mt to 5,670.9 mt during the open transferability period.

Table 2.3.1. Vessel age and calculated gross registered tonnage (GRT) for the initial and current limited entry fleet.

	Initial Fleet	**Current Fleet**
Average Vessel Age	**35 years**	**30 years**
Range of Vessel Ages	**12 - 66 years**	**4 - 64 years**
Average GRT	**71.3 mt**	**87.2 mt**
Range of GRT	**12.8 - 206.9 mt**	**23.8 - 224.7 mt**
Sum of Fleet GRT	**4,635.9 mt**	**5,670.9 mt**

3.0 Stock Assessment Models

3.1 Pacific Sardine

Conser et al., 2000, summarized the status of the Pacific sardine resource in California and Baja California, Mexico. An age-structured stock assessment model (CANSAR-TAM, Catch-at-age ANalysis for SARdine - Two Area Model; see Hill et al. 1999) is 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 model is based on a "forward-simulation" approach (see Megrey 1989) for a description of the general modeling 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) include 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 survey (fishery-independent) data. Bootstrap procedures are used to calculate variance and bias (95% confidence intervals) of sardine biomass and recruitment estimates generated from the assessment model. The CANSAR-TAM model is based on two fisheries (California, U.S. and Ensenada, Mexico) and semesters within a year are used as time steps, with ages being incremented between semesters on July 1 and spawning that is assumed to occur on April 1 (middle of the first semester).

Fishery-dependent data from the California and Ensenada fisheries (1983 through the semester 1 of the most recent year) are used to develop the following time series: (1) catch (in mt), (2) age distributions (catch-at-age in numbers of fish); and (3) estimates of weight-at-age (fishery- and population-specific). 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 southern California) and used as relative abundance measures: (1) index (proportion-positive stations) of sardine egg abundance from California Cooperative Oceanic and Fisheries Investigations (CalCOFI) survey data (*CalCOFI Index*; see Deriso et al. 1996); (2) index of spawning biomass (mt) based on the Daily Egg Production Method survey data (*DEPM Index*; see Lo et al. (1996); (3) index of spawning area (Nmi^2) from CalCOFI and DEPM survey data (*Spawning Area Index)*; and (4) index of pre-adult biomass (mt) from aerial spotter plane survey data (*Aerial Spotter Index*; see Lo et al. 1992). Time series of sea-surface temperatures 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).

3.2 Pacific Mackerel

A modified virtual population analysis (VPA) stock assessment model ("ADEPT", Jacobson 1993), based on Gavaris' (1988) procedure, is used to estimate biomass of Pacific mackerel. ADEPT employs both fishery-dependent and fishery-independent data to estimate abundance. ADEPT adjusts population abundance estimates using the fishery-independent indices of relative abundance. ADEPT has been used to assess Pacific mackerel for the past seven years. A conventional VPA back-calculates age-structured biomass estimates utilizing catch-at-age data, weight-at-age data, natural mortality estimates, and fishing mortality (F) estimates for the most recent year (referred to as "terminal F"). ADEPT improves upon a conventional VPA by choosing terminal F and other parameters to obtain the best statistical fit (lowest log-scale sums of squares) between VPA output and survey indices of relative abundance, including spotter pilot sightings, CalCOFI larval data from southern California, recreational fishery catch-per-unit-effort, power plant impingement rates, and triennial trawl survey data. The crux of the estimate lies in the models' ability to estimate terminal F based upon the survey indices, essentially using them to adjust the conventional VPA output.

The assessment model is based on an annual time increment and now incorporates 72 years (1929 to 2000) of fishery data, including landings, age composition, and mean weights-at-age. Abundance estimates are adjusted by the model to better match the fishery-independent (survey) indices of relative abundance, including aerial spotter sightings (Lo et al. 1992), CalCOFI larval data, recreational fishery catch-per-unit-effort, triennial shelf survey, and power plant impingement rates. Component likelihoods for most surveys are weighted equally to a value of 1.0. The power plant impingement index (age-0 Pacific mackerel caught in

cooling water at San Onofre Nuclear Generating Station) represents a relatively small portion of the coastline and is down-weighted to 0.1. ADEPT also has the ability to weight influence of annual survey observations using the coefficient of variation (CV; a measure of relative variation in any sample). Coefficients of variation (CV) are calculated for each survey and re-scaled the CVs to the median value. Re-scaling CVs of each survey to a value of 1.0 has the effect of maintaining equal weighting among surveys while down-weighting annual observations within surveys for poorly-sampled or highly-variable years.

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4.0 Optimum Yield, Maximum Sustainable Yield, and Maximum Sustainable Yield Control Rules

4.1 Optimum Yield

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

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

Optimum yield for a CPS stock is defined to be the level of harvest which is less than or equal to ABC estimated using a MSY control rule, consistent with the goals and objectives of this FMP, and used by the

Council to manage the stock. The ABC is a prudent harvest level calculated based on an MSY control rule. In practice, OY will be determined with reference to ABC. In particular, OY will be set less than ABC to the degree required to prevent overfishing.

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

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

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

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

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

4.3 Default CPS MSY Control Rule

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

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

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

4.3.1 General MSY Control Rule for Actively Managed Species

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

$$H = (\text{BIOMASS-CUTOFF}) \times \text{FRACTION}$$

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

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

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

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

5.0 Overfishing Considerations

5.1 Definition of Overfishing

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

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

5.2 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.

5.3 Rebuilding Programs

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

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

6.0 Bycatch and Discard Mortality

Fishery management plans prepared by a fishery management Council or by the Secretary must, among other things, establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority:

1. Minimize bycatch.
2. Minimize the mortality of bycatch that cannot be avoided.

CPS vessels fish with roundhaul gear (purse seine or lampara nets of approximately one-half mile in total length). These are encircling type nets, which are deployed around a school of fish or part of a school. When the school is surrounded, the bottom of the net may be closed, then the net drawn next to the boat. The area including the free-swimming fish is diminished by bringing one end of the net aboard the vessel. When the fish are crowded near the fishing vessel, pumps are lowered into the water to pump fish and water into the ship's hold. Another technique is to lift the fish out of the net with netted scoops (e.g., brails). Roundhaul fishing results in little unintentionally caught fish, primarily, because the fishers target a specific school, which usually consists of one species. The tendency is for fish to school by size, so if another species is present in the school, it is typically similar in size. The most common incidental catch in the CPS fishery is another CPS species (e.g., Pacific mackerel incidental to the Pacific sardine fishery). If larger fish are in the net, they can be released alive before pumping or brailing by lowering a section of the cork-line or by using a dip-net. The load is pumped out of the hold at the dock, where the catch is weighed and incidentally caught fish can be observed and sorted. Because pumping at sea is so common, any incidental catch of small fish would not be sorted at sea. Incidental harvest of non-prohibited larger fish are often taken home for personal use or processed. CPS finfish landings are sold as relatively high volume/low value products (e.g., mackerel canned for pet food, sardine frozen and shipped to Australia to feed penned tuna, and anchovy reduced to meal and oil). In addition to fishing for CPS finfish, many of the vessels fish for market squid, Pacific bonito, bluefin tuna, and Pacific herring.

Market squid are fished at night with the use of powerful lights, which aggregate squid, where they can be pumped directly from the sea or encircled with a net.

As stated in the fishery description contained in the FMP, most bycatch in the CPS fishery is incidental harvest that is sold. Several circumstances in the fishery tend to reduce bycatch, these are:

1. Most of what would be called bycatch under the Magnuson-Stevens Act is caught when roundhaul nets fish in shallow water over rocky bottom, a practice that fishers try to avoid to protect gear or are specifically prohibited to fish, because of area closures.

2 South of Pt. Buchon, California, many areas are closed to roundhaul nets under California law and the FMP, which reduces the chance for bycatch.

3 In California, a portion of the sardine caught incidentally by squid or anchovy fishers can be sold for

reduction, which reduces discard.

4 The five tons or less allowable landing by vessels without limited entry permits under the FMP should reduce any regulatory discard, because those fish can be landed.

5 From 1996 to the partial year 1999, bycatch from the live bait logs was reported with an incidence of 10%. The primary species taken as incidental catch was barracuda. Virtually all fish caught incidentally in this fishery are either used for bait, for personal use, or released alive.

6 CDFG has implemented a logbook program for the squid fishery. The data to be collected includes bycatch.

6.1 Fishery South of Pigeon Point

Information from at-sea observations of the CDFG and conversations with CPS fishers suggest that bycatch has been and is not significant. Some individuals have expressed concern that sportfish and salmon might constitute significant bycatch in this fishery. This is a reasonable concern, because anchovy and sardine are forage for virtually all predators, but there are no data to confirm significant bycatch, whereas, information from CDFG port samples indicates minimal bycatch in the California fishery. The behavior of predators may have something to do with this. Predators tend to dart through a school of prey rather than linger in the school, and predators can more easily avoid encirclement with a purse seine.

In California, CDFG samples coastal pelagic landings in Monterey and ports to the south. Biological samples are taken to monitor the fish stocks, and dock samplers report incidentally caught fish (see Appendix A). Reports of bycatch by California dock samplers confirm small and insignificant landings of bycatch at California off-loading sites. These data are likely representative of actual bycatch, because fish are pumped from the sea into fish holds aboard the fishing vessel. Fishers do not sort catch at sea that pass through the pump; they land whatever is caught and pumped into the hold. Between 1985 and the partial year of 1999, there were 5,306 CDFG port samples taken from the sardine and mackerel landings. From 1992 to 1999, incidental catch was reported on only 179 occasions, representing a 3.4% occurrence in which some incidental catch was noted. The reports of incidental catch were sparse, and prior to 1992 none was reported. Earlier incidents of bycatch may not have been noted, because the harvest of anchovy and sardine was small, and only in recent years has the harvest of sardine increased. The incidental catch reported are primarily those species that are marketable and do not meet the definition of bycatch in the Magnuson-Stevens Act. Unless an incidental species represents a significant portion of the load, at least a whole percentage point, the amount of the incidental catch is not recorded. Of the incidental catch reported, the two most prevalent species were market squid at 79%, and northern anchovy at 12% incidence within samples (not by load composition). CDFG port sample information provides a useful database for determining the significance of bycatch in the CPS fishery off California (south of Pigeon Point), the primary area of the CPS fishery.

6.2 Fishery North of Pigeon Point

The CPS fishery has not operated on a significant scale during recent times north of Monterey, California; therefore, little is known about incidental catch or bycatch that might occur in this area. However, there is increased interest in harvesting Pacific sardine off the coasts of Washington and Oregon. The states of Oregon and Washington are gathering information about the effects of these northern fisheries.

In Oregon, Pacific sardine is regarded as a developmental fishery. In 2000, 15 permits were issued for this fishery. Landings began in mid-June and continued through mid-September. Fourteen vessels made 327 landings for a total of 9,524 mt, averaging over 29 mt per trip, with 8 vessels making over 98% of the landings. Based on logbook data, 75% of the trips occurred and pounds landed were taken off Oregon and 25% off Washington.

Permit stipulations include allowing observers when requested and requiring a grate over the hold opening to sort out larger species of fish. In 2000, a seasonal employee was hired for the main purpose of riding along on sardine vessels and observing bycatch of non-target species. Twenty-two trips and 45 sets of the gear were observed (7% of the total trips landed in Oregon). Vessel skippers also were required to record all

species caught in the logbook. Logbooks turned in by October 31, 2000 accounted for 91% of the landings.

Based on both observer and logbook data, bycatch was low. Bycatch (species caught but not landed) included chinook and coho salmon, dogfish, soupfin and salmon sharks, herring, hake, flatfish, and a sunfish (Table 6.1). One sea lion was encircled by a set of the gear, but was released unharmed. Numerous jellyfish were also observed in the net and pumped into the hold but not quantified. Salmon was the major species of concern. The species of salmon was usually not recorded on the log sheets and they were often released before the observers could determine the species. Observed salmon averaged 2.1 salmon per trip or 1.0 salmon per set of gear, with 76% being released alive. The estimated total catch of salmon for the fishery, based on observer data, is 518 - 663 salmon (Table 6.2).

In addition to observing bycatch species, species composition data was collected on the vessels as fish were pumped into the holds and at the dock as the vessels were off-loading. A total of 32 species composition samples were taken. Twenty-seven samples (84%) were 100% sardines. The other five samples ranged from 87-99% sardines. Observed incidental catch (landed non-target species) consisted of Pacific mackerel, jack mackerel, and herring, for an overall average of 0.6% of the landings (Table 6.3). Incidental catch recorded on fish tickets consisted of 27.3 mt of Pacific mackerel and 18.2 mt of jack mackerel, for a total of 0.5% of the total catch.

Table 6.1. Observed and reported catches of non-target species caught in Oregon sardine fishery, 2000.

Species	Logbook data	Observer data	
	# Caught	# Released Alive	# Dead
Dogfish shark	2		
Soupfin shark	2		
Salmon shark			1
Herring			~500 lb
Chinook salmon		3	5
Coho salmon		11	3
Salmon (unknown)	206	21	3
Hake		2	
Mackerel	96,672 lb		26,500 lb
Starry flounder			1
Sanddab			1
Unknown flatfish	54 lb		
Sunfish	1		
Jellyfish			undetermined
Sea lion	1	1	

Table 6.2. Observed and expanded total number of salmon caught in sardine fishery, 2000.

	Chinook		Coho		Unknown		Total		Grand total
	alive	dead	alive	dead	alive	dead	alive	dead	
observed	3	5	11	3	21	3	32	11	46
expanded total based on salmon/trip	43	72	159	43	303	43	504	159	663
expanded total based on salmon/set	34	56	124	34	237	34	394	124	518

Table 6.3. Observed and recorded incidental catch in Oregon sardine fishery, 2000.

Species	Fish ticket data		Observer data
	mt landed	percent of catch	percent of catch
Pacific mackerel	27.3	0.3	0.1
Jack mackerel	18.2	0.2	0.4
Herring	-	-	0.1

In Washington, Pacific sardine is managed under the Emerging Commercial Fishery provisions as a trial commercial fishery. A trial commercial fishery allows the harvest of a newly classified species, or harvest of a previously classified species in a new area or by new means. In response to requests from Washington-based fishers and processors, the Washington Fish and Wildlife Commission approved a trial ocean purse seine sardine fishery for 2000 and 2001.

The fishery opened on May 15, 2000; however, the first landing into Washington occurred on June 26, 2000. The Washington Department of Fish and Wildlife (WDFW) issued a total of 45 permits and 11 permit holders participated in the fishery. A total of 4,791.4 mt of sardines were landed into Washington. There were three primary vessels who accounted for 88% of the total landings.

A total of 288 sets were made with 66% (190) of them successful. Average catch per successful set was about 25 mt. Landings averaged about 31.1 mt overall with higher individual landings occurring in September. The majority of the landings (70%) were made into Ilwaco, and the majority of the catch (about 65%) occurred in Oregon waters.

Vessels licensed in Oregon or Washington commonly fish in waters off of both states. The states have control of the entire fishery within 3 miles in waters contiguous to the state, and control of fishers licensed in the respective state regardless of where they fish. Oregon's developmental fishery allows purse seine fishing within state waters (<3 miles), while the provisions of Washington's experimental fishery prohibit purse seine fishing for sardine in state waters (except for a minor bait fishery).

The target of the trial fishery was Pacific sardine; however, anchovy, mackerel, and squid could also be retained and landed. All other species had to be released immediately with care taken to minimize damage to prohibited species. Salmon could not be landed on the boat's deck and had to be released or dip netted directly from the net before the completion of each set.

In 2000, WDFW required at-sea observer coverage to document total catch and bycatch in the purse seine fishery. Bycatch was recorded in terms of species, amount, and condition; observers noted whether the fish were released or landed, and whether the fish were alive, dead, or in poor condition. The Department was aiming for 50% coverage and averaged about 41% overall.

Based on observer data, the bycatch of non-targeted species was minimal. Bycatch included chinook and coho salmon, herring, dogfish, soupfin shark, and other species. One fisher accidentally set his net on a school of herring thinking that they were sardines which is why the herring bycatch is so large. Salmon, shark, and herring were the three primary bycatch species of concern. The estimated total catch of these species (in numbers of individuals) for the fishery, based on observer data, is contained in Table 6.4.

Table 6.4. Expanded bycatch of salmon, shark and herring based on observer data.

Chinook # released alive	Chinook # dead	Coho # released alive	Coho # dead	Unknown Salmon # released alive	Shark # released alive	Shark # dead	Herring
38	3	276	116	7	169	31	12,698

Salmon and shark species accounted for less than 1% of the overall bycatch with only one observed chinook mortality. Incidental catch included anchovy, Pacific mackerel, starry flounder, black rockfish, sole, thresher shark, and other species. A complete list of the observed and reported catches of non-targeted species caught in the fishery is contained in Table 6.5.

In addition to collecting observer and logbook data, WDFW staff routinely sampled the fishery at the dock to gather catch composition data and to weigh sardine samples. Based on sampling information, catch of non-targeted species was minimal with minor amounts of herring and Pacific mackerel in the samples.

Table 6.5. Observed and reported catches of incidental species caught in the trial sardine fishery.

	Observer Data		Logbook Data	
Species	**# Released Alive**	**# Dead**	**# Released Alive**	**# Dead**
Anchovy	0	26 lbs	0	0
Black rockfish	1	1	0	0
Chinook salmon	22	1	6	0
Coho salmon	92	55	38	19
Dogfish	23	4	6	1
Dungeness crab	10	2	0	0
Unidentified mackerel	0	5197	0	0
Herring	5650	27	0	0
Jellyfish	~ 4000 lbs	35	~ 2400 lbs	0
Mola mola	3	0	1	0
Pacific mackerel	0	9916	10	3
Sanddab	5	0	0	0
Sculpin	1	0	0	3
Skate	3	0	0	0
Soupfin shark	8	0	7	0
Starry flounder	143	4	0	1
Thresher shark	0	1	0	0
Unknown salmon	3	0	1	0
Unknown sole	2	8	0	0

7.0 Live Bait Fishery (California)

7.1 Introduction

Through much of the 20th century, CDFG monitored the harvest of CPS finfish in the California live bait fisheries with Live Bait Logs. Northern anchovy and Pacific sardine are the predominant species in this fishery, with a variety of other nearshore or coastal pelagic species taken incidentally. An estimated 20% of this harvest is sold to private fishing vessels, with the remainder tied to the Commercial Passenger Fishing Vessel (CPFV) industry, where payment to the bait haulers is on a percentage basis of the CPFV revenues (Thomson et al. 1994). An example of the first Live Bait Log from 1939, termed a "Daily Bait Record" as printed for the State of California, Department of Natural Resources, Division of Fish and Game, can be found in Aplin (1942). The nature of the data collected were self-reported daily estimates of the number of "scoops" taken and sold by the fishermen, by species. Although this variety of data does not lend itself readily to rigorous scientific analysis, there are at least sixty-one years of data available, collected in a reasonably uniform manner, that can serve as an index to this low volume, high value fishery.

A number of CDFG, NMFS and other studies have examined this fishery, generally with a focus on the dominant species taken over a given period. As in the directed commercial CPS fisheries, the local availability of each coastal pelagic to the bait fleet changes periodically. Problems with the live bait data such as conversion factors for scoops of live fish to weight, the economics of the fishery, the character of the fleet, and compliance rates in submitting logs have been addressed in various agency reports (Maxwell, 1974, Thomson et al. 1992, 1994).

7.2 Legislative History

Aplin (1942) describes the earliest implementation of the live bait log program in 1939, which followed a pilot program of verbal interaction with the fishermen that established four categories describing the variation in abundance or availability of CPS to the recreational industry.

Live bait logs have been at different times mandated by State law, or submitted to the Department on a voluntary basis. In the early 1990's sardine became more prevalent in the bait fishery, and quotas were imposed on their annual take pursuant to management efforts to recover the sardine population off California. In 1995, CDFG lifted quotas restricting the quantity of sardines that the live bait industry could harvest. The sardine population along the California coast was increasing toward a "recovered" level, as anchovy showed a decline, and sardines became the preferred live bait over anchovy. With the sardine quota lifted, the level of scrutiny on the harvest of the live bait industry lessened.

7.3 Logbook Information

The CDFG Live Bait Log (DFG 158, 10/89) required only the estimated scoops taken daily of either anchovy or sardine be reported, a check mark be made if other particular species were taken, with space for comments related to fishing. Other species noted, but not consistently enumerated in the live bait harvest include white croaker (*Genyonemus lineatus*), queenfish (*Seriphus politus*), Pacific and jack mackerels (*Scomber japonicus* and *Trachurus symmetricus*), various small fishes collectively known as "brown bait" that can include juvenile barracuda (*Sphyraena argentea*), Osmerids, Atherinids, and market squid. Estimates of ancillary catch data has been documented in earlier reports, and in Amendment 9 to the CPS FMP.

The CDFG Pelagic Fisheries Assessment Unit (PFAU) at the Southwest Fisheries Science Center (SWFSC) in La Jolla, presently archives the CDFG Live Bait Logs. Preliminary estimates of the reported total live bait harvest in California through the partial year 2000 have been appended to previously reported estimates from Thomson et al. (1992-1994).

Table 7.3.1. Preliminary estimates of Pacific sardine and Northern anchovy live bait harvest in California (mt). Data for 1939-1992 from Thomson et al. (1994), and 1993-2000 from CDFG logs. *2000 partial year only.

Year	Anchovy	Sardine
1939	1,364	0
1940	1,820	0
1941	1,435	0
1942	234	0
1943	World War II	World War II
1944	World War II	World War II
1945	World War II	World War II
1946	2,493	0
1947	2,589	0
1948	3,379	0
1949	2,542	0
1950	3,469	0
1951	4,665	0
1952	6,178	0
1953	5,798	0
1954	6,066	0
1955	5,557	0
1956	5,744	0
1957	3,729	0
1958	3,843	0
1959	4,297	0
1960	4,225	0
1961	5,364	0
1962	5,595	0
1963	4,030	0
1964	4,709	0
1965	5,645	0
1966	6,144	0
1967	4,898	0
1968	6,644	0
1969	4,891	0
1970	5,543	0
1971	5,794	0
1972	5,307	0
1973	5,639	0
1974	5,126	0
1975	5,577	0
1976	6,202	0
1977	6,410	0
1978	6,013	107
1979	5,364	0
1980	4,921	12
1981	4,698	6
1982	6,978	38
1983	4,187	193
1984	4,397	53
1985	3,775	11
1986	3,956	17
1987	3,572	216
1988	4,189	50
1989	4,594	100
1990	4,842	543
1991	5,039	272
1992	2,572	1,807
1993	669	176
1994	2,076	1,506
1995	1,278	2,055
1996	703	1,801
1997	1,077	2,344
1998	304	2,037
1999	453	2,411
2000*	735	1,120

7.4 Species Composition

The ratio of anchovy to sardine in the southern California live bait harvests has shifted significantly as the populations of these two fish expand and contract over periods of years or decades. Much of the early reported harvest consisted of anchovy, following the collapse of the sardine fishery in the 1940's.

Through the years 1994 to 2000 the proportion of anchovy in the total reported harvest ranged from a low of 13% in 1998, to a high of 58% in 1994. The proportion of sardine ranged from a low of 42% in 1994, to a high of 87% in 1998.

Table 7.4.1. Ratio of northern anchovy to Pacific sardine in preliminary reported live bait catch in California, 1994-2000. *2000 partial year only.

Year	Anchovy	Sardine	Total	%anch	%sard
2000*	735	1,120	1,855	0.40	0.60
1999	453	2,411	2,864	0.16	0.84
1998	304	2,037	2,341	0.13	0.87
1997	1,077	2,344	3,420	0.31	0.69
1996	703	1,801	2,504	0.28	0.72
1995	1,278	2,055	3,333	0.38	0.62
1994	2,076	1,506	3,582	0.58	0.42

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8.0 Vessel Safety Considerations

In implementing any form of management, it is imperative to evaluate whether the strategy will impact the safety of fishing activities. Roundhaul fisheries operating off the Pacific Coast are often limited by environmental conditions, most notably, inclement weather. Given that the average age of permitted CPS vessels is 30 years and 16 of them are wooden, concern has been raised regarding the safety and seaworthiness of some of these vessels. Implementing time/area closures or restricting transferability are examples of strategies that could impact safety by restricting the ability of an older vessel to be replaced with a newer, safer vessel or by promoting fishing activity during potentially hazardous weather conditions.

In February 2000, the California Fish and Game Commission enacted an interim market squid fishery regulation prohibiting the commercial take of market squid on weekends throughout California. Previously, a similar measure was in place for waters only North of Point Conception. Many opponents of the measure have stressed that eliminating two fishing days per week could have implications for vessel safety since the regulation may promote fishing in less than desirable weather conditions.

9.0 Summary of Stock Status and Management Recommendations

As of January 1, 2000 CDFG relinquished management of CPS fisheries to NMFS, through the Pacific Council. CDFG biologists continue to participate in management through the Council and the Council's CPSMT, the CDFG Port Sampling Program, and stock assessments.

9.1 Actively Managed Species

9.1.1 Pacific sardine

CDFG Code Section 8150.7 states that it was the intent of the Legislature that the Pacific sardine resource off California be rehabilitated, and that once the spawning population was estimated to reach 18,144 mt, a 907 mt directed fishery would be established. This happened in the 1980's and the quota was expanded as the population increased. The Pacific sardine has made a strong recovery in waters off the Pacific Coast. Estimates of the increase in sardine biomass in Pacific Coast waters is 30% annually. Estimates of sardine biomass in waters off Oregon were greater than 50,000 mt in 1994 (Bently et al. 1996), and greater than 100,000 mt in waters around Vancouver Island, B.C. in 1998 (McFarlane, DFO, pers. comm.).

Biomass estimates for Pacific sardine in waters off California incorporate fishery-dependent data gathered from the CDFG port sampling program. Fishery independent indices include an aerial spotter index, and data gathered by CalCOFI cruises.

Conser et al., 2000, summarized the status of the Pacific sardine resource in California and Baja California, Mexico. Pacific sardine landings for the directed fisheries off California, U.S. and Ensenada, Mexico remained at the high levels that were reached last year (115,000 mt), with a total harvest of roughly 114,000 mt; note that semester 2 landings in 2000 reflect projected estimates based on landing patterns observed in the fisheries during the mid to late 1990s. California landings in 2000 (59,925 mt) are expected to increase slightly (6% or 3,200 mt) from the 1999 estimated landings (56,747 mt), while Ensenada landings in 2000 (53,579 mt) are forecasted to decrease slightly (9% or 5,000 mt) from landings made in 1999 (58,569 mt). Currently, the U.S. fishery (California landings) is regulated using a quota (harvest guideline) management scheme and the Mexico fishery (Ensenada landings) is essentially unregulated. Since the mid 1990s, actual landings from the California fishery have been less than the recommended quotas.

As was the case in recent years, landings from the U.S. Pacific sardine fishery (California, Oregon, and Washington) are well below the harvest guideline recommended for 2000 (186,791 mt), with roughly 55,543 mt (30% of harvest guideline) landed through September 2000 and over 131,000 mt of the quota remaining (the fishing year ends on December 31, 2000).

Estimated stock biomass (>1-year old fish on July 1, 2000) 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 1.2 million mt. Estimated recruitment (age-0 fish on July 1, 2000), albeit more variable than stock biomass statistics, also remained at relatively high abundance, with number of recruits increasing slightly from last year to nearly 14 billion.

9.1.1.1 Harvest Guideline for 2001

The harvest guideline recommended for the U.S. (California, Oregon, and Washington) Pacific sardine fishery for 2001 is 134,737 mt. Statistics used to determine this harvest guideline are discussed below. To calculate the proposed harvest guideline for 2001, 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:

$$HG_{2001} = (\text{TOTAL STOCK BIOMASS}_{2000} - \text{CUTOFF}) \times \text{FRACTION} \times \text{U.S. DISTRIBUTION},$$

where HG_{2001} is the total U.S. (California, Oregon, and Washington) harvest guideline recommended for 2001, TOTAL STOCK $BIOMASS_{2000}$ is the estimated stock biomass (ages 1+) from the current assessment conducted in 2000, 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 U.S. DISTRIBUTION is the percentage of TOTAL STOCK $BIOMASS_{2000}$ in U.S. 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%. The F_{MSY} is equal to 15% under current oceanic conditions (T_{2000} = 17.73 °C; Figure 6).

9.1.2 Pacific mackerel

The coast-wide harvest of Pacific mackerel increased in calendar year 2000 from relatively low levels in 1999. The combined directed fisheries off California and Ensenada (northern Baja California, Mexico) yielded 30,387 mt, compared to 19,697 mt in 1999. California landings for the calendar year 2000 totaled 23,205 mt - over twice the 1999 yield. The Ensenada fishery experienced a 29% decrease in yield, from 10,168 mt in 1999 to 7,182 mt in 2000. The U.S. commercial fishery was allocated a 20,740 mt harvest guideline for the 2000-2001 (July-June) season based on a July 1, 2000 biomass estimate of 116,967 mt (Hill 2000). High local availability of young mackerel led to a dramatic increase in southern California landings during the first several months of the 2000-2001 season. As of October 31, 2000, the U.S. fishery (based primarily in San Pedro, CA) had landed approximately 19,776 mt, or 95% of the harvest guideline, with less than 1,100 mt remaining. The National Marine Fisheries Service closed the directed fishery on October 27, 2000. An incidental allowance guideline was implemented, permitting up to 20% by weight Pacific mackerel in landings in other CPS fisheries. The incidental allowance was amended in February 2001 to include a trip limit of up to one metric ton of "pure" Pacific mackerel to be landed by both limited entry and non-CPS fishermen. NMFS closed the Pacific mackerel season on March 27, 2001, eliminating the 20% incidental catch, however, the 1 mt allowance remains in effect.

ADEPT recalculates biomass for all years in the 72-year time series. Differences in biomass estimates between assessment years can be caused by interannual variation in landings, shifts in fishery age composition, and changes in relative abundance as measured by fishery-independent surveys. As is true for all age-structured population models, abundance-at-age estimates are the least certain for the most recent years when the youngest year classes have not yet become fully vulnerable to, or utilized by, the fishery. Compounding this uncertainty is the general lack of fishery or survey data for Pacific mackerel outside the Southern California Bight. Catch-at-age and weight-at-age data have not been made available from the Ensenada fishery, which is comparable in volume to the California fishery.

Biomass trends for the current assessment were similar to those estimated during the 2000 stock assessment (Hill 2000). Biomasses for the current assessment were slightly higher over the most recent decade (average of 7% higher), however, the most recent two years (1999 and 2000) dropped below estimates from the 2000 assessment (Hill 2000). The current estimate of July 1, 1999 biomass is estimated to be 17.5% lower than last years' estimate, and the 2000 biomass is 24.9% lower than last year's projection. The more precipitous decline in biomass can be attributed in part to a weak 1998 year class combined with high fishing mortality during the 1998 fishery. The 1998 fishery was the second largest on record (71,355 mt), but 71% of these landings were made by the Ensenada fleet.

The July 1, 2000 biomass projection was based on ADEPT results and certain assumptions about recruitment in January, 2000, and fishing mortality during the first half of 2001. ADEPT's estimates of recruitment are unreliable for the most recent year, so recruitment was forecast based on recent trends in reproductive success. Recruits per spawning biomass was high during the late 1970s and early 1980s, but has remained relatively low since 1982. The relationship between spawning biomass in July and number of recruits (age-0) in the following January was regressed for the period 1982/83 to 1998/99. Based on this regression, we estimated approximately 249 million age-zero fish in January 2000. Based on this recruitment value and an estimate of fishing mortality during the first half of 2001, we estimate the July 1, 2001, age 1+ biomass will be approximately 84,090 mt.

9.1.2.1 Harvest Guideline for 2001-2002

In Amendment 8 (PFMC 1998), the recommended maximum sustainable yield control rule for Pacific mackerel was:

HARVEST = (BIOMASS-CUTOFF) **X** FRACTION **X** U.S. DISTRIBUTION

where HARVEST is the U.S. harvest guideline, CUTOFF (18,200 mt) is the lowest level of estimated biomass at which harvest is allowed, FRACTION (30%) is the fraction of biomass above CUTOFF that can be taken by fisheries, and STOCK DISTRIBUTION (70%) is the average fraction of total BIOMASS in U.S. waters. BIOMASS (84,090 mt) is the estimated biomass of fish age 1 and over for the whole stock as of July 1, 2001. Based on this formula, the 2001-2002 season harvest guideline should be 13,837 mt. This harvest guideline is 33% lower than the 2000-2001 season, but similar to the average yield (14,053 mt) realized by the fishery since the 1992-1993 season.

9.2 Monitored Species

9.2.1 Northern anchovy

Under the CPS FMP, Northern anchovy is a monitored species (i.e., not actively managed with annual harvest guidelines and stock assessments). The most recent complete assessment for Northern anchovy was described in Jacobson et al., 1995. During the period of 1955 to 1994, California landings of northern anchovy began increasing in 1964, peaking in 1975 at 143,799 mt. After 1975, landings declined. From 1983 to 1999, landings did not exceed 6,000 mt/yr. California anchovy landings reported by PacFIN totaled 5,214 mt in 1999, 11,487 mt in 2000, and 3,400 mt for the first quarter of 2001. There are no reported landings of anchovy from Oregon in the period 1981 to 2000, and about 42 mt reported in Washington in 1988. Through the 1970s and early 1980s, Mexican landings increased, peaking at 258,700 mt in 1981. Mexican landings decreased to less than 2,324 mt/yr during the early 1990s. There was an increase in Mexican landings to 21,168 mt in 1995, primarily during the months of September to November, but this did not continue as a trend in 1996.

Jacobson et al. (1995, 1997) summarized the disposition of Northern anchovy landed in California. Beginning in 1965, when a reduction quota was first established separately from nonreduction uses, statistics for each use became available. All nonreduction uses are combined and include fresh, frozen, processed for human consumption, and dead bait. Mexican landings data first appears for 1962.

Total age 1+ biomass of Northern anchovy rose in the early 1970's to a maximum estimate of 1,598,000 mt in 1973, and decreased to 392,000 mt in 1994. Further estimates of spawning biomass (age 1+) peaked in 1975 at 1,069,000 mt, and declined to 388,000 mt in 1994. Fishing mortality estimates in 1990 to 1994 did not exceed 0.03%, and declined to zero in 1993 and 1994.

9.2.2 Jack mackerel

Until 1999, with implementation of the CPS FMP, jack mackerel was managed under the Council's Pacific Coast groundfish FMP. Jack mackerel are now a monitored species under the CPS fishery management plan. There is no evidence of significant exploitation of this species on the Pacific Coast of North America, and accordingly there have not been regular stock assessments or efforts to collect biological information.

Management efforts, (e.g., CDFG Port Sampling Program) to collect fishery-dependent age composition data, are in place for the two actively managed CPS, Pacific sardine and Pacific mackerel, but not for jack mackerel. Previous discussions of jack mackerel, such as in the groundfish FMP were brief:

> Available data indicate that the current, nearly un-used spawning biomass is about 1.4 million mt, the natural mortality rate is in the range of 0.1 to 0.2, a fishery located North of 39° N latitude would harvest fish that are mostly older than age 16, and the long-term potential yield for this age range is 19,000 mt. The [Council's Groundfish Management Team] GMT recommends continuation of the 52,600 mt ABC on the basis of a constant exploitation rate (equal to natural mortality) applied to estimates of current biomass of ages 16 and over. Biomass and short-term yield are expected to slowly decline under this level of exploitation. If this level of exploitation reduces long-term biomass to approximately 30% to 50% of the current biomass, the long-term average yields for this age range would be near 19,000 mt. The GMT recommends close tracking of this fishery, especially with regard to catches outside the exclusive economic zone (EEZ) and to the age composition of the harvested fish. (PFMC. 1998.)

In California, CDFG landing receipts for jack mackerel totaled 953 mt in 1999, 1,135 mt in 2000, and 333 mt for the first quarter of 2001. Oregon reported 2,941 mt cumulatively over the period 1992-2000, and Washington reported only about 39 mt landed in 1997-1998. Landings of jack mackerel in the California Pelagic Wetfish fishery through the decade of the 1990's reached a maximum of 5,878 mt in 1992, and averaged under 1,900 mt over 1990-2000. During the previous decade, California landings ranged from a high of 25,984 mt in 1982 to a low of 9,210 mt in 1985.

Mason (1992) described an estimated spawning biomass of 1.5 million tons and a estimated total biomass of 1.63 to 1.99 million tons. Anecdotal evidence suggests that the spawning biomass may be relatively high in California waters.

9.2.3 Market Squid

Although stock biomass information for market squid is currently limited, much progress was made in 2000 on development of escapement-fecundity strategies and depletion modeling which may be used for long-term management of the fishery in the near future.

To advance the understanding of squid life history and explore management alternatives, the Council co-sponsored a workshop to review market squid stock assessment methods. The workshop is, in part, to address disapproved provisions in the CPS FMP; specifically, MSY for market squid. Since development of the FMP, collection of additional biological and fishery data has led to significant progress in squid population modeling. A principal goal of the workshop is to developing approaches to integrate the latest research into the CPS fishery management. The Stock Assessment Review Panel included representatives of the Council's SSC, CPS Management Team, and CPS Advisory Subpanel; California Department of Fish and Game; National Marine Fisheries Service; and two outside reviewers. A preliminary report will be provided to the Council at the June 2001 Council meeting.

9.2.3.1 California's Market Squid Fishery

The California market squid fishery is separated at Point Conception into northern and southern fisheries. Historically, the northern fishery accounted for the majority of the catch. Since the early 1980s the southern fishery has repeatedly increased its landings and has been dominant since the mid-1980s. Typically, the northern fishery occurs during the summer months and the southern fishery in the winter months. However, in 1999 the southern California fishery operated almost throughout the entire year, with record-high monthly totals during April, May and June. Although fishermen and processors alike acknowledge that market squid was readily available during most of the year in southern California, generally catch levels were dictated by worldwide market conditions that expressed only moderate demand for the product. During most of the year, vessels were fishing on market-imposed limits of 30 short tons per trip. Conversely, the northern fishery was virtually nonexistent during 1999. Only 348.2 mt were landed, less than 0.5 % of the statewide total.

In 1999, La Niña conditions contributed to record-high market squid landings of 90,387 mt for California, surpassing the previous high in 1996 of 80,402 mt. This was more than a 30-fold increase over the previous

year (2,894 mt) when the fishery was hampered by the 1997/1998 El Niño event. New landings records were set five times in the 1990s, reflecting a continued expansion of the southern California fishery and increased international demand for market squid.

In 2000, an abundance of squid and somewhat favorable market conditions contributed to record-high market squid landings of 97,600 mt in California, surpassing the previous high in 1999 of 91,500 mt. New landings records were set five times in the 1990's, reflecting a continued expansion of the southern California fishery and increased international demand for market squid.

The California state Legislature placed a three-year moratorium (starting in 1998) on the number of vessels in the squid fishery and required participants to purchase a $2,500 permit each year to either land more than two short tons per trip or to attract market squid by light for purposes of commercial harvest. In addition, participants must have purchased a permit the previous year. For the 1999-2000 market squid fishing season (1 April to 31 March), 218 market squid vessel permits and 52 light boat permits were sold, down from 248 vessel permits and 54 light boat permits during the 1998-1999 season. For the 2000-2001 season, 197 market squid vessel permits and 50 light boat permits were sold. The sale of market squid permits during these three years provided funds for biological assessment of the resource and development of management recommendations. These management recommendations were provided by the California Department of Fish and Game to the state Legislature in April 2001. Currently (June 2001), three bills are pending in the state Legislature which may establish some or all of these recommendations by statute.

In their report, CDFG recommends several management measures for the market squid fishery, including a limited entry program geared to maintain the long-term economic viability of the fishery. The limited entry program seeks to match the level of fishing effort to the health of the resource. CDFG also recommends management approaches intended to provide sustainability of the market squid resource both as a forage item and for those that rely upon squid for their livelihood. These management approaches are based on precautionary principles and utilize the best science available.

Specifically, the report recommends the California Legislature permanently delegate squid fishery management authority to the California Fish and Game Commission. In developing a restricted access program, the CDFG supports a "moderately productive and specialized" fleet capacity goal of 52 round-haul vessels, 52 light boats, and 18 brail boats. These goals are within the range of the number of vessels actively participating in the fishery in a given year. The recommendations include establishing limited entry permit criteria based on prior catch or fishing history, and for full transferability of vessel permits only between vessels of comparable capacity.

Additionally, CDFG recommends enacting catch limits to prevent increases in the volume of the current fishery, limit future participation by vessels of a significantly larger size, and prevent current vessels from increasing catch volume on a per-trip basis should market-imposed trip limits be dissolved or technological developments allow for increased efficiency. These catch limitations include both daily trip limits for round-haul and brail vessels and a seasonal landings cap of 125,000 short tons (113,400 mt) for the statewide fishery.

In their report, the CDFG does not recommend any specific closure areas for squid replenishment at this time, but supports continued evaluation and identification of squid harvest replenishment areas as a future resource protection tool. Further consideration of area closures to mitigate potential fishery impacts on the environment is also encouraged, as is maintaining the existing interim wattage and shielding regulations enacted to reduce potential light impacts on nesting seabirds and coastal communities, and continuing closure of the fishery on weekends statewide in the spirit of precautionary management. In the absence of conclusive biological information upon which to base a quota or other management approach, a two-day per week time period provides assurance there is some uninterrupted spawning in areas where squid are present. Unlike a seasonal quota or seasonal closure, this measure spreads escapement of squid throughout the year, rather than concentrating it at the beginning or end. Continuing squid research and the fishery monitoring program is also encouraged. This includes sampling efforts conducted at ports statewide, required logbooks for all permitted vessels participating in commercial squid fishing activity, and ongoing monitoring of catch information and continuation of independent research contracts, especially those focused on developing population models useful for management.

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10.0 Economic Status of Washington, Oregon, and California CPS Fisheries in 2000

This section briefly summarizes economic data presented in the Economic Appendix – *Economic Status of Washington, Oregon, and California CPS Fisheries in 2000.* Pacific Coast landings of CPS continued their increase in 2000 to a high of 219,840 mt for the 1981-2000 period, representing a 31% increase in landings from 1999. Market squid landings reached a period high of 117,111 mt in 2000, as did sardine landings, 67,888 mt. The inflation adjusted (real) exvessel value of CPS landings was just under $38 million in 2000, down 7% from 1999 (Table 9, Figure 2). Market squid accounted for 54%, and Pacific sardine 31% of total landings in 2000. Landings of Pacific mackerel and northern anchovy more than doubled from 1999 to 2000. Two thousand squid revenues decreased 20 % from 1999 because the increase in landings was more than offset by a sharp drop in exvessel price from $364 to $225 per mt. Aggregate CPS finfish real exvessel revenues increased 53% from 2000 due to the increase in landings together with a 14% increase in overall exvessel price. In 2000, market squid made up over 8% of the value of total Pacific Coast landings, and CPS finfish accounted for almost 4%. Market squid ranked first among California commercial fisheries in value in 2000, with exvessel revenue double that of Dungeness crab, the next most valuable fishery.

California accounted for 93% of coastwide CPS landings in 2000, down from 99% in 1999. Pacific sardine landings in Oregon increased from 776 mt in 1999 to 9,526 mt in 2000. Oregon landings of Pacific mackerel fell from 259 mt in 1999 to 119 mt in 2000. With implementation of a trial sardine fishery in Washington during 2000, Washington landings of sardine went from one mt in 1999 to 4,482 mt in 2000. Washington landings of mackerel dropped from 155 mt to 39 mt and anchovy landings dropped from 98 mt to 79 mt from 1999 to 2000. The major west coast processors and buyers of CPS are concentrated in the Los Angeles, Santa Barbara-Ventura, and Monterey port areas.

In 2000, the number of vessels with Pacific Coast landings of CPS finfish was 248, up from 203 in 1999. This increase in CPS finfish vessel activity can be partly attributed to the developing sardine fisheries off Oregon and Washington. Of the CPS finfish vessels active in 2000, only 16% depended on CPS finfish for most of their 2000 exvessel revenues. From 1999 to 2000, the number of vessels with Pacific Coast landings of market squid increased from 182 to 184, with over 51% depending on market squid for the largest share of their 2000 exvessel revenues. Market squid total revenue shares for vessels that depend mainly on market squid are higher on average than average finfish total revenue shares for vessels that depend primarily on CPS finfish, suggesting that market squid vessels tend to be more specialized than CPS finfish vessels. Roundhaul gear accounts by far for the largest share of total CPS landings, dip net gear is a distant second. Vessels that depend on finfish for most of their exvessel revenues mainly land in the Los Angeles area. Vessels that depend on market squid for the largest share of their exvessel revenues make most of their landings in the Los Angeles, Santa Barbara-Ventura and Monterey port areas.

Seventy-two percent, 84,868 mt, of west coast market squid landings were exported in 2000, with an export value of $72 million. Squid exports in 2000 were two and one half times the quantity and twice the value of exports in 1999. The primary country of export was China, which received 36,057 mt, three and one half times the quantity exported to China in 1999. Over 75% of squid exports went to China and four additional countries: the Philippines (11,110 mt), Japan (5,838 mt), Spain (5,800 mt) and Switzerland (4,809 mt). Domestic sales were generally to restaurants, Asian fresh fish markets or packaged for use as frozen bait.

Seventy-two percent, 48,613 mt, of Pacific sardine landings were exported in 2000, up 23% from 1999; most of the remaining landings are consumed domestically as canned sardine. Pacific sardine exports were valued at $29.6 million in 2000. Almost 90% of Pacific sardine exports are in the frozen form, the balance is in the preserved form. Australia was the primary export market in 2000, receiving 28,261 mt, 58% of total exports. Pacific sardine has become the preferred fish food species in Australia's bluefin tuna grow-out operations, because of their freshness – being caught close to shore – and high oil content which promotes rapid growth in bluefin tuna. Japan was the second most important export market with 16,840 mt, 35% of total Pacific sardine exports. Japanese demand for large frozen Pacific sardines has been growing, for use as bait in its longline fisheries.

Table 1. History of Council Actions

The Council initiated development of the FMP for Northern anchovy in January of 1977. The FMP was submitted to the U.S. Secretary of Commerce (Secretary) in June of 1978. Regulations implementing the FMP for Northern anchovy were published in the *Federal Register* on September 13, 1978 (43 *FR* 40868). Subsequently, the Council has considered seven amendments.

The first amendment changed the method of specifying the domestic annual harvest for Northern anchovy and added a requirement for an estimate of domestic processing capacity and expected annual level of domestic processing. Approval for this amendment was published in the *Federal Register* on July 18, 1979 (44 *FR* 41806).

The second amendment, which became effective on February 5, 1982, was published in the *Federal Register* on January 6, 1982 (47 *FR* 629). The purpose of this amendment was to increase the domestic fishing fleet's opportunity to harvest the entire optimum yield (OY) of Northern anchovy from the U.S. EEZ by releasing, inseason, unutilized portions of the Northern quota.

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

The fourth amendment, which had two parts, was published in the *Federal Register* on August 2, 1983 (48 *FR* 34963) and became effective on August 13, 1983. The first part abolished the five-inch size limit in the commercial fishery and established a minimum mesh size of 5/8 inch for Northern anchovy. The mesh size requirement did not become effective until April 1986 in order to give the fleet additional time to comply without undue economic hardship. The second part established a mid-season quota evaluation that was simpler in design than the method proposed in Amendment 3.

The fifth amendment in 1983 incorporated advances in scientific information concerning the size and potential yield of the central subpopulation of Northern anchovy. In addition, the fifth amendment included changes to a variety of other management measures. Two or more alternative actions were considered in each of seven general categories; (1) OY and harvest quotas; (2) season closures; (3) area closures; (4) quota allocation between areas; (5) the reduction quota reserve; (6) minimum fish size or mesh size; and (7) foreign fishing and joint venture regulations. The alternatives for the fifth amendment were reviewed by the Council during 1983. The final rule was published in the *Federal Register* on March 14, 1984 (49 *FR* 9572).

In 1990, the sixth amendment implemented a definition of overfishing for Northern anchovy consistent with National Standard 7, and addresses vessel safety (56 *FR* 15299, April 16, 1991).

The Council began developing the seventh amendment as a new FMP for CPS on a motion from NMFS and California in 1990. A complete draft was available in November of 1993, but the Council suspended further work, because NMFS withdrew support due to budget constraints. In July of 1994, the Council decided to proceed with the plan through the public comment period. NMFS agreed with the decision on the condition that the Council also consider the options of dropping or amending the anchovy FMP. Thus, four principal options were considered for managing CPS (1) drop the anchovy FMP (no federal or Council involvement in CPS); (2) continue with the existing FMP for anchovy (status quo); (3) amend the FMP for Northern anchovy; and (4) implement an FMP for the entire CPS fishery. In March of 1995, after considering all four principal options, the Council decided to proceed with the FMP for CPS. Final action was postponed until June 1995 when the Council adopted a draft plan that had been revised to address comments provided by NMFS and the SSC. Amendment 7 was submitted to the US Secretary of Commerce, but rejected by NMFS, Southwest Region, as being inconsistent with National Standard 7. NMFS announced its intention to drop the FMP for Northern anchovy (in addition to FMP's other species) in the *Federal Register* on March 26, 1996 (61 *FR* 13148), but the action was never completed.

Development of Amendment 8 began in June, 1997 when the Council directed the CPSPDT to amend the FMP for Northern anchovy to conform to the recently revised Magnuson-Stevens Fishery Conservation and Management Act and to expand the scope of the FMP to include the entire CPS fishery. Amendment 8 was partially approved by the U.S. Secretary of Commerce on June 10, 1999, and final regulations were published on December 15, 1999 (64 *FR* 69888). The FMP was implemented on January 1, 2000.

At its meeting in June 1999, the Council directed its Coastal Pelagic Species Management Team (CPSMT) to recommend appropriate revisions to the FMP and report to the Council the following September. A public meeting of the CPSMT was held in La Jolla, CA, on August 3 and 4, 1999, and August 24, 1999, and a meeting was held between the CPSMT and the Coastal Pelagic Species Advisory Subpanel on August 24, 1999. At its September 1999 meeting, the Council gave further direction to the CPSMT regarding MSY for squid. At its March 2000 meeting, the Council asked the CPSMT for a more thorough analysis of the alternatives proposed for establishing MSY for squid and for bycatch. At a public meeting in La Jolla, CA, on April 20 and 21, 2000, the CPSMT reviewed comments from the Council, the Council's Scientific and Statistical Committee (SSC) and prepared additional material for establishing MSY for squid based on spawning area.

The Council distributed Amendment 9 for public review on July 27, 2000. At its September 2000 meeting, the Council reviewed written comments, received comments from its advisory bodies, and heard public comments, and decided to submit only two provisions for Secretarial review. Based on testimony concerning MSY for squid, the Council decided to include in Amendment 9 only the bycatch provision and a provision providing a framework to ensure that Indian fishing rights are implemented according to treaties between the U.S. and the specific tribes. Since implementation of the FMP, the CPS fishery has expanded to Oregon and Washington. As a result, the FMP must discuss Indian fishing rights in these areas. These rights were not included in the FMP; and the Council decided to address this issue in Amendment 9. The Council decided to conduct further analysis of the squid resource and will prepare a separate amendment that addresses OY and MSY for squid.

The Secretary of Commerce approved Amendment 9 on March 22, 2001.

In April 2001, the Council adopted a capacity goal for the CPS limited entry finfish fishery and asked the CPSMT to begin work on a 10th amendment to the FMP. Amendment 10 will include the capacity goal, provisions for permit transferability, a process for monitoring fleet capacity relative to the goal, and a framework for modifying transferability provisions as warranted by increases or decreases in fleet capacity. The amendment will also address determination of OY and MSY for market squid.

Table 2. Regulatory Actions

January 25, 2000. National Marine Fisheries Service (NMFS) published harvest guidelines for Pacific sardine and Pacific mackerel for the fishing year beginning January 1, 2000 (65 *FR* 3890). A harvest guideline of 186,791 mt was established for Pacific sardine, based on a biomass estimate of 1,581,346 mt. The harvest guideline is allocated for Subarea A, which is north of 35° 40' N latitude (Pt. Piedras Blancas) to the Canadian border, and for Subarea B, which is south of 35° 40' N latitude to the Mexican border. Any unused resource in either area will be reallocated between areas to help ensure that optimum yield will be achieved. The northern allocation was 62,264 mt; the southern allocation was 124,527 mt. The sardine harvest guideline is in effect until December 31, 2000, or until it is reached and the fishery closed. A harvest guideline of 42,819 mt was established for Pacific mackerel based on a biomass estimate of 239,286 mt. The harvest guideline for Pacific mackerel is in effect until June 30, 2000, or until it is reached and the fishery closed.

September 11, 2000. NMFS announced the annual harvest guideline for Pacific mackerel in the exclusive economic zone off the Pacific coast. The Coastal Pelagic Species Fishery Management Plan (FMP) and its implementing regulations require NMFS to set an annual harvest guideline for Pacific mackerel based on a formula in the FMP. The intended effect of this action is to establish allowable harvest levels for Pacific mackerel off the Pacific coast. Based on the estimated biomass of 116,967 mt and the formula in the FMP, a harvest guideline of 20,740 mt was calculated for the fishery beginning on July 1, 2000. This harvest guideline is available for harvest for the fishing season July 1, 2000, through June 30, 2001.

November 1, 2000. NMFS announced the closure of the directed fishery for Pacific mackerel in the exclusive economic zone off the Pacific coast on October 27, 2000. The FMP and its implementing regulations require NMFS to set an annual harvest guideline for Pacific mackerel based on a formula in the FMP and to close the fishery when the harvest guideline is reached. The harvest guideline of 20,740 metric tons is projected to be reached before the end of the fishing season on June 30, 2001, which requires closing the directed fishery and setting an incidental harvest limit for Pacific mackerel so that the harvest of other coastal pelagic species will not be further restricted. The intended effect of this action is to ensure conservation of the Pacific mackerel resource. For the reasons stated here and in accordance with the FMP and its implementing regulations at 50 CFR 660.509, the directed fishery for Pacific mackerel will be closed October 27, 2000, after which time no more than 20 percent by weight of any landing of Pacific sardine may be Pacific mackerel.

November 17, 2000. This document contains a correction to the Pacific mackerel closure which was published on November 1, 2000. In rule FR DOC. 00-28109, on page 65272, in the issue of Wednesday, November 1, 2000 (65 FR 65272), make the following correction: On page 65272, in the third column, under the heading SUPPLEMENTARY INFORMATION, the last sentence is corrected to read as follows: ''For the reasons stated here and in accordance with the FMP and its implementing regulations at 50 CFR 660.509, the directed fishery for Pacific mackerel will be closed October 27, 2000, after which time no more than 20 percent by weight of a landing of Pacific sardine, northern anchovy, jack mackerel, or market squid may consist of Pacific mackerel."

December 27, 2000. NMFS announced the annual harvest guideline for Pacific sardine in the exclusive economic zone off the Pacific coast for the January 1, 2001, through December 31, 2001, fishing season. This harvest guideline has been calculated according to the regulations implementing the FMP. The intended effect of this action is to establish allowable harvest levels for Pacific sardine off the Pacific coast. Based on the estimated biomass of 1,182,465 mt and the formula in the FMP, a harvest guideline of 134,737 mt was calculated for the fishery beginning January 1, 2001. The harvest guideline is allocated one-third for Subarea A, which is north of 35° 40' N latitude (Pt. Piedras Blancas) to the Canadian border, and two-thirds for Subarea B, which is south of 35° 40' N latitude to the Mexican border. Any unused resource in either area will be reallocated between areas to help ensure that the optimum yield will be achieved. The northern allocation is 44,912 mt; the southern allocation is 89,825 mt.

February 22, 2001. NMFS announced changes to the restriction on landings of Pacific mackerel for individuals participating in the coastal pelagic species (CPS) fishery and for individuals involved in other fisheries who harvest small amounts of Pacific mackerel. The incidental limit on landings of 20 percent by weight of Pacific mackerel in landings of Pacific sardine, northern anchovy, jack mackerel, and market squid remains in effect; however, CPS fishermen may land up to 1 metric ton (mt) of Pacific mackerel even if they

land no other species from the trip. Non-CPS fisherman may land no more than 1 mt of Pacific mackerel per trip. After the harvest guideline of 20,740 mt is reached, all landings of Pacific mackerel will be restricted to 1 mt per trip. This action is authorized by the FMP and is intended to ensure that the fishery achieves, but does not exceed, the harvest guideline while minimizing the economic impact on small businesses. For the reasons stated here, no fishing vessel may land more than 1 mt of Pacific mackerel per fishing trip, except that fishing vessels with other CPS on board may land more than 1 mt of Pacific mackerel in a fishing trip if the total amount of Pacific mackerel on board the vessel does not exceed 20 percent by weight of the combined weight of all CPS on board the vessel.

March 30, 2001. NMFS announced the closure of the fishery for Pacific mackerel in the exclusive economic zone off the Pacific coast at 12 a.m. on March 27, 2001. The FMP and its implementing regulations require NMFS to set an annual harvest guideline for Pacific mackerel based on a formula in the FMP and to close the fishery when the harvest guideline is reached. The harvest guideline of 20,740 metric tons (mt) has been reached. Following this date no more than 1 mt of Pacific mackerel may be landed from any fishing trip. The effect of this action is to ensure conservation of the Pacific mackerel resource.

Table 3. Occurrence of Incidental Catch from the CDFG Port Sampling Program. (This information represents occurrence of incidental catch, not numbers or weights.)

Landings Sampled per Year

Year	Sardine	Mackerel	Total
99	61	--	61
98	97	97	194
97	113	116	229
96	96	85	181
95	254	215	469
94	119	167	286
93	85	183	268
92	231	113	344
91	169	42	211
90	99	233	332
89	149	451	600
88	190	385	575
87	128	510	638
86	105	440	545
85	40	333	373

Incidental Catch from Port Sampling Records

Yr	Anchovy	Jacksmelt	Herring	White Croaker	M. Squid	Lingcod	Pac Mack	Y-tail	Jack Mackerel	Y-fin Tuna	Skipjack Tuna	Total
99	5	1	1									7
98	3		2	1	4							10
97	1		1		44							46
96	8			1	22	1						32
95	5		1		71		1	1	1			80
94			1									1
93												--
92					1					1	1	3

Live Bait Logs

Year	Days Fished	Smelts, true	Barracuda	Herring	Shiner Surfperch	Sea Star
99	187	1	4			
98	812		84	1	1	
97	778		102		3	1
96	131		1			
Total	1908	1	191	1	4	1

Table 4. 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	5,056	5,056	2,957	10,099	141,403	88,847	246,958
84	12,816	12,878	9,063	21,581	226,169	147,229	371,294
85	20,961	21,439	15,673	33,385	219,856	155,365	352,332
86	29,917	31,484	24,446	46,926	846,294	615,775	1,287,227
87	72,083	75,573	59,772	108,304	832,040	617,653	1,190,540
88	105,088	114,408	94,477	152,212	1,461,068	1,063,523	2,219,947
89	160,457	178,912	148,464	239,814	1,158,867	810,564	1,894,887
90	175,762	208,108	173,068	282,917	4,709,570	3,090,489	8,018,753
91	222,968	258,856	198,733	394,671	5,902,130	3,685,261	10,226,905
92	350,673	416,435	308,879	643,578	4,105,231	2,593,962	7,299,626
93	331,202	438,385	336,054	655,658	8,927,805	6,324,826	14,328,381
94	482,639	635,350	511,046	912,435	10,906,645	7,633,095	16,934,560
95	511,541	720,733	580,872	1,013,478	6,785,885	4,781,041	10,792,603
96	537,008	789,746	654,219	1,076,120	5,565,890	3,820,403	9,088,025
97	483,698	765,450	644,562	1,032,142	8,135,807	5,105,778	13,574,897
98	435,700	738,098	601,127	1,030,048	19,021,736	12,389,294	33,111,696
99	693,865	1,084,814	818,716	1,654,253	11,581,850	6,958,572	22,728,400
00	718,662	1,182,465	834,879	1,896,204	13,584,794	6,940,772	28,942,209

Table 5. West coast Pacific sardine landings (metric tons) by year, 1981-2000. Mexican landings are for Ensenada, northern Baja California.

Year	Mexico	California	Oregon	Washington	Canada	Total
1981	0.0	14.8	0.0	0.0	0.0	14.8
1982	0.0	1.8	0.0	0.0	0.0	1.8
1983	273.6	488.7	0.0	0.0	0.0	762.3
1984	0.2	375.0	0.0	0.0	0.0	375.2
1985	3,722.3	665.4	0.0	0.0	0.0	4,387.7
1986	242.6	1,286.6	0.0	0.0	0.0	1,529.2
1987	2,431.6	2,920.6	0.0	0.0	0.0	5,352.2
1988	2,034.9	4,127.7	0.0	0.0	0.0	6,162.6
1989	6,224.2	3,722.5	0.0	0.0	0.0	9,946.7
1990	11,375.3	3,305.3	0.0	0.0	0.0	14,680.6
1991	31,391.8	9,034.2	0.0	0.0	0.0	40,426.0
1992	34,568.2	21,237.5	0.0	0.0	0.0	55,805.7
1993	32,045.0	17,842.2	0.2	0.0	0.0	49,887.4
1994	20,876.9	14,050.1	0.0	0.0	0.0	34,927.0
1995	35,396.2	43,489.9	0.0	0.0	25.0	78,911.1
1996	39,064.7	36,056.6	0.0	0.0	88.0	75,209.3
1997	68,439.1	46,196.5	0.0	0.0	34.0	114,669.6
1998	47,812.2	41,055.4	1.0	0.0	745.0	89,613.6
1999	58,569.4	59,076.2	775.5	0.0	1,250.0	119,671.1
2000	51,172.9	57,934.8	9,525.5	4,791.9	1,718.0	125,143.1

Table 6. Pacific sardine directed fishery quotas and landings for the California fishery, 1990-1999, and U.S. west coast 2000-2001.

Year	CA Quota	U.S. Harvest Guideline	CA Landings	U.S. Landings
1990	907	---	3,305	3,305
1991	10,886	---	9,034	9,034
1992	18,597	---	21,238	21,238
1993	18,144	---	17,842	17,842
1994	9,072	---	14,050	14,050
1995	47,305	---	43,490	43,490
1996	34,791	---	36,057	36,057
1997	48,988	---	46,196	46,196
1998	43,545	---	41,055	41,056
1999	120,474	---	59,076	59,852
2000	---	186,791	57,935	72,252
*2001	---	134,737	23,701	23,701

*Preliminary

Table 7. RecFIN estimates of P. mackerel harvest (mt) in California by fishing mode, 1980-2000.

Year	Man Made Structures	Beach/Bank	Shore Modes	CPFV	Private/Rental	Totals
1980	351	76	None	1214	1027	2668
1981	224	63	None	594	520	1401
1982	272	3	None	866	543	1684
1983	371	3	None	703	404	1481
1984	257	24	None	578	586	1445
1985	146	1	None	559	400	1105
1986	None	None	93	529	399	1020
1987	None	None	451	254	629	1334
1988	334	None	None	163	374	871
1989	None	None	257	147	236	639
1990	N/A	N/A	N/A	N/A	N/A	N/A
1991	N/A	N/A	N/A	N/A	N/A	N/A
1992	N/A	N/A	N/A	N/A	N/A	N/A
1993	107	1	None	160	355	623
1994	204	4	None	411	390	1009
1995	119	2	None	381	540	1042
1996	97	1	None	324	287	708
1997	172	3	None	167	660	1003
1998	112	1	None	133	219	465
1999	55	5	None	59	81	201
2000	41	19	None	45	120	225

Notes from RecFIN query:

1. No data in 1990, 1991 or 1992.
2. No data in wave 1 1995.
3. Data in waves 1-6, 2000 are preliminary and may be incomplete.
4. N California charter boats were not fully sampled due to refusals.

Table 8. RecFIN estimated harvest of Pacific Mackerel 1980-2000. Metric tons by subregion.

Year	SoCal	NoCal	OR	WA	Totals
1980	2659	9	None	None	2668
1981	1233	169	None	None	1401
1982	1571	113	None	None	1684
1983	1354	126	1	None	1481
1984	1257	188	<1	None	1445
1985	1053	52	<1	None	1105
1986	986	34	None	None	1020
1987	1320	14	None	None	1334
1988	848	22	None	None	871
1989	634	5	None	None	639
1990	N/A	N/A	N/A	N/A	N/A
1991	N/A	N/A	N/A	N/A	N/A
1992	N/A	N/A	N/A	N/A	N/A
1993	590	32	1	None	623
1994	994	15	<1	None	1009
1995	1040	2	<1	None	1042
1996	678	31	<1	None	708
1997	603	399	1	None	1003
1998	443	21	<1	<1	465
1999	200	1	None	<1	201
2000	224	1	<1	None	225

Notes from RecFIN query:
1. No data from 1990-1992.
2. No data in wave 1 1995.
3. Data in waves 1-6, 2000 are preliminary and may be incomplete.
4. N California charter boats were not fully sampled due to refusals.

Table 9. West coast landings (mt) and real[1] exvessel revenues ($ 1999) for Pacific sardine, Pacific mackerel[2], jack mackerel, anchovy and market squid, 1981-2000.

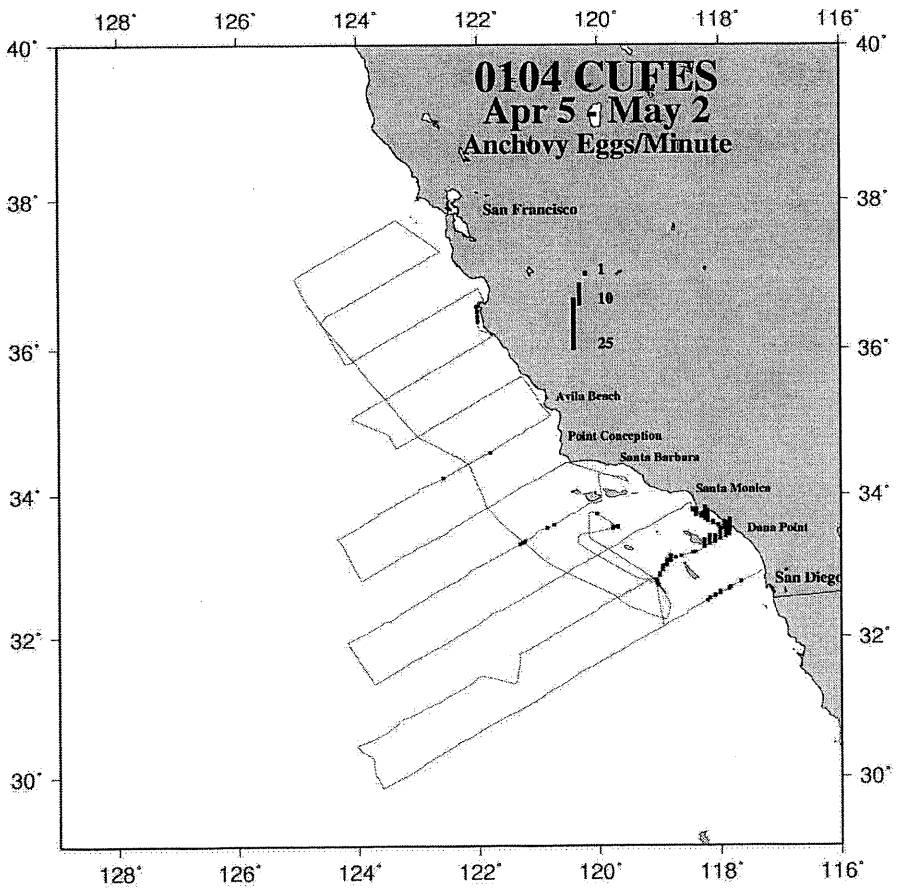
Year	Pacific Sardine mt	Pacific Sardine Rev	Pacific Mackerel mt	Pacific Mackerel Rev	Jack Mackerel mt	Jack Mackerel Rev	Anchovy mt	Anchovy Rev	Squid mt	Squid Rev
1981	15	$5,258	35,388	$12,686,571	17,778	$6,364,916	52,309	$5,702,835	23,510	$8,849,596
1982	2	$882	36,065	$11,915,303	19,617	$6,530,938	42,155	$3,562,011	16,308	$5,855,359
1983	1	$275	41,479	$12,662,469	9,829	$2,821,898	4,430	$659,757	1,824	$1,191,684
1984	1	$1,316	44,084	$12,602,105	9,149	$2,069,051	2,899	$629,609	564	$453,412
1985	6	$2,071	37,772	$9,711,895	6,876	$1,889,452	1,638	$338,972	10,276	$5,486,227
1986	388	$116,694	48,089	$11,370,459	4,777	$1,207,202	1,557	$470,554	21,278	$6,456,819
1987	439	$86,578	46,725	$9,266,244	8,020	$1,639,358	1,467	$429,089	19,984	$5,482,449
1988	1,188	$212,742	50,864	$11,318,700	5,068	$1,062,922	1,518	$535,321	37,232	$10,509,715
1989	837	$235,171	47,713	$9,171,820	10,745	$2,008,836	2,511	$1,274,453	40,893	$8,914,853
1990	1,664	$244,181	40,092	$6,572,562	3,223	$534,680	3,259	$780,397	28,447	$5,833,866
1991	7,587	$1,058,165	32,019	$6,313,592	1,712	$294,058	4,068	$784,863	37,389	$7,192,813
1992	17,954	$2,102,748	19,045	$4,564,465	1,526	$274,149	1,166	$275,390	13,110	$2,869,115
1993	15,347	$1,725,203	12,129	$1,692,751	1,950	$320,827	2,003	$550,368	42,830	$11,386,197
1994	11,644	$1,982,103	10,293	$1,573,505	2,906	$425,971	1,859	$605,419	55,892	$19,268,399
1995	40,256	$3,942,920	8,823	$1,214,024	1,877	$298,491	2,016	$464,455	70,252	$24,145,236
1996	32,553	$3,218,376	9,725	$1,377,958	2,438	$318,529	4,505	$1,011,693	80,320	$33,553,517
1997	42,839	$4,198,370	20,162	$2,867,314	1,534	$290,540	5,778	$852,687	70,247	$22,528,532
1998	42,581	$3,683,513	20,405	$2,589,304	1,563	$314,351	1,553	$244,027	2,709	$1,550,042
1999	60,130	$5,158,332	9,094	$1,093,376	1,579	$201,184	5,311	$959,397	91,519	$33,276,811
2000	67,888	$7,168,719	21,360	$2,764,323	1,316	$242,203	11,565	$1,152,507	117,711	$26,519,569

Source PacFIN data extracted May, 2001.

[1]Real values are current values adjusted to eliminate the effects of inflation. This adjustment has been made by dividing current values by the current year GDP implicit price deflator, with a base year of 1999.

[2]Pacific mackerel landings and revenues also include landings and revenues of unspecified mackerel.

Figure 1. Distribution of northern anchovy and jack mackerel eggs collected during CalCOFI cruise 0104 (April-May 2001) using the Continuous Underway Fish Egg Sampler (CUFES).



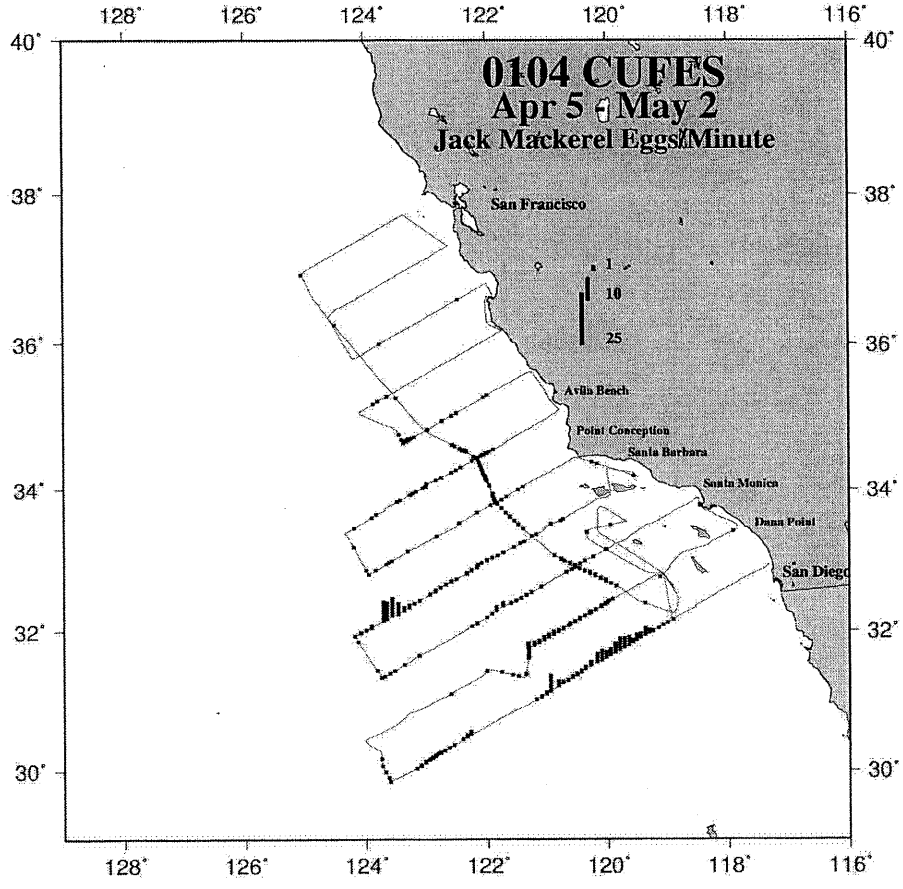
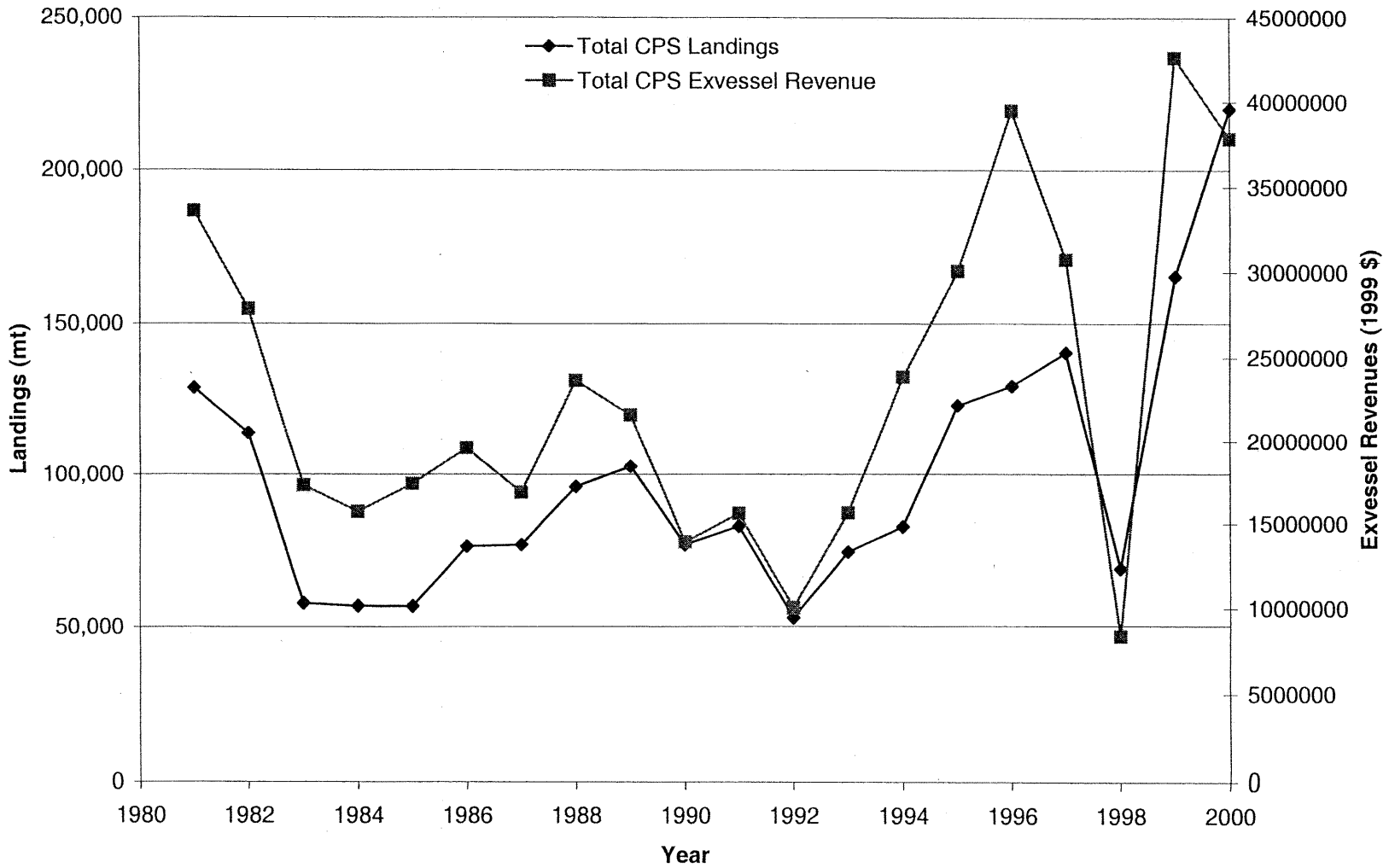


Figure 2. Annual Pacific coast landings and real exvessel revenues for all CPS species, 1981-2000.



APPENDIX 1

ECONOMIC STATUS

OF

WASHINGTON, OREGON, AND CALIFORNIA

CPS FISHERIES

IN 2000

Samuel F. Herrick, Jr. National Marine Fisheries Service, Southwest Fisheries Science Center

June 2001

Table 1. Pacific coast landings (mt) and real1 exvessel revenues ($ 1999) for Pacific sardine, Pacific mackerel2, jack mackerel, anchovy and market squid by landing area, 1981-2000.

Species	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	San Diego																			
	Landings (mt)																			
Sardine				<.5				<.5	<.5	<.5		<.5	<.5	2	5	1	3	215	592	19
P. Mack	13	30	18	27	19	9	10	17	8	8	11	17	16	21	31	26	16	52	15	2
J. Mack	12	<.5	<.5	<.5	<.5	<.5	1			<.5	<.5	1	3	5	<.5				<.5	<.5
Anchovy	2		2					6	94	18	400	121	4	28	38	145	12	2	2	4
Squid	4	<.5	1		<.5		3	19	2	1		16	<.5	1	1	2	3	2	4	35
	Exvessel Revenues (1999 $)																			
Sardine				$399			$46	$73	$201	$238		$203	$594	$951	$4,386	$1,170	$3,053	$20,441	$59,857	$7,182
P. Mack	$16,044	$21,761	$14,983	$19,659	$26,328	$8,566	$10,653	$15,997	$8,254	$7,009	$9,112	$16,093	$14,834	$14,889	$18,577	$16,293	$10,179	$8,776	$4,564	$2,096
J. Mack	$7,078	$213	$838	$623	$128	$299	$1,339		$19	$76	$93	$1,100	$2,886	$2,803	$469		$2		$125	$223
Anchovy	$1,140		$1,079				$16	$4,315	$213,916	$49,334	$116,314	$23,371	$992	$10,589	$40,525	$71,455	$5,685	$1,039	$665	$1,698
Squid	$3,141	$35	$1,123	$37	$211	$17	$1,988	$9,440	$2,839	$1,329		$4,154	$97	$237	$620	$552	$741	$1,340	$4,500	$10,116
	Orange/LA																			
	Landings (mt)																			
Sardine	15	2	1	<.5	3	287	317	1,172	505	1,180	6,415	13,849	13,978	9,032	34,137	23,923	26,083	30,781	39,084	39,031
P. Mack	29,140	29,875	33,904	35,574	32,013	41,072	39,865	47,659	41,722	37,139	31,567	18,078	11,724	9,844	7,864	8,761	13,997	16,987	8,551	20,949
J. Mack	14,706	18,141	6,788	3,567	5,860	4,289	7,801	4,939	10,704	2,936	1,640	1,096	1,269	2,460	1,596	2,054	823	798	927	1,076
Anchovy	38,384	32,632	1,023	264	68	161	115	94	503	201	434	137	119	137	298	239	1,121	338	1,418	1,279
Squid	8,291	4,293	854	66	3,097	8,125	5,422	15,090	16,354	9,798	12,307	1,701	12,890	11,231	18,415	14,768	17,697	238	27,574	44,781
	Exvessel Revenues (1999 $)																			
Sardine	$5,245	$811	$254	$514	$1,193	$86,259	$63,915	$207,691	$74,970	$179,005	$902,048	$1,581,579	$1,577,407	$1,079,542	$3,207,491	$2,287,323	$2,573,840	$2,827,137	$3,510,678	$4,091,837
P. Mack	$10,529,441	$9,838,938	$10,642,979	$10,959,421	$8,409,211	$9,868,176	$7,943,015	$10,316,388	$8,220,677	$6,101,870	$6,214,386	$4,435,716	$1,650,797	$1,495,302	$1,101,276	$1,191,718	$2,275,863	$2,209,041	$1,036,737	$2,726,311
J. Mack	$5,259,642	$6,055,375	$2,170,799	$1,062,523	$1,602,494	$1,049,734	$1,589,672	$1,021,475	$1,996,109	$477,445	$270,604	$250,523	$205,812	$318,793	$207,596	$286,882	$185,835	$249,402	$185,239	$194,986
Anchovy	$4,133,913	$2,550,006	$205,102	$140,794	$27,497	$37,219	$29,993	$23,795	$75,511	$41,966	$63,773	$23,887	$17,572	$18,051	$30,441	$25,704	$98,314	$41,861	$218,085	$143,306
Squid	$1,675,807	$946,113	$512,423	$55,695	$1,498,039	$2,628,870	$1,539,781	$4,143,090	$3,428,585	$1,695,080	$1,911,615	$299,165	$3,023,538	$2,613,741	$5,520,721	$4,550,709	$5,988,004	$138,445	$9,117,139	$11,110,103
	Ventura/Santa Barbara																			
	Landings (mt)																			
Sardine						18	74	13	93	236	186	973	692	315	432	641	3,394	1,155	2,545	3037.3
P. Mack	4,873	4,096	4,083	1,310	3,002	5,007	5,885	3,122	5,908	421	138	94	39	98	269	100	1,165	1,314	215	230
J. Mack	2,847	1,195	583	101	787	297	8	7	<.5	76	9	<.5		48	22	31	7			9.1
Anchovy	9,077	6,514	2,749	192	114	162	172	190	168	144	194	93	306	346	346	377	513	208	2,233	3512.5
Squid	2,390	1,403	7	10	3,289	6,832	8,606	16,898	17,369	10,601	16,905	2,834	20,847	27,363	48,456	60,328	44,056	2,449	52,281	47811.5
	Exvessel Revenues (1999 $)																			
Sardine	$13		$2			$4,288	$15,234	$3,951	$15,729	$26,234	$25,295	$79,936	$58,523	$25,227	$51,637	$88,740	$314,756	$99,016	$243,304	$285,558
P. Mack	$1,750,028	$1,431,263	$1,179,709	$362,814	$698,525	$1,144,861	$1,143,242	$956,486	$917,022	$62,977	$18,234	$10,075	$5,460	$18,330	$37,665	$35,444	$109,163	$67,759	$36,010	$21,063
J. Mack	$1,017,843	$383,011	$160,614	$27,478	$206,591	$74,548	$2,275	$1,497	$29	$8,473	$1,125	$94	$10	$3,523	$3,657	$8,445	$506		$8	$823
Anchovy	$993,085	$578,010	$255,468	$88,448	$46,176	$60,893	$62,981	$74,780	$57,864	$56,267	$70,993	$34,496	$96,548	$155,220	$156,435	$157,134	$94,130	$79,907	$322,792	$374,299
Squid	$375,132	$244,282	$6,370	$15,034	$1,285,591	$1,616,326	$2,147,172	$4,717,768	$3,456,239	$2,375,883	$2,960,504	$527,339	$4,895,838	$10,296,107	$17,461,622	$27,383,753	$13,435,291	$1,392,077	$20,005,516	$9,638,200
	San Luis Obispo																			
	Landings (mt)																			
Sardine					<.5					121				<.5						
P. Mack	1	3	1	5	20	1	1	<.5	1	2	1	<.5	<.5	<.5				<.5		
J. Mack					<.5					17										
Anchovy	17				48	11	2		<.5				1	1			23		2	
Squid	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5	19	<.5		<.5	2,036	1,344	183	217		4	17	
	Exvessel Revenues (1999 $)																			
Sardine					$92			$1		$13,384				$29			$20	$33		
P. Mack	$862	$1,948	$504	$2,890	$4,301	$301	$635	$278	$760	$1,053	$556	$278	$49	$103	$17	$5	$2	$150	$28	$2
J. Mack	$15	$9			$52	$16			$2	$1,812	$10	$62	$14	$4	$3			$41		
Anchovy	$11,194				$22,854	$4,431	$868		$1,141				$560	$394			$9,642		$892	
Squid	$132	$393	$204	$117	$392	$120	$359	$79	$5,477	$68	$20	$115	$905,317	$638,186	$42,780	$64,814	$16	$2,204	$4,645	$7

Table 1. Pacific coast landings (mt) and real1 exvessel revenues ($ 1999) for Pacific sardine, Pacific mackerel2, jack mackerel, anchovy and market squid by landing area, 1981-2000.

Species	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	Monterey/Santa Cruz																			
	Landings (mt)																			
Sardine				<.5	2	85	48	3	238	127	986	3,093	676	2,289	5,678	7,988	13,357	9,945	16,180	11383.1
P. Mack	1,359	2,053	3,449	7,149	2,704	1,988	957	59	60	2,496	298	375	38	38	461	703	3,208	1,457	3	39.4
J. Mack	212	280	2,457	5,481	228	191	210	122	37	192	44	110	345	191	109	91	327	33	24	49.9
Anchovy	4,617	2,609	321	1,895	1,138	808	676	696	929	2,132	2,527	608	1,285	986	1,111	3,554	3,895	901	1,511	6574.8
Squid	12,823	10,607	500	391	3,813	5,488	5,611	4,897	7,140	7,918	6,700	6,111	6,040	13,648	2,449	4,672	8,283		267	6978.5
	Exvessel Revenues (1999 $)																			
Sardine		$70	$20	$404	$786	$26,147	$7,292	$1,022	$144,255	$25,285	$130,822	$434,037	$88,679	$874,087	$677,982	$841,020	$1,305,369	$701,289	$1,175,292	$1,001,568
P. Mack	$389,265	$617,297	$806,075	$1,247,224	$565,186	$340,592	$163,087	$24,176	$16,710	$385,212	$69,247	$87,436	$14,564	$19,341	$51,211	$104,461	$446,128	$283,948	$9,998	$6,238
J. Mack	$78,838	$91,593	$489,293	$978,283	$80,150	$82,605	$45,493	$39,522	$8,789	$45,972	$19,278	$20,533	$100,240	$91,993	$78,708	$13,838	$102,319	$11,260	$1,747	$26,348
Anchovy	$471,494	$244,086	$71,101	$176,099	$129,306	$208,599	$107,913	$225,213	$648,324	$393,217	$361,995	$116,042	$282,175	$274,025	$145,234	$664,756	$591,051	$59,497	$336,002	$523,943
Squid	$6,793,565	$4,662,070	$348,099	$300,627	$2,652,220	$1,900,083	$1,682,909	$1,538,490	$2,017,900	$1,723,496	$1,908,793	$1,495,363	$2,155,066	$5,000,126	$886,570	$1,438,883	$3,029,076		$78,698	$1,893,454
	San Francisco																			
	Landings (mt)																			
Sardine							<.5					35		1	2		3	464	949	<.5
P. Mack		4	13	16	15	12	6	6	9	14	3	12	1	2	1	5	4	4	1	
J. Mack	2	<.5	1	<.5			<.5	<.5	4	2	<.5	1	<.5	<.5	<.5	1	<.5	1		<.5
Anchovy	211	395	332	538	259	393	424	492	755	714	459	164	244	280	93	105	156	<.5	47	116.5
Squid		2	462	97	77	832	343	299	9	129	1,475	2,448	1,018	2,236	747	333	205	16	5	
	Exvessel Revenues (1999 $)																			
Sardine	$1						$90	$5	$15	$35		$6,993		$628	$516		$1,333	$31,847	$81,374	$205
P. Mack	$39	$2,639	$4,700	$8,650	$8,341	$7,841	$4,879	$4,916	$6,815	$8,713	$1,774	$11,117	$1,298	$1,685	$558	$2,560	$2,506	$3,626	$575	$20
J. Mack	$1,484	$262	$328	$142	$37		$577	$425	$3,887	$902	$82	$397	$236	$307	$333	$595	$368	$821	$29	$665
Anchovy	$91,494	$174,209	$118,558	$208,199	$95,757	$131,121	$145,990	$163,630	$208,335	$188,260	$127,730	$39,568	$122,088	$90,938	$9,361	$26,086	$10,968	$20	$14,656	$62,131
Squid	$13	$853	$323,413	$81,775	$49,758	$311,100	$110,184	$90,824	$3,345	$37,833	$410,732	$541,706	$406,336	$700,640	$232,428	$114,805	$73,133	$15,933	$1,770	$3
	Northern CA																			
	Landings (mt)																			
Sardine														5	2	<.5		21		
P. Mack	2	4	3	<.5					<.5	2	<.5	<.5	<.5	<.5	<.5	5	6	9	3	1.7
J. Mack		1	<.5									1	55	<.5	<.5		2	6		<.5
Anchovy				<.5								1	<.5	8						
Squid	2	2		<.5		<.5	<.5	30	1	1	2	<.5		38	2		4			<.5
	Exvessel Revenues (1999 $)																			
Sardine														$1,640	$909	$122		$2,959		
P. Mack	$877	$1,389	$1,250	$66		$29	$14		$73	$1,100	$53	$387	$126	$178	$35	$2,572	$3,239	$3,003	$772	$329
J. Mack	$15	$474	$26	$2			$3	$3				$521	$8,649	$73	$34		$655	$4,639	$14	$88
Anchovy				$909								$109	$101	$3,058						
Squid	$1,806	$1,612	$51	$127	$18	$302	$55	$10,023	$469	$177	$1,149	$1,273	$6	$11,483	$496		$2,272	$42	$6	$569
	Other CA																			
	Landings (mt)																			
Sardine																				
P. Mack				<.5		<.5								4						
J. Mack																				
Anchovy														4						
Squid														33						
	Exvessel Revenues (1999 $)																			
Sardine																				
P. Mack	$13			$26		$92			$8					$9,945						
J. Mack																				
Anchovy														$267						
Squid														$7,879						

Table 1. Pacific coast landings (mt) and real1 exvessel revenues ($ 1999) for Pacific sardine, Pacific mackerel2, jack mackerel, anchovy and market squid by landing area, 1981-2000.

Species	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	Oregon																			
	Landings (mt)																			
Sardine												4	<.5					1	776	9525.6
P. Mack			8	3			2	1	5	10	<.5	462	280	252	189	61	1,611	536	259	119
J. Mack											19	317	277	202	149	259	373	686	518	160.9
Anchovy		<.5												1	<.5					<.5
Squid																				
	Exvessel Revenues (1999 $)																			
Sardine																		$790	$85,889	$1,125,386
P. Mack	$2	$68	$12,269	$1,224	$3	$1	$720	$459	$1,437	$4,424	$183	$178	$961	$10,515	$3,811	$4,015	$2,358	$8,805	$1,008	$6,158
J. Mack					$1						$2,866	$917	$2,980	$8,474	$7,691	$8,050	$774	$44,606	$5,956	$16,889
Anchovy		$164			$57			$17	$19					$219	$519					$294
Squid																				
	Washington																			
	Landings (mt)																			
Sardine																			1	4841.9
P. Mack				<.5					<.5	<.5	<.5	6	30	33	8	65	153	46	47	19.1
J. Mack																3	1	39	108	20.3
Anchovy	1	5	3	10	12	22	78	40	62	50	55	42	20	39	118	86	59	103	98	78.7
Squid																				
	Exvessel Revenues (1999 $)																			
Sardine																			$1,650	$649,867
P. Mack				$130					$64	$191	$47	$3,185	$4,661	$3,217	$874	$20,889	$17,331	$4,189	$3,663	$1,912
J. Mack																$719	$82	$3,580	$7,599	$2,180
Anchovy	$515	$15,537	$8,449	$15,159	$17,326	$28,291	$81,327	$43,571	$69,342	$51,354	$44,058	$37,916	$12,164	$29,748	$69,938	$66,559	$42,897	$61,701	$66,298	$46,766
Squid																				
	Other																			
	Landings (mt)																			
Sardine																			3	49
P. Mack																	3	<.5	<.5	0.6
J. Mack																			1	
Anchovy													24	31	11				<.5	
Squid																			11,371	18105.7
	Exvessel Revenues (1999 $)																			
Sardine																			$290	$7,116
P. Mack										$12							$546	$6	$21	$195
J. Mack												$1							$467	$1
Anchovy													$18,168	$22,910	$12,003				$6	$71
Squid																			$4,064,539	$3,867,117

Source: PacFIN data extracted May, 2001.

[1]Real values are current values adjusted to eliminate the effects of inflation. This adjustment has been made by dividing current values by the current year GDP implicit price deflator, with a base year of 1999.

[2]Pacific mackerel landings and revenues also include landings and revenues of unspecified mackerel.

Table 2. Average annual real[1] exvessel prices ($ 1999) for Pacific sardine, Pacific mackerel[2], jack mackerel, anchovy and market squid, 1981-2000.

Year	Pacific Sardine $/lb	Pacific Mackerel $/lb	Jack Mackerel $/lb	Anchovy $/lb	Squid $/lb
1981	$0.16	$0.16	$0.16	$0.05	$0.17
1982	$0.20	$0.15	$0.15	$0.04	$0.16
1983	$0.12	$0.14	$0.13	$0.07	$0.30
1984	$0.60	$0.13	$0.10	$0.10	$0.36
1985	$0.16	$0.12	$0.12	$0.09	$0.24
1986	$0.14	$0.11	$0.11	$0.14	$0.14
1987	$0.09	$0.09	$0.09	$0.13	$0.12
1988	$0.08	$0.10	$0.10	$0.16	$0.13
1989	$0.13	$0.09	$0.08	$0.23	$0.10
1990	$0.07	$0.07	$0.08	$0.11	$0.09
1991	$0.06	$0.09	$0.08	$0.09	$0.09
1992	$0.05	$0.11	$0.08	$0.11	$0.10
1993	$0.05	$0.06	$0.07	$0.12	$0.12
1994	$0.08	$0.07	$0.07	$0.15	$0.16
1995	$0.04	$0.06	$0.07	$0.10	$0.16
1996	$0.04	$0.06	$0.06	$0.10	$0.19
1997	$0.04	$0.06	$0.09	$0.07	$0.15
1998	$0.04	$0.06	$0.09	$0.07	$0.26
1999	$0.04	$0.05	$0.06	$0.08	$0.16
2000	$0.05	$0.06	$0.08	$0.05	$0.10

Source: PacFIN data extracted May, 2001.

[1]Real values are current values adjusted to eliminate the effects of inflation. This adjustment has been made by dividing current values by the current year GDP implicit price deflator, with a base year of 1999.

[2]Pacific mackerel landings and revenues also include landings and revenues of unspecified mackerel.

Table 3. West coast landings (mt) and real[1] exvessel revenues ($ 1999) for Pacific sardine, Pacific mackerel[2], jack mackerel, anchovy and market squid, 1981-2000.

Year	Pacific Sardine mt	Pacific Sardine Rev	Pacific Mackerel mt	Pacific Mackerel Rev	Jack Mackerel mt	Jack Mackerel Rev	Anchovy mt	Anchovy Rev	Squid mt	Squid Rev
	California									
1981	15	$5,258	35,388	$12,686,568	17,778	$6,364,916	52,308	$5,702,320	23,510	$8,849,596
1982	2	$882	36,065	$11,915,235	19,617	$6,530,938	42,150	$3,546,311	16,308	$5,855,359
1983	1	$275	41,471	$12,650,200	9,829	$2,821,898	4,427	$651,308	1,824	$1,191,684
1984	1	$1,316	44,081	$12,600,751	9,149	$2,069,051	2,889	$614,449	564	$453,412
1985	6	$2,071	37,772	$9,711,892	6,876	$1,889,451	1,626	$321,590	10,276	$5,486,227
1986	388	$116,694	48,089	$11,370,458	4,777	$1,207,202	1,535	$442,263	21,278	$6,456,819
1987	439	$86,578	46,724	$9,265,524	8,020	$1,639,358	1,390	$347,762	19,984	$5,482,449
1988	1,188	$212,742	50,863	$11,318,241	5,068	$1,062,922	1,478	$491,733	37,232	$10,509,715
1989	837	$235,171	47,708	$9,170,319	10,745	$2,008,836	2,449	$1,205,092	40,893	$8,914,853
1990	1,664	$244,181	40,081	$6,567,935	3,223	$534,680	3,208	$729,043	28,447	$5,833,866
1991	7,587	$1,058,165	32,018	$6,313,362	1,693	$291,193	4,014	$740,805	37,389	$7,192,813
1992	17,950	$2,102,748	18,577	$4,561,102	1,209	$273,231	1,124	$237,473	13,110	$2,869,115
1993	15,346	$1,725,203	11,819	$1,687,129	1,673	$317,847	1,959	$520,037	42,830	$11,386,197
1994	11,644	$1,982,103	10,008	$1,559,773	2,704	$417,496	1,789	$552,542	55,892	$19,268,399
1995	40,256	$3,942,920	8,626	$1,209,339	1,728	$290,799	1,886	$381,995	70,252	$24,145,236
1996	32,553	$3,218,376	9,599	$1,353,053	2,176	$309,760	4,419	$945,135	80,320	$33,553,517
1997	42,839	$4,198,370	18,395	$2,847,079	1,160	$289,685	5,719	$809,790	70,247	$22,528,532
1998	42,580	$3,682,723	19,823	$2,576,304	838	$266,164	1,450	$182,326	2,709	$1,550,042
1999	59,353	$5,070,794	8,788	$1,088,705	952	$187,629	5,214	$893,099	91,519	$33,276,811
2000	53,520	$5,393,466	21,222	$2,756,254	1,135	$223,134	11,487	$1,105,448	117,711	$26,519,569
	Oregon									
1981			<1	$2						
1982			<1	$68			<1	$164		
1983			8	$12,269						
1984			3	$1,224						
1985			<1	$3	<1	$1	<1	$57		
1986			<1	$1						
1987			1	$720						
1988			1	$459			<1	$17		
1989			5	$1,437			<1	$19		
1990			10	$4,436						
1991			<1	$183	19	$2,866				
1992	4	NA	462	$178	317	$918				
1993	<1	NA	280	$961	277	$2,980	<1	NA		
1994	<1	NA	252	$10,515	202	$8,474	1	$219		

Table 3. West coast landings (mt) and real [1] exvessel revenues ($ 1999) for Pacific sardine, Pacific mackerel [2], jack mackerel, anchovy and market squid, 1981-2000.

	Pacific	Pacific	Pacific	Pacific	Jack	Jack				
Year	Sardine mt	Sardine Rev	Mackerel mt	Mackerel Rev	Mackerel mt	Mackerel Rev	Anchovy mt	Anchovy Rev	Squid mt	Squid Rev
1995			189	$3,811	149	$7,691	<1	$519		
1996	<1	NA	61	$4,015	259	$8,050				
1997	<1	NA	1,611	$2,358	373	$774				
1998	1	$790	536	$8,805	686	$44,606	<1	NA		
1999	776	$85,889	259	$1,008	518	$5,956				
2000	9,526	$1,125,386	119	$6,158	161	$16,889		$294		
	Washington									
1981							1	$515		
1982							5	$15,537		
1983							3	$8,449		
1984			<1	$130			10	$15,159		
1985							12	$17,326		
1986							22	$28,291		
1987							78	$81,327		
1988							40	$43,571		
1989			<1	$64			62	$69,342		
1990			<1	$191			50	$51,354		
1991			<1	$47			54	$44,058		
1992			6	$3,185			42	$37,916		
1993			30	$4,661			44	$30,332		
1994			33	$3,217			70	$52,658		
1995			7	$874			130	$81,941		
1996			65	$20,889	3	$719	86	$66,559		
1997			156	$17,876	1	$82	59	$42,897		
1998			46	$4,195	39	$3,580	103	$61,701		
1999	1	$1,650	47	$3,663	108	$7,599	98	$66,298		
2000	4,842	$649,867	19	$1,912	20	$2,180	79	$46,766		

Source: PacFIN data extracted May, 2001.

[1]Real values are current values adjusted to eliminate the effects of inflation. This adjustment has been made by dividing current values by the current year GDP implicit price deflator, with a base year of 1999.

[2]Pacific mackerel landings and revenues also include landings and revenues of unspecified mackerel.

Table 4. Pacific coast CPS landings (mt) and real[1] exvessel revenues by gear group, 1981-2000.

Year	Roundhaul or Lampara	Dip Net	Pot or Trap	Trawl	Hook and Line	Gillnet	Other or Unknown
	Landings (metric tons)						
1981	120,510	8,231	0	11	92	75	81
1982	108,952	3,668	1	13	102	71	1,341
1983	41,397	490	0	8	29	27	15,611
1984	48,057	64	0	3	147	144	8,281
1985	50,312	494	0	20	120	374	5,247
1986	65,595	88	4	2	71	107	10,224
1987	64,607	213	1	6	41	1,296	10,471
1988	86,612	138	1	39	153	1,377	7,550
1989	94,757	248	0	132	272	96	7,194
1990	70,263	489	2	15	127	64	5,725
1991	58,327	724	37	127	53	56	23,452
1992	45,788	4,322	3	802	77	28	1,780
1993	68,233	5,171	2	592	102	43	114
1994	77,694	2,988	59	510	128	9	1,084
1995	119,406	1,341	4	386	400	8	1,600
1996	128,160	808	1	401	124	22	0
1997	138,070	165	0	2,157	127	12	10
1998	67,338	36	2	1,334	76	5	5
1999	165,912	528	72	983	12	10	93
2000	217,277	1,552	45	273	420	4	195
	Revenues (1999 $)						
1981	$32,011,816	$1,459,255	$335	$6,735	$54,740	$47,653	$28,641
1982	$26,710,680	$737,566	$3,183	$6,812	$50,445	$35,534	$320,273
1983	$12,837,729	$301,747	$1,427	$4,293	$22,032	$13,565	$4,155,289
1984	$13,501,912	$52,597	$2,504	$2,807	$60,197	$48,546	$2,086,928
1985	$14,211,056	$454,782	$390	$13,363	$48,519	$170,948	$2,529,558
1986	$16,481,773	$37,785	$1,486	$1,853	$47,003	$46,943	$3,004,884
1987	$14,034,048	$56,244	$1,828	$3,259	$43,917	$331,572	$2,432,850
1988	$21,043,460	$42,958	$1,176	$38,836	$55,384	$330,319	$2,127,268
1989	$19,828,320	$54,936	$212	$38,396	$64,704	$29,879	$1,588,685
1990	$12,720,808	$56,179	$1,071	$8,064	$83,005	$32,642	$1,063,917
1991	$11,682,097	$63,538	$8,133	$27,211	$50,619	$18,331	$3,793,562
1992	$9,045,539	$601,092	$2,265	$8,149	$62,339	$11,631	$354,851
1993	$14,651,250	$878,954	$1,990	$10,226	$85,047	$21,054	$26,827
1994	$22,885,653	$571,977	$15,474	$30,553	$90,770	$5,042	$227,456
1995	$29,191,611	$370,306	$2,125	$18,695	$128,494	$4,546	$327,516
1996	$39,122,598	$189,305	$519	$42,337	$95,123	$10,787	$9
1997	$30,507,882	$60,252	$66	$30,773	$121,005	$5,905	$3,525
1998	$8,198,290	$24,761	$646	$78,955	$71,078	$3,001	$2,873
1999	$40,403,058	$188,065	$15,942	$34,977	$25,416	$5,924	$6,975
2000	$37,283,664	$379,687	$9,881	$25,766	$86,597	$1,951	$28,421

Source: PacFIN data extracted May, 2001.

[1]Real values are current values adjusted to eliminate the effects of inflation. This adjustment has been made by dividing current values by the current year GDP implicit price deflator, with a base year of 1999.

Table 5. Number of vessels with Pacific coast landings of CPS finfish or market squid by landing area, 1981-2000.

	Year																			
Landing Area	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
	CPS Finfish																			
San Diego	52	28	29	14	13	15	30	35	44	41	52	53	46	49	40	35	26	20	18	16
Orange/LA	131	99	75	72	69	79	107	99	96	87	94	93	105	95	96	101	98	80	80	84
Ventura/Santa Barbara	71	20	18	12	18	19	43	42	27	36	33	17	21	21	44	50	30	19	17	18
San Luis Obispo	29	5			7	5	1	3	8	15	11	27	16	7	3	1	2	8	2	2
Monterey/Santa Cruz	60	57	48	71	77	52	43	44	24	81	30	150	73	52	35	41	49	37	23	39
San Francisco	7	7	10	11	26	15	18	25	13	25	6	143	43	53	39	38	36	57	18	37
Northern CA	5	4	3	2			1	2	1			6	6	8	3	4	2	12	4	7
Other CA	1													4						
Oregon		1			3			1	1		2	20	14	38	43	41	50	46	44	43
Washington	4	1	1	1	2	2	2	3	2	2	2	3	3	2	1	9	9	8	10	18
Other												1	3	2	1				7	10
	Market Squid																			
San Diego	6	1	4	1	1	2	7	10	3	7		1	1	3	2	4	3	3	1	2
Orange/LA	61	51	44	9	45	43	41	51	48	43	37	18	43	42	59	63	54	21	76	86
Ventura/Santa Barbara	26	26	17	20	46	32	35	34	33	27	24	15	31	39	54	90	61	58	81	63
San Luis Obispo	9	7	4	6	5	7	3	4	7	3	2	4	13	11	8	8	3	2	3	1
Monterey/Santa Cruz	53	53	32	31	59	41	33	30	28	36	30	36	33	34	28	28	28		13	23
San Francisco	1	2	22	8	10	4	17	7	4	9	8	16	13	6	4	2	6	5	1	1
Northern CA	11	9	3	2	1	2	1	9	2	2	2	4	1	3	2		15	2	2	2
Other CA														1						
Oregon	1	7	14	13	16	6	2	1	3		1	17	21	29	23	24	56	49	21	29
Washington	13	9	29	23	4	10	12	8	5	2	1	2	2	8	11	7	5	5	5	2
Other	11	8	2	1	8	12	8	5	5	2	4	3		2					44	42

Source: PacFIN data extracted May, 2001.

Table 6. Number of vessels with CPS finfish or market squid as principle species[1] by principle landing area[2], 1981-2000.

	Year																			
Landing Area	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
	CPS Finfish																			
San Diego	3	2	4		1		1	2	6	4	6	5	2	2	2	2	1	3	1	0
Orange/LA	54	43	18	22	23	17	31	19	22	23	36	38	24	27	18	20	26	39	19	26
Ventura/Santa Barbara	7	5	4	7	4	3	4	3	2	3	4	4	4	6	5	7	3	4	2	3
San Luis Obispo	1	1			2	1			1				1	1			1			
Monterey/Santa Cruz	3	2	4	17	1	2	1	1	4	2	4	3	1	2	2	8	5	9	6	3
San Francisco	2	1		1	1	1	2	2	1			1	1						1	1
Northern CA												1						1		
Other CA														1						
Oregon								1							1				2	6
Washington	1	1	1	1	2	2	2	2	2	2	2	1							1	1
Other													1						0	0
	Market Squid																			
San Diego	2						3	4	2	1									0	1
Orange/LA	14	16	6		8	10	7	19	19	8	5		15	8	24	30	26	4	31	45
Ventura/Santa Barbara	3	2	1		8	5	8	19	12	13	15	4	15	24	37	58	42	26	48	30
San Luis Obispo													3							
Monterey/Santa Cruz	33	35	4	3	27	17	14	15	15	12	12	16	16	17	3	8	8		1	8
San Francisco			1			1					1	2		2	2				0	0
Northern CA																				
Other CA																			20	
Oregon				4	3														0	0
Washington	1	2	7	7											2	1			0	0
Other																				9

Source: PacFIN data extracted May, 2001.

[1]Principle species is the species that accounts for the greatest share of a vessel's total exvessel revenues across all species landed.

[2]Principle landing area is the area that accounts for the greatest share of a vessel's total exvessel revenues accros all areas in which it had landings.

Table 7. Number of processors and buyers, by landing area, whose annual purchases of CPS finfish or market squid represents the largest share of their total annual expenditures, 1981-2000.

	Year																			
Landing Area	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
	CPS Finfish																			
San Diego	1		1						3	5	2	1	2	3	3	3	2	2	2	0
Orange/LA	7	7	5	3	3	4	3	4	3	3	9	8	5	5	7	4	7	10	5	10
Ventura/Santa Barbara	4	5	2	4	1	1	2	3	1	2	2	4	1	2	3	5	2	6	3	4
San Luis Obispo	2	1	1		2						1		2	1			2	1	1	0
Monterey/Santa Cruz	1		1	2	1	1	1	1	1	1	2	1	2	2		1	2	3	2	3
San Francisco	1		1	2	1	1	2	1	1	2	1	1	1	1	1	1	1	1	2	
Northern CA														1				1	1	
Other CA														1				1		
Oregon															1					2
Washington		1	1	1	1	1	2	2	2	2	2	1	1	1		1	1	1	1	1
Other																			0	0
	Squid																			
San Diego													1					1	0	1
Orange/LA	1	1				1	1	2	2	2				1	1	4	6		5	9
Ventura/Santa Barbara					2	5	2	2	8	3	4	2	4	13	14	9	10	2	11	18
San Luis Obispo					1	1	1	2	2	1		2	5	4	3	4	3		6	4
Monterey/Santa Cruz	5	7		1	5	6	4	2	3	4			1	2		2	1		1	1
San Francisco	6	1	2			1	3	3	3	1	3	3	1	1		1			1	
Northern CA														1					0	
Other CA														1						
Oregon																				0
Washington		2	3	2												1			0	0
Other																			3	4

Source: PacFIN data extracted May, 2001.

Figure 1. Percentage contribution of Pacific coast CPS finfish and market squid landings to the total exvessel value of all Pacific coast landings, 1981-2000.

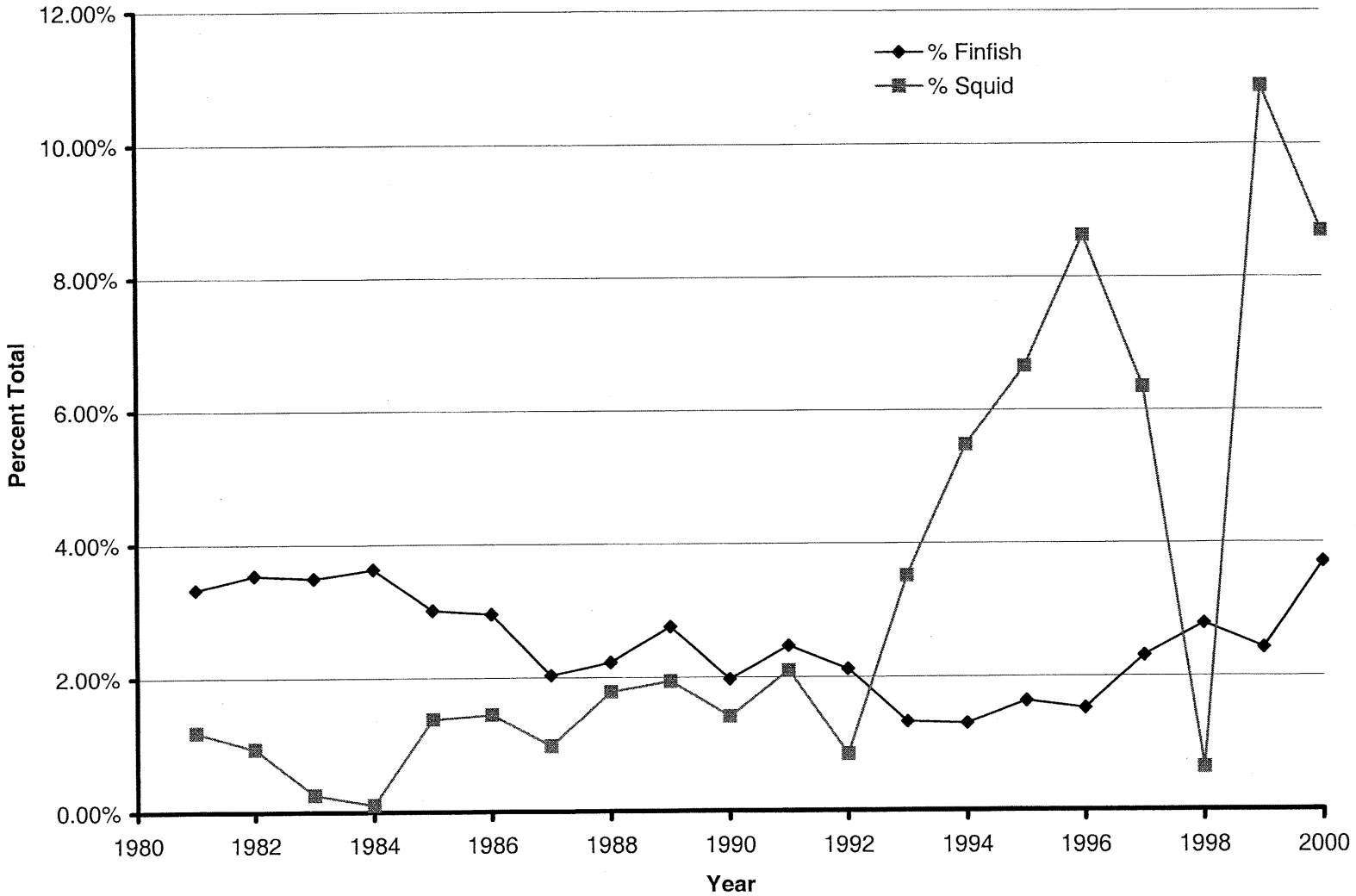


Figure 2. Pacific coast CPS finfish landings and real exvessel price $/lb (1999 $), 1981-2000.

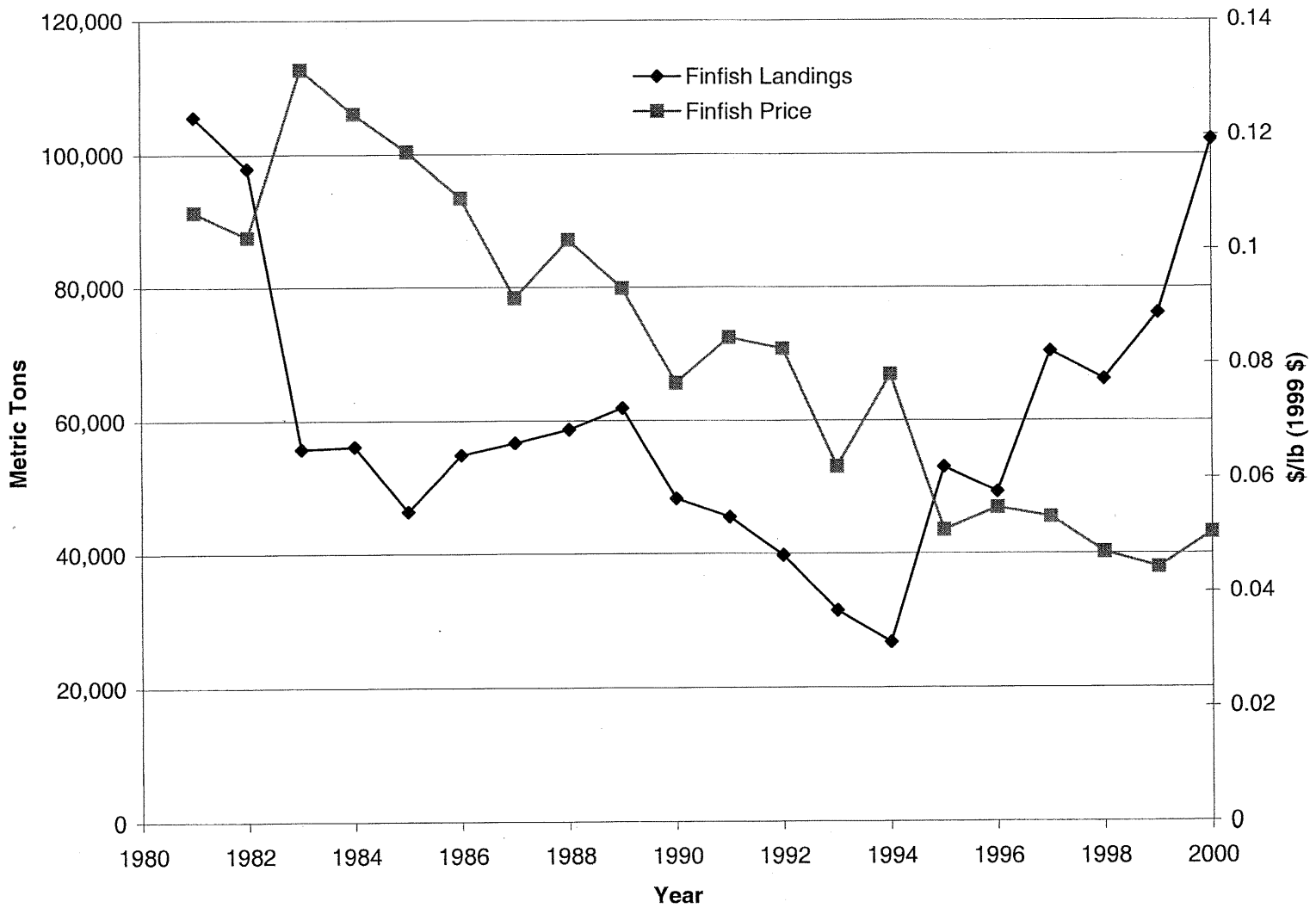


Figure 3. Pacific coast market squid landings and real exvessel price $/lb (1999 $), 1981-2000.

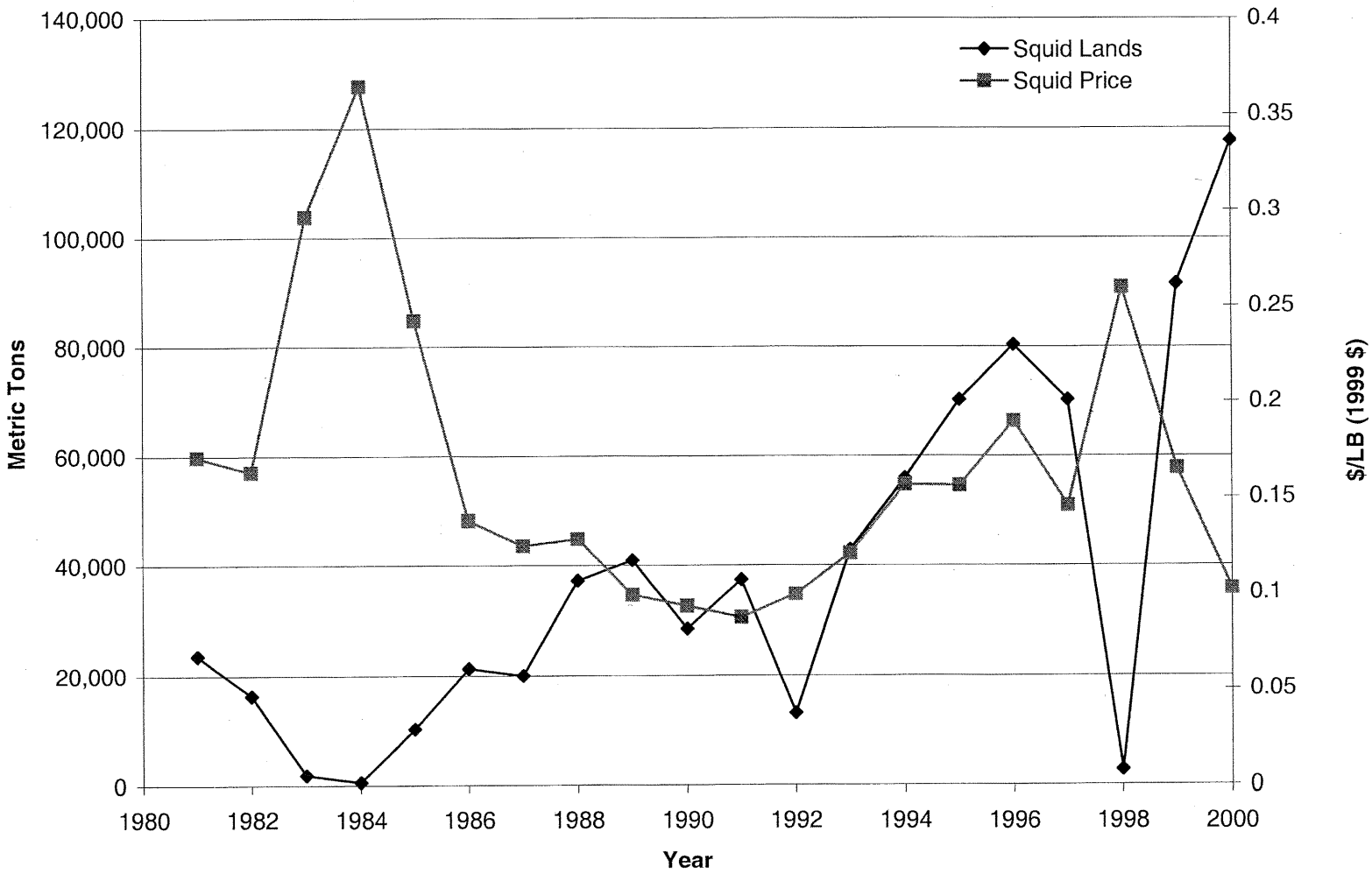


Figure 4. Number of vessels with Pacific coast landings of CPS finfish, and number for which CPS finfish was the principle species, 1981-2000.

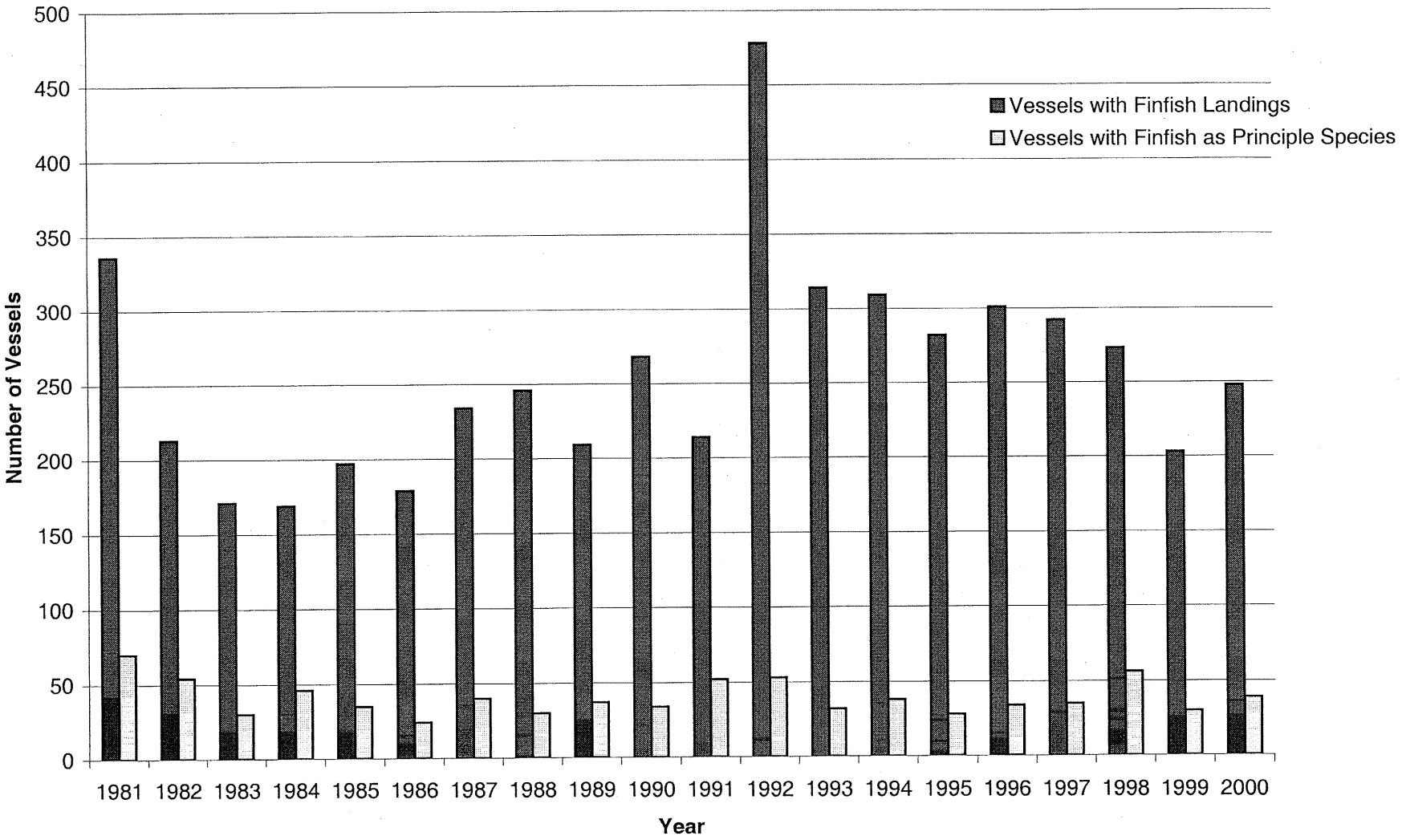


Figure 5. Number of vessels with Pacific coast landings of market squid, and number for which market squid was the principle species, 1981-2000.

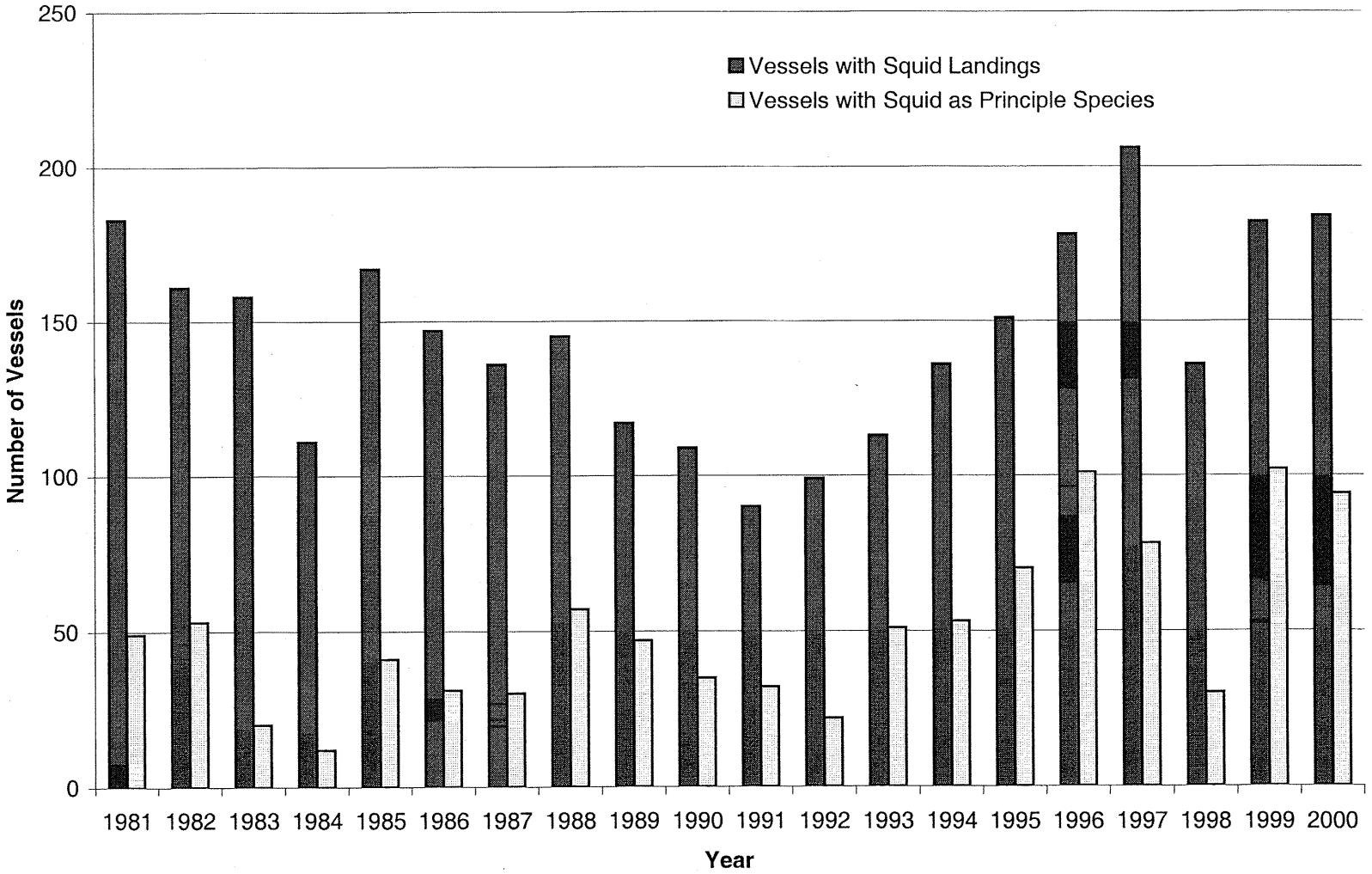
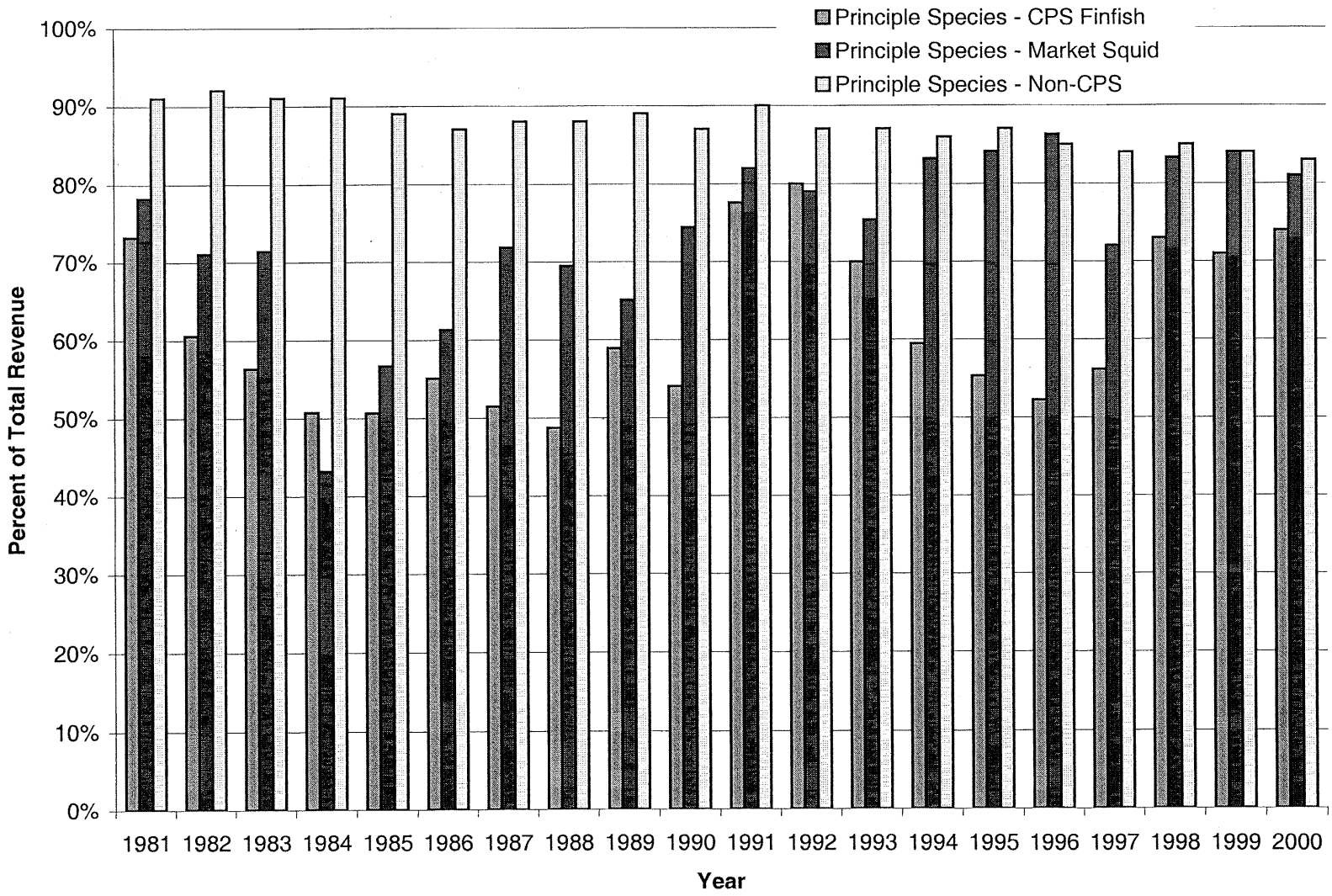


Figure 6. Average share principle species revenues of total revenues for vessels whose principle species was CPS finfish, market squid or non-CPS, 1981-2000.



APPENDIX 2

STOCK ASSESSMENTS FOR ACTIVELY MANAGED SPECIES

PACIFIC MACKEREL

AND

PACIFIC SARDINE

STOCK ASSESSMENT OF PACIFIC MACKEREL WITH RECOMMENDATIONS FOR THE 2001-2002 MANAGEMENT SEASON

EXECUTIVE SUMMARY

May 17, 2001

by

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Submitted to

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INTRODUCTION

The following summarizes stock assessment results and harvest guideline recommendations for Pacific mackerel (*Scomber japonicus*) developed for the Pacific Fishery Management Council's (PFMC) management season of July 1, 2001 to June 30, 2002. This Executive Summary will be included in the PFMC's Stock Assessment and Fishery Evaluation (SAFE) report for coastal pelagic species (CPS), which will be distributed prior to the June 2001 PFMC meeting. A full stock assessment report will not be developed until 2002 when the first formal stock assessment review (STAR) for this species will be conducted.

METHODS

We used a modified virtual population analysis (VPA) stock assessment model ('ADEPT', Jacobson 1993), based on Gavaris' (1988) procedure, to estimate biomass of Pacific mackerel that employs both fishery-dependent and fishery-independent data to estimate abundance. ADEPT adjusts or "tunes" biomass estimates using the fishery-independent indices of relative abundance. ADEPT has been used to assess Pacific mackerel for the past seven years. A conventional VPA back-calculates age-structured biomass estimates utilizing catch-at-age data, weight-at-age data, natural mortality estimates, and fishing mortality (F) estimates for the most recent year (referred to as 'terminal F'). ADEPT improves upon a conventional VPA by choosing terminal F and other parameters to obtain the best statistical fit (lowest log-scale sums of squares) between VPA output and survey indices of relative abundance, including spotter pilot sightings, CalCOFI larval data from southern California, recreational fishery catch-per-unit-effort, power plant impingement rates, and triennial trawl survey data. The crux of the estimate lies in the models' ability to estimate terminal F based upon the survey indices, essentially using them to adjust the conventional VPA output.

The assessment model is based on an annual time increment and now incorporates 72 years (1929 to 2000) of fishery data, including landings (Table 1, Figure 1), age composition (Figure 2), and mean weights-at-age (Figure 3). Abundance estimates are adjusted by the model to better match the fishery-independent (survey) indices of relative abundance, including aerial spotter sightings (Lo et al. 1992; Figure 4), CalCOFI larval data (Figure 5), recreational fishery catch-per-unit-effort (Figures 6 & 7), triennial shelf survey, and power plant impingement rates. As in past assessments, component likelihoods for most surveys were weighted equally to a value of 1.0. The power plant impingement index (age-0 Pacific mackerel caught in cooling water at San Onofre Nuclear Generating Station) represents a relatively small portion of the coastline and was therefore down-weighted to 0.1. ADEPT also has the ability to weight influence of annual survey observations using the coefficient of variation (CV; a measure of relative variation in any sample). As per Hill et al. (1999) and Hill (2000), we calculated CVs for each survey and re-scaled the CVs to the median value. Re-scaling CVs of each survey to a value of 1.0 had the effect of maintaining equal weighting among surveys while down-weighting annual observations within surveys for poorly-sampled or highly-variable years.

We used ADEPT to calculate biomass estimates through the end of 2000 (calendar year), and then projected an estimate of biomass for July 1, 2001, based upon: 1) the number of Pacific mackerel estimated to comprise each year class at the beginning of 2000; 2) the modeled estimates of fishing mortality during 2000; 3) the assumptions for natural mortality (M=0.5) and F through the first half of 2001; and 4) estimates of age-specific growth.

RESULTS

The coast-wide harvest of Pacific mackerel increased in calendar year 2000 from relatively low levels in 1999. The combined directed fisheries off California and Ensenada (northern Baja California, Mexico) yielded 30,387 mt, compared to 19,697 mt in 1999 (Table 1, Figure 1). California landings for the calendar year 2000 totaled 23,205 mt - over twice the 1999 yield. The Ensenada fishery experienced a 29% decrease in yield, from 10,168 mt in 1999 to 7,182 mt in 2000 (Table 1). The U.S. commercial fishery was allocated a 20,740 mt harvest guideline for the 2000-2001 (July-June) season based on a July 1, 2000 biomass estimate of 116,967 mt (Hill 2000). High local availability of young mackerel led to a dramatic increase in southern California

landings during the first several months of the 2000-2001 season. As of October 31, 2000, the U.S. fishery (based primarily in San Pedro, CA) had landed approximately 19,776 mt, or 95% of the harvest guideline, with less than 1,100 mt remaining. The National Marine Fisheries Service closed the directed fishery on October 27, 2000. An incidental allowance guideline was implemented, permitting up to 20% by weight Pacific mackerel in landings in other CPS fisheries. The incidental allowance was amended in February 2001 to include a trip limit of up to one metric ton of 'pure' Pacific mackerel to be landed by both limited entry and non-CPS fishermen. NMFS closed the Pacific mackerel season on March 27, 2001, eliminating the 20% incidental catch, however, the 1 mt allowance remains in effect.

ADEPT recalculates biomass for all years in the 72-year time series. Differences in biomass estimates between assessment years can be caused by interannual variation in landings, shifts in fishery age composition, and changes in relative abundance as measured by fishery-independent surveys. As is true for all age-structured population models, abundance-at-age estimates are the least certain for the most recent years when the youngest year classes have not yet become fully vulnerable to, or utilized by, the fishery. Compounding this uncertainty is the general lack of fishery or survey data for Pacific mackerel outside the Southern California Bight. Catch-at-age and weight-at-age data have not been made available from the Ensenada fishery, which is comparable in volume to the California fishery.

Biomass trends for the current assessment were similar to those estimated during the 2000 stock assessment (Hill 2000; Table 2, Figure 8). Biomasses for the current assessment were slightly higher over the most recent decade (average of 7% higher), however, the most recent two years (1999 & 2000) dropped below estimates from the 2000 assessment (Hill 2000). The current estimate of July 1, 1999 biomass is estimated to be 17.5% lower than last years' estimate, and the 2000 biomass is 24.9% lower than last year's projection. The more precipitous decline in biomass can be attributed in part to a weak 1998 year class combined with high fishing mortality during the 1998 fishery. The 1998 fishery was the second largest on record (71,355 mt), but 71% of these landings were made by the Ensenada fleet (Table 1).

The July 1, 2000 biomass projection was based on ADEPT results and certain assumptions about recruitment in January, 2000, and fishing mortality during the first half of 2001 (Table 3). ADEPT's estimates of recruitment are unreliable for the most recent year, so recruitment was forecast based on recent trends in reproductive success. Recruits per spawning biomass was high during the late 1970s and early 1980s, but has remained relatively low since 1982 (Figure 9). The relationship between spawning biomass in July and number of recruits (age-0) in the following January was regressed for the period 1982/83 to 1998/99 (Figure 10). Based on this regression, we estimated approximately 249 million age-zero fish in January 2000. Based on this recruitment value and an estimate of fishing mortality during the first half of 2001, we estimate the July 1, 2001, age 1+ biomass will be approximately 84,090 mt (Table 3).

HARVEST GUIDELINE FOR 2001-2002

In Amendment 8 (PFMC 1998), the recommended maximum sustainable yield control rule for Pacific mackerel was:

HARVEST = (BIOMASS-CUTOFF) x FRACTION x STOCK DISTRIBUTION

where HARVEST is the U.S. harvest guideline, CUTOFF (18,200 mt) is the lowest level of estimated biomass at which harvest is allowed, FRACTION (30%) is the fraction of biomass above CUTOFF that can be taken by fisheries, and STOCK DISTRIBUTION (70%) is the average fraction of total BIOMASS in U.S. waters. BIOMASS (84,090 mt) is the estimated biomass of fish age 1 and over for the whole stock as of July 1, 2001. **Based on this formula, the 2001-2002 season harvest guideline should be 13,837 mt** (Table 4, Figure 11). This harvest guideline is 33% lower than the 2000-2001 season, but similar to the average yield (14,053 mt) realized by the fishery since the 1992-1993 season (Table 4).

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Table 1. Commercial and recreational landings (metric tons) of Pacific mackerel in California and Ensenada (northern Baja California, Mexico), for calendar years 1929 to 2000.

Year	CA Com.	MX Com.	CA Rec.	Total	Year	CA Com.	MX Com.	CA Rec.	Total
1929	26,297	0	134	26,431	1965	3,198	7,615	365	11,177
1930	7,499	0	134	7,633	1966	2,100	5,290	493	7,883
1931	6,466	0	134	6,600	1967	530	949	260	1,739
1932	5,658	0	134	5,792	1968	1,422	107	190	1,718
1933	31,576	0	134	31,711	1969	1,070	201	288	1,559
1934	51,641	0	134	51,776	1970	282	0	311	593
1935	66,419	0	135	66,554	1971	71	0	538	609
1936	45,605	0	43	45,648	1972	49	0	590	639
1937	27,641	0	85	27,726	1973	25	0	478	503
1938	36,218	0	119	36,337	1974	61	0	246	307
1939	36,700	0	234	36,934	1975	131	0	312	443
1940	54,660	0	196	54,856	1976	298	0	123	421
1941	35,456	0	112	35,569	1977	9,220	0	1,163	10,383
1942	23,838	0	112	23,950	1978	21,520	0	2,256	23,776
1943	34,117	0	112	34,229	1979	35,823	0	3,053	38,876
1944	37,947	0	112	38,058	1980	38,188	0	2,612	40,800
1945	24,366	0	112	24,478	1981	42,450	0	1,368	43,818
1946	24,438	852	112	25,401	1982	35,019	0	1,559	36,578
1947	21,082	1,263	345	22,690	1983	35,454	135	1,541	37,130
1948	17,865	515	479	18,859	1984	45,572	128	1,609	47,309
1949	22,576	1,352	225	24,153	1985	40,514	2,581	1,113	44,208
1950	14,810	2,029	142	16,981	1986	46,557	4,882	880	52,318
1951	15,204	1,321	99	16,624	1987	41,212	2,081	1,433	44,727
1952	9,347	1,052	148	10,547	1988	43,991	4,882	797	49,670
1953	3,403	1,178	118	4,698	1989	38,637	13,383	691	52,711
1954	11,519	5,681	700	17,900	1990	39,850	35,757	1,126	76,732
1955	10,573	9,799	338	20,710	1991	32,162	17,445	1,190	50,798
1956	22,686	10,725	259	33,669	1992	19699	24,338	778	44,815
1957	28,143	2,035	365	30,542	1993	12,680	7,739	726	21,145
1958	12,541	449	327	13,317	1994	10,043	13,318	1,060	24,421
1959	17,056	495	213	17,764	1995	8,667	4,821	885	14,373
1960	16,697	2,982	191	19,869	1996	10,287	5,604	691	16,582
1961	20,008	5,965	274	26,247	1997	20,615	12,477	943	34,034
1962	22,036	3,231	280	25,547	1998	20,073	50,726	555	71,355
1963	18,254	7,966	352	26,572	1999	9,527	10,168	221	19,916
1964	12,169	8618	243	21030	2000	23206	7182	236	30624

Figure 1. Pacific mackerel landings, 1929 to 2000.

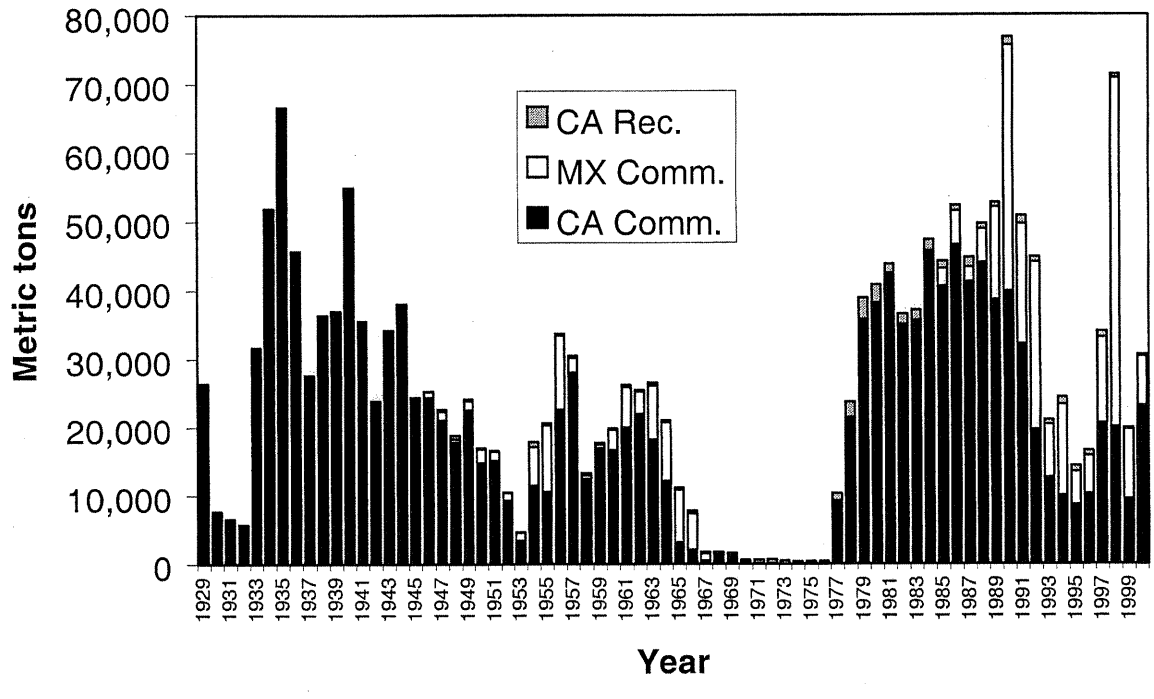


Figure 2. Proportional catch-at-age
California commercial fishery

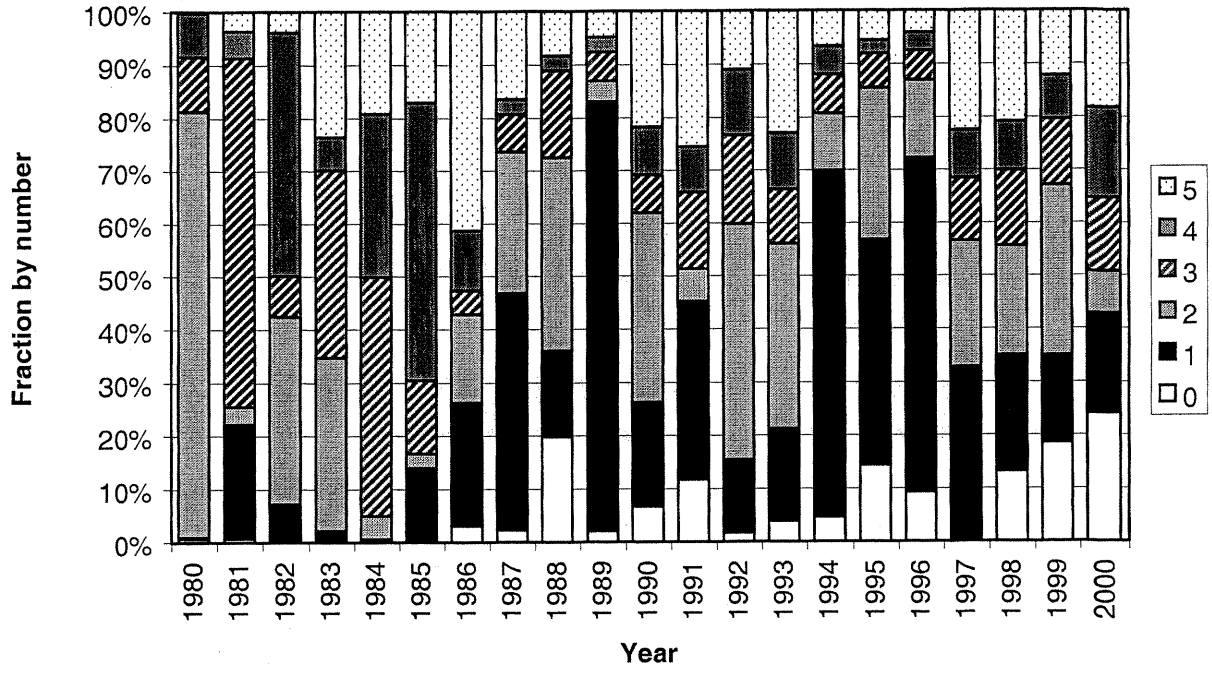


Figure 3. Mean weight-at-age
California Commercial Fishery

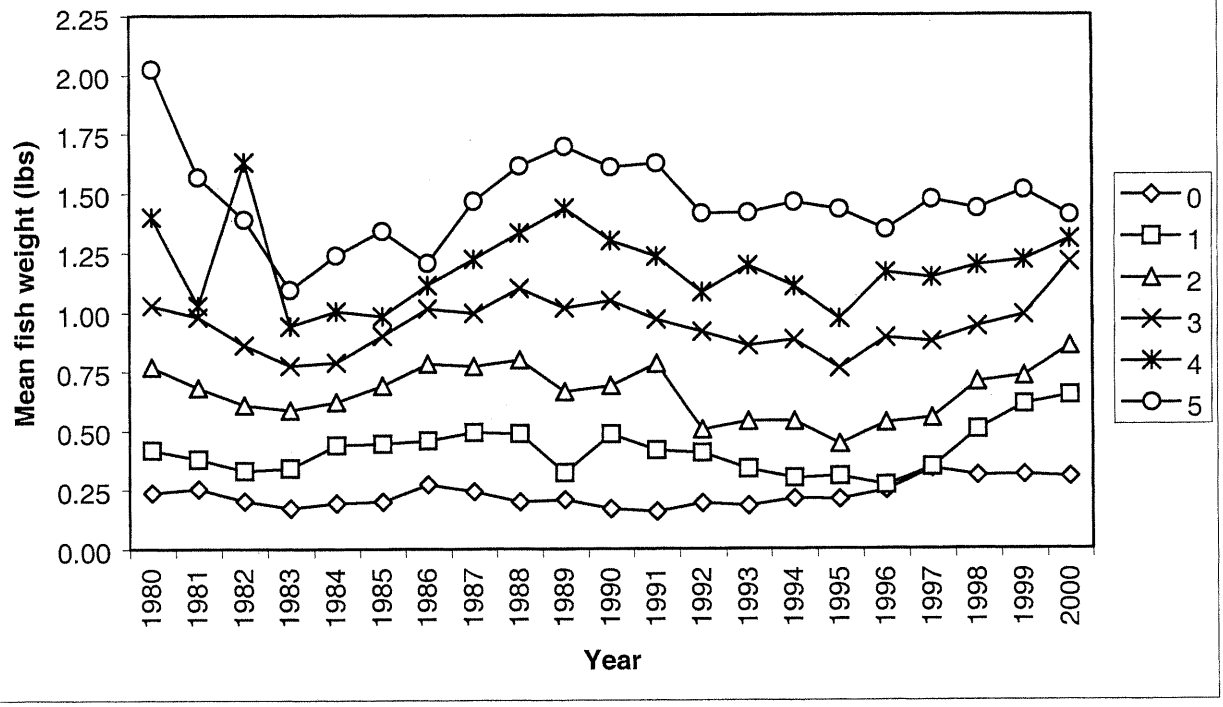


Figure 4. Aerial Spotter Index

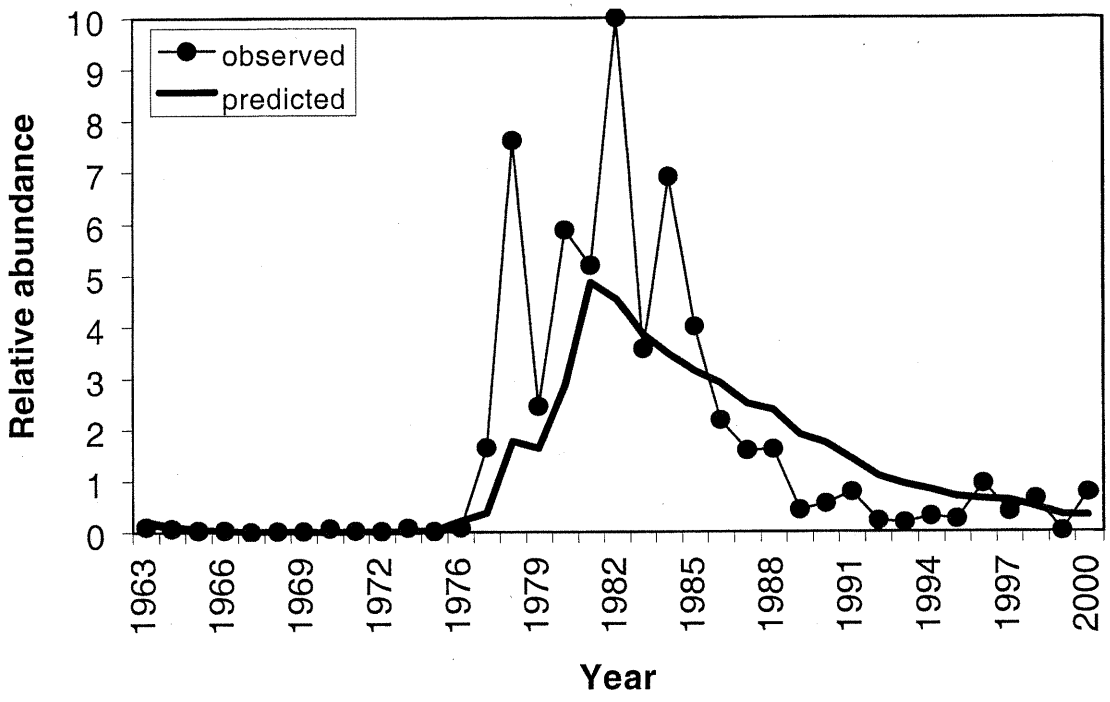


Figure 5. CalCOFI Larval Index

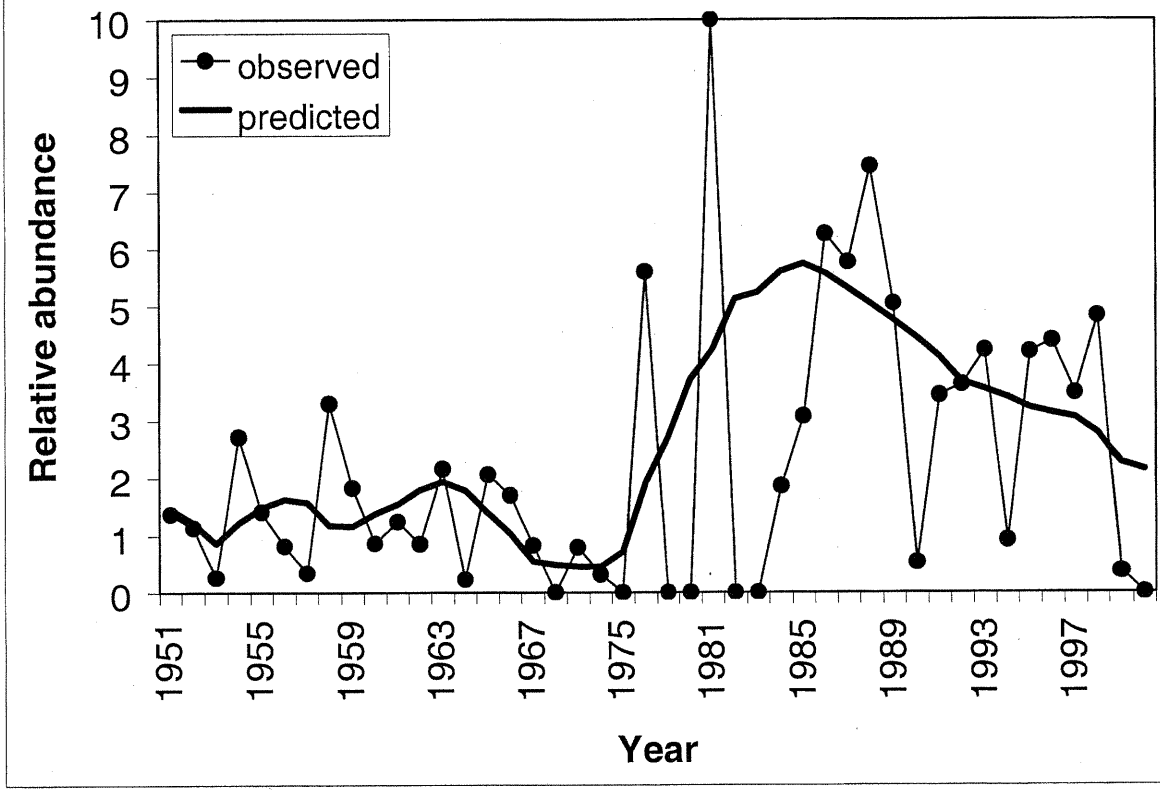


Figure 6. So. Calif. CPFV Index

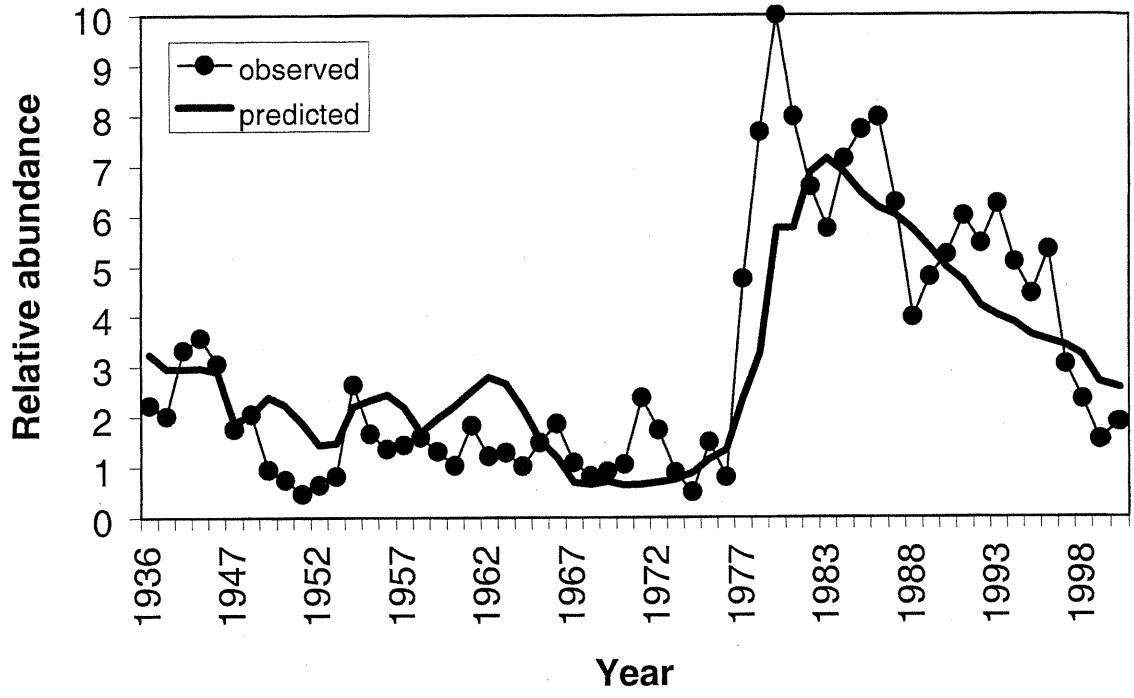


Figure 7. No. Calif. CPFV Index

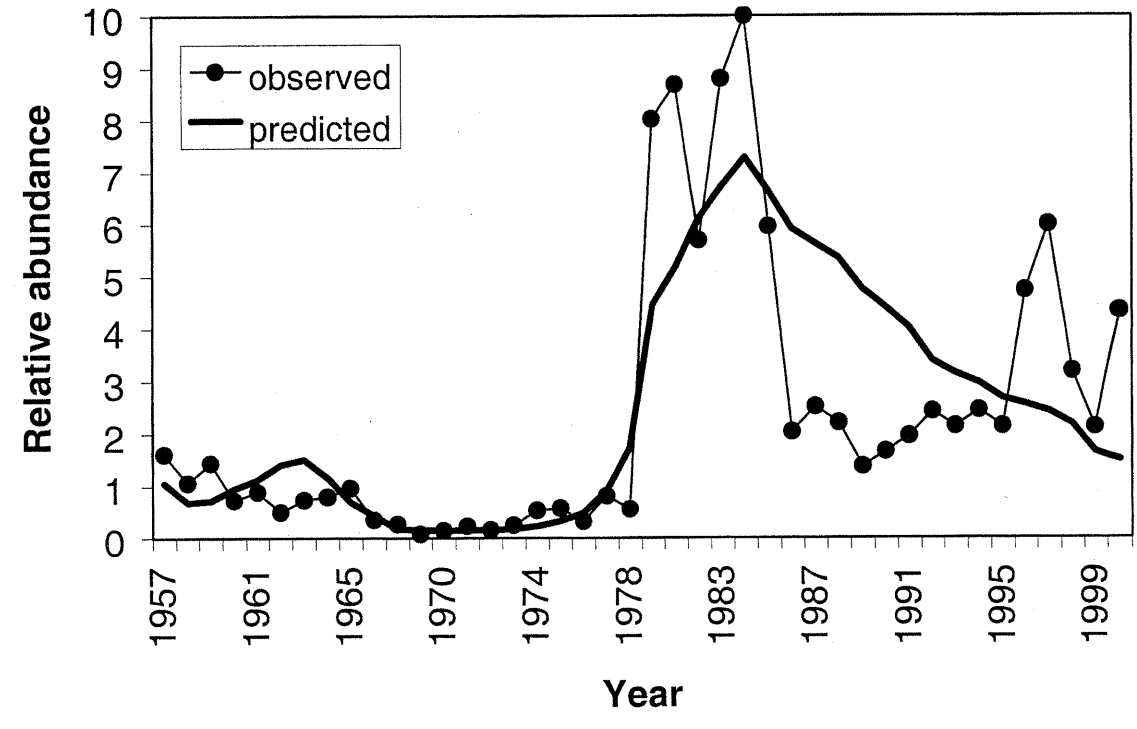


Table 2. Historical estimates of Pacific mackerel biomass (age 1+, metric tons) and recruitment (age 0, number $1x10^6$) estimated using the ADEPT model. The July 1, 2001 biomass was projected based on estimates in Table 3.

YEAR	Age 1+ Biomass (metric tons)	Recruits (millions)	YEAR	Age 1+ Biomass (metric tons)	Recruits (millions)
1929	155,896	1,020	1965	13,080	26
1930	223,033	1,392	1966	4,765	6
1931	296,408	1,552	1967	1,876	10
1932	365,252	1,106	1968	1,696	15
1933	350,660	373	1969	2,127	6
1934	289,642	167	1970	1,602	7
1935	192,454	187	1971	1,763	9
1936	127,778	399	1972	2,072	13
1937	114,806	319	1973	2,894	21
1938	105,650	549	1974	4,834	52
1939	116,944	363	1975	11,067	32
1940	91,214	312	1976	13,932	737
1941	86,466	635	1977	94,141	490
1942	114,291	233	1978	164,761	4,654
1943	105,889	210	1979	539,726	673
1944	84,429	217	1980	716,136	3,021
1945	65,560	68	1981	838,298	7,831
1946	41,260	57	1982	1,475,490	1,664
1947	20,911	582	1983	1,331,845	756
1948	57,101	311	1984	1,158,493	1,084
1949	60,937	35	1985	1,003,484	1,479
1950	42,660	15	1986	909,398	1,128
1951	22,102	10	1987	844,204	621
1952	8,371	199	1988	708,052	1,722
1953	26,419	497	1989	623,981	712
1954	61,973	193	1990	540,751	998
1955	55,240	328	1991	477,128	545
1956	62,799	66	1992	335,265	712
1957	33,036	98	1993	306,084	534
1958	21,457	332	1994	268,426	395
1959	44,194	282	1995	216,950	452
1960	51,912	473	1996	200,788	394
1961	81,419	266	1997	180,591	261
1962	97,143	41	1998	137,993	107
1963	70,707	25	1999	92,390	215
1964	36,733	10	2000	87,868	---
		FORECAST:	2001	***84,090***	

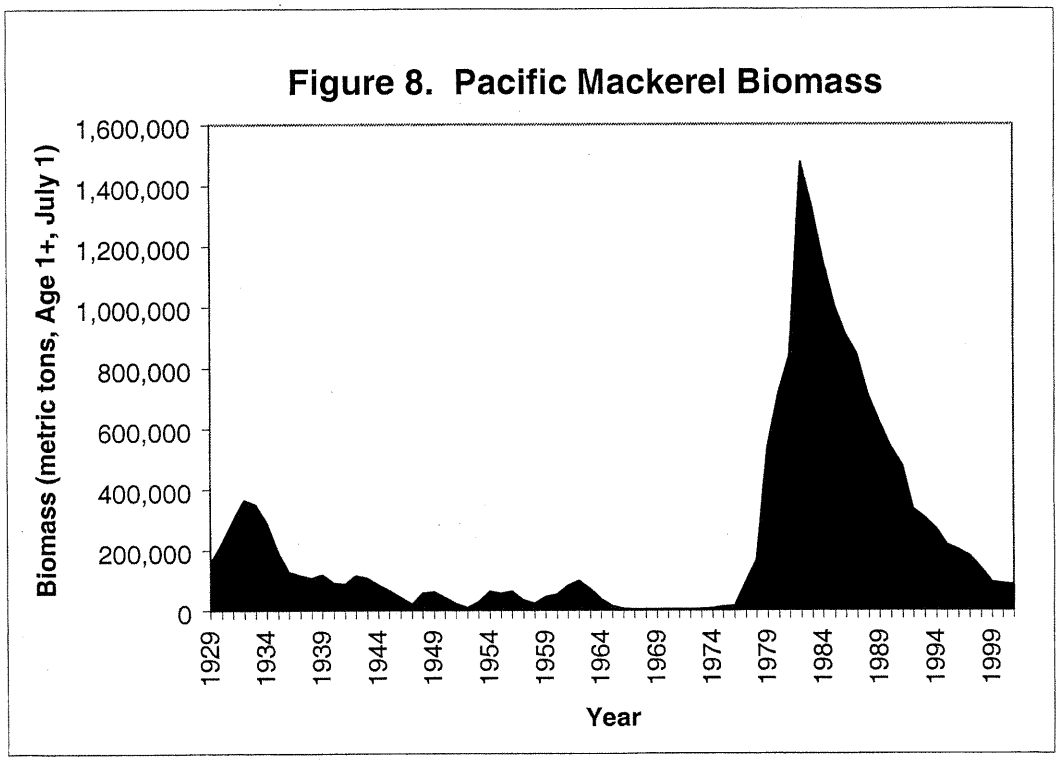


Figure 9. Recruits/Spawning Biomass

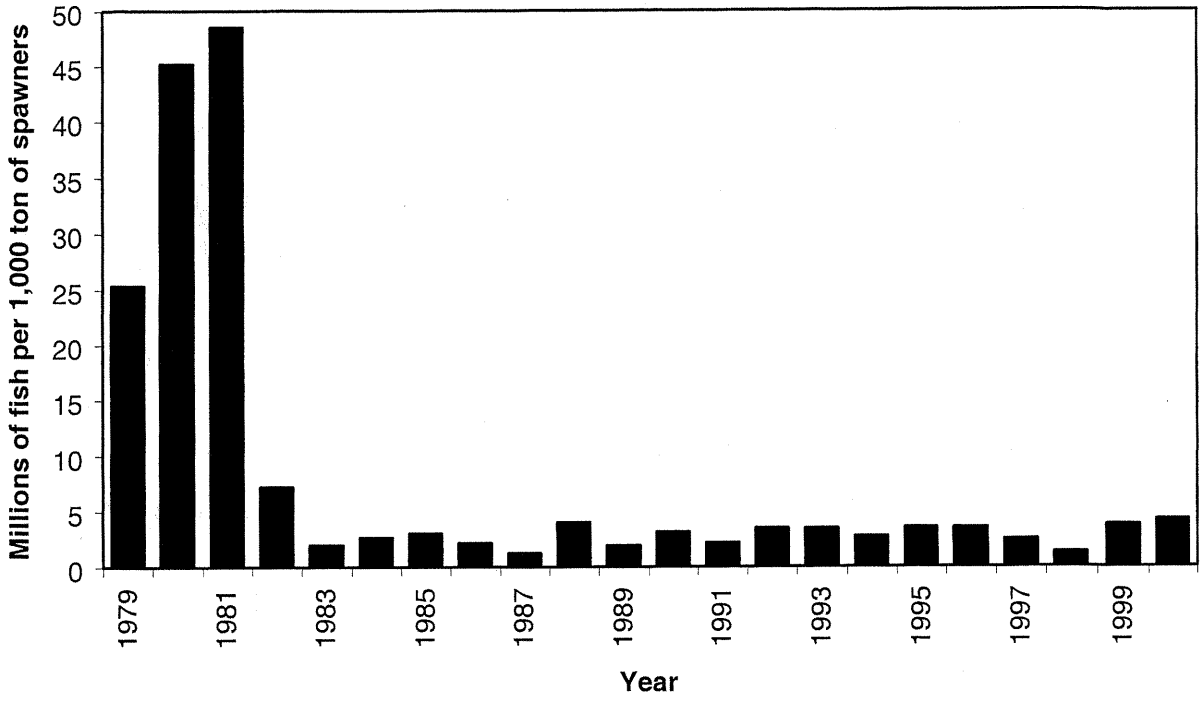


Figure 10. Recruitment Forecast for Biomass Projection

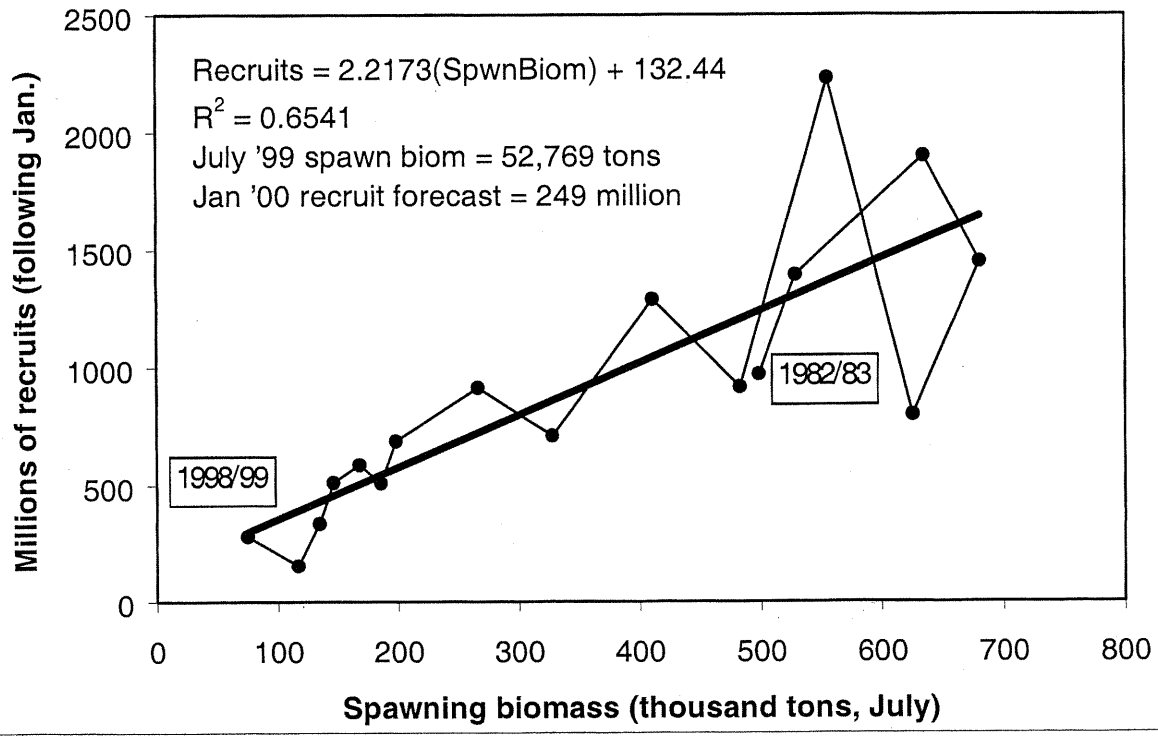


Table 3. Projected Pacific mackerel biomass and calculated harvest guideline for the 2001/2002 management season.

Age	#Fish (10^6) Jan 2000	F Mort 2000	#Fish (10^6) Jan 2001	Selectivity 2001	F Mort* 2001	#Fish (10^6) July 2001	Wt-at-Age (lbs/fish)	Projected Biomass (mt) July 2001
0	249	0.107						
1	163	0.114	136	0.200	0.026	104	0.649	30,779
2	38	0.213	88	0.373	0.048	67	0.857	26,061
3	42	0.366	19	0.642	0.083	14	1.209	7,636
4	36	0.570	18	1.000	0.129	13	1.305	7,639
5+	39	0.570	26	1.000	0.129	19	1.405	11,974
							TOTAL (mt)=	**84,090**

*Annual F in 2001 = 0.1294 <----- adjusted to match projected catch of 3,350 mt for Jan-Jun, 2001.

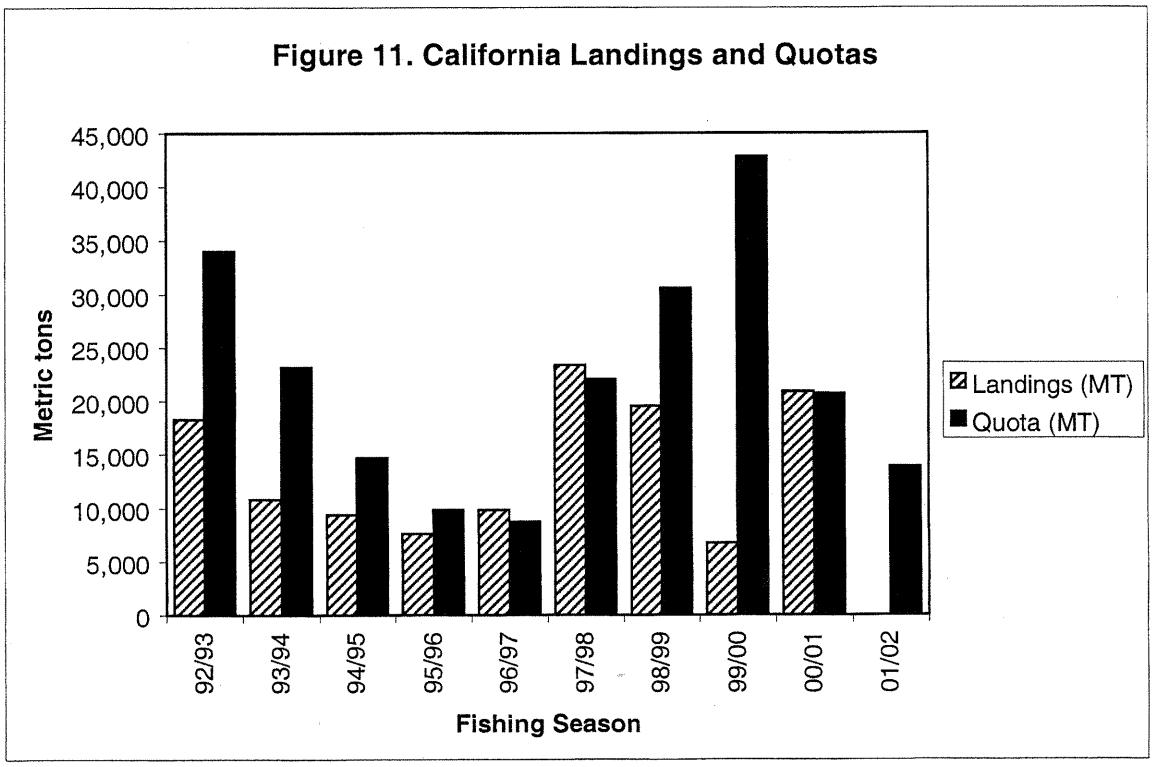
HARVEST GUIDELINE = (BIOMASS - CUTOFF) x FRACTION x STOCK DISTRIBUTION
where: BIOMASS=84,090; CUTOFF=18,200 mt; FRACTION=30%; STOCK DISTRIBUTION=70%

HARVEST GUIDELINE for 2001-2002 = 13,837 mt

Table 4. Commercial landings (California directed fishery) and quotas (92/93 to 98/99) or harvest guidelines (99/00 to present) for Pacific mackerel. See also Figure 11 below.

Season	Landings (mt)	Quota/HG (mt)
92/93	18,307	34010
93/94	10,793	23147
94/95	9,372	14706
95/96	7,615	9798
96/97	9,788	8709
97/98	23,413	22045
98/99	19,578	30572
99/00	6,732	42,819
36891	20,882	20740
01/02	-------	**13837**

Figure 11. California Landings and Quotas



Stock Assessment of Pacific Sardine with Management Recommendations for 2001

Executive Summary

24 October 2000

by

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Introduction

The following summary presents pertinent results and harvest recommendations from a stock assessment conducted on Pacific sardine (*Sardinops sagax*) in 2000. It is intended that this information will be referred to by the Pacific Fishery Management Council (PFMC) when developing management goals for the upcoming fishing season for sardine beginning January 2001. A complete document that describes details regarding data sources, analyses, and modeling used in this assessment will be prepared later this year and will be distributed prior to the PFMC meeting in March 2001; the complete assessment document, as well as the Executive Summary, will be included in the PFMC series *Stock Assessment and Fishery Evaluation (SAFE)* reports.

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. The majority of the fishery-independent and fishery-dependent data were collected off northern Mexico and southern California only (Area 1 or *Inside* Area); however, as was done in past assessments, assumptions regarding sample coverage (e.g., representativeness of survey trends to areas outside Area 1) and sardine biology (e.g., recruit emigration out of Area 1) were used to make scientific inferences about the entire population, e.g., to provide fishery managers coastwide estimates of stock biomass, mortality rates, and harvest guidelines.

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 (see above). The models are based on a 'forward-simulation' approach (see Megrey (1989) for a description of the general modeling 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 survey (fishery-independent) 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, U.S. 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 (1983 to first semester 2000) were used to develop the following time series: (1) catch (in mt)-Table 1 and Figure-1; (2) age distributions (catch-at-age in numbers of fish); and (3) estimates of weight-at-age (fishery- and population-specific). 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 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, see Deriso et al. (1996); (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).

Survey indices of relative abundance were re-estimated using generally similar techniques as was done in previous assessments (e.g., see Hill et al. 1999). 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. Finally, in past assessments the Aerial Spotter Index was assumed to primarily track adult spawning biomass. However, further examination of the sampling design used to collect these data (i.e., sampling space is inshore waters only) indicated this index more likely observed pre-adult fish (mostly age 0-2 fish) than strictly adult spawners and thus, the 'selectivity' ogive was adjusted to reflect this sampling attribute.

It is important to note that survey indices used in fishery assessments are often based on variable and biased data; however, we assumed that biases were generally consistent from year to year, which in effect, allows the trend indicated in an index to be interpreted in relative terms and ultimately, useful in statistical modeling. Additionally, sensitivity analysis included alternative model configurations that were based on differentially weighted indices, which produced generally similar results from the modeling. For example, reduced weighting of the Aerial Spotter Index and CalCOFI Index (see Hill et al. 1999) resulted in similar model predicted fits to these survey data, as well as similar trends in estimated spawning biomass ($\geq$1-year old fish).

Results

Pacific sardine landings for the directed fisheries off California, U.S. and Ensenada, Mexico remained at the high levels that were reached last year (115,000 mt), with a total harvest of roughly 114,000 mt (Table 1, Figure 1); note that semester 2 landings in 2000 reflect projected estimates based on landing patterns observed in the fisheries during the mid to late 1990s (Table 1). California landings in 2000 (59,925 mt) are expected to increase slightly (6% or 3,200 mt) from the 1999 estimated landings (56,747), while Ensenada landings in 2000 (53,579 mt) are forecasted to decrease slightly (9% or 5,000 mt) from landings made in 1999 (58,569 mt). Currently, the U.S. fishery (California landings) is regulated using a quota (harvest guideline) management scheme and the Mexico fishery (Ensenada

landings) is essentially unregulated. Since the mid 1990s, actual landings from the California fishery have been less than the recommended quotas.

As was the case in recent years, landings from the U.S. Pacific sardine fishery (California, Oregon, and Washington) are well below the harvest guideline recommended for 2000 (186,791 mt), with roughly 55,543 mt (30% of harvest guideline) landed through September 2000 and over 131,000 mt of the quota remaining (the fishing year ends on December 31, 2000).

Estimated stock biomass (≥1-year old fish on July 1, 2000) 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 1.2 million mt (Table 3 and Figure 7). Estimated recruitment (age-0 fish on July 1, 2000), albeit more variable than stock biomass statistics, also remained at relatively high abundance, with number of recruits increasing slightly from last year to nearly 14 billion (Table 3 and Figure 8).

Harvest Guideline for 2001

The harvest guideline recommended for the U.S. (California, Oregon, and Washington) Pacific sardine fishery for 2001 is 134,737 mt. Statistics used to determine this harvest guideline are discussed below and presented in Table 4. To calculate the proposed harvest guideline for 2001, 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:

$$HG_{2001} = (\text{TOTAL STOCK BIOMASS}_{2000} - \text{CUTOFF}) \bullet \text{FRACTION} \bullet \text{U.S. DISTRIBUTION},$$

where HG_{2001} is the total U.S. (California, Oregon, and Washington) harvest guideline recommended for 2001, $\text{TOTAL STOCK BIOMASS}_{2000}$ is the estimated stock biomass (ages 1+) from the current assessment conducted in 2000 (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 U.S. DISTRIBUTION is the percentage of $\text{TOTAL STOCK BIOMASS}_{2000}$ in U.S. 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%. The F_{msy} is equal to 15% under current oceanic conditions (T_{2000} = 17.73 °C; Figure 6).

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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), 1983-2000. Semester 2 (2000) estimates are projections.

	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	34,518	25,407	59,925	25,800	27,779	53,579	113,504

Table 2. Pacific sardine time series of survey indices of relative abundance and sea-surface temperature, 1983-00.

Year	CalCOFI (% positive)	DEPM (mt)	Spawning area (Nmi^2)	Spotter plane (mt)	Sea-surface temperature (C)
83	na	na	40	na	17.25
84	4.362	na	480	na	17.58
85	2.715	na	760	na	17.80
86	1.316	7,659	1,260	43,478	17.87
87	4.286	15,705	2,120	15,430	17.71
88	6.716	13,526	3,120	85,266	17.55
89	9.140	na	3,720	47,847	17.24
90	3.623	na	1,760	29,723	17.19
91	12.805	na	5,550	54,242	17.35
92	10.825	na	9,697	60,442	17.61
93	6.061	na	7,685	104,223	17.84
94	17.010	111,493	24,539	253,270	17.97
95	10.811	na	23,816	249,428	18.04
96	28.000	83,176	25,889	151,646	18.06
97	17.949	356,300	40,592	86,121	18.06
98	17.447	313,986	33,447	150,258	18.44
99	16.667	282,248	55,173	52,652	18.04
00	5.556	1,063,837	32,785	74,410	17.73

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	5,056	5,056	2,957	10,099	141,403	88,847	246,958
84	12,816	12,878	9,063	21,581	226,169	147,229	371,294
85	20,961	21,439	15,673	33,385	219,856	155,365	352,332
86	29,917	31,484	24,446	46,926	846,294	615,775	1,287,227
87	72,083	75,573	59,772	108,304	832,040	617,653	1,190,540
88	105,088	114,408	94,477	152,212	1,461,068	1,063,523	2,219,947
89	160,457	178,912	148,464	239,814	1,158,867	810,564	1,894,887
90	175,762	208,108	173,068	282,917	4,709,570	3,090,489	8,018,753
91	222,968	258,856	198,733	394,671	5,902,130	3,685,261	10,226,905
92	350,673	416,435	308,879	643,578	4,105,231	2,593,962	7,299,626
93	331,202	438,385	336,054	655,658	8,927,805	6,324,826	14,328,381
94	482,639	635,350	511,046	912,435	10,906,645	7,633,095	16,934,560
95	511,541	720,733	580,872	1,013,478	6,785,885	4,781,041	10,792,603
96	537,008	789,746	654,219	1,076,120	5,565,890	3,820,403	9,088,025
97	483,698	765,450	644,562	1,032,142	8,135,807	5,105,778	13,574,897
98	435,700	738,098	601,127	1,030,048	19,021,736	12,389,294	33,111,696
99	693,865	1,084,814	818,716	1,654,253	11,581,850	6,958,572	22,728,400
00	718,662	1,182,465	834,879	1,896,204	13,584,794	6,940,772	28,942,209

Table 4. Proposed harvest guideline for Pacific sardine for the 2001 fishing season. See the **Harvest Guideline for 2001** section for methods used to derive harvest guideline.

Total stock biomass (mt)	Cutoff (mt)	Fraction (%)	U.S. Distribution (%)	Harvest guideline (mt)
1,182,465	150,000	15%	87%	**134,737**

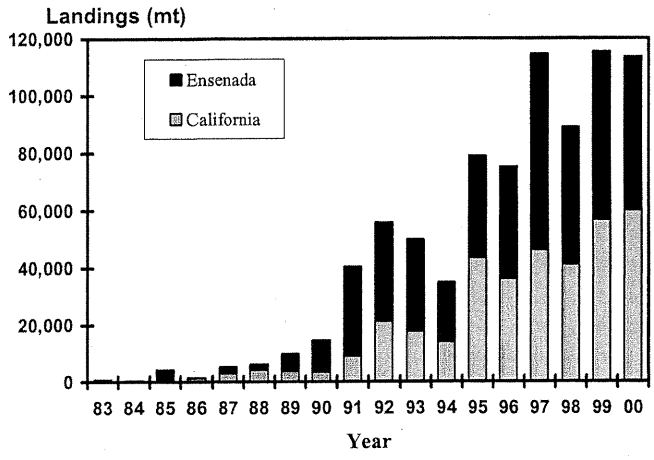

Figure 1. Pacific sardine landings (mt) in California and Baja California (Ensenada), 1983-00.

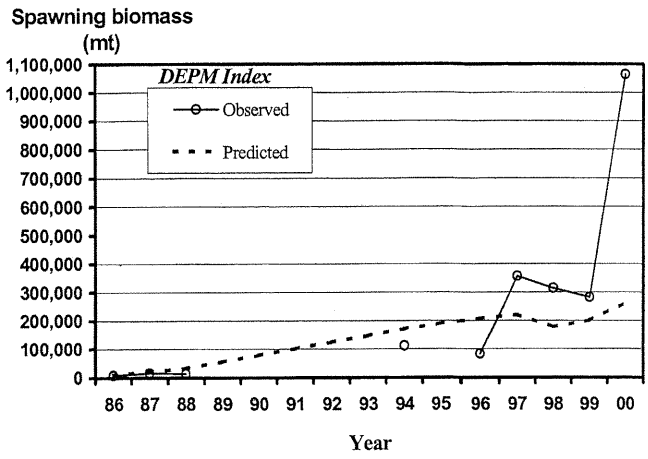

Figure 3. Index of relative abundance of Pacific sardine spawning biomass (mt) off California based on daily egg production method (DEPM) estimates from ichthyoplankton survey data (1986-00). Note no sample data (Observed estimates) were available for years 1989-93 and 1995.

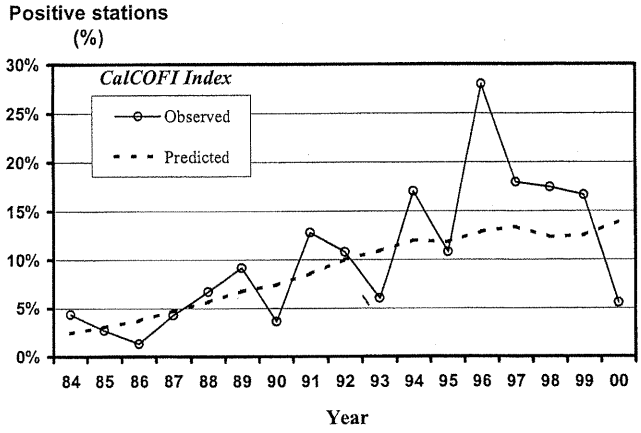

Figure 2. Index of relative abundance of Pacific sardine eggs (proportion-positive stations) off southern California based on CalCOFI bongo-net survey (1984-00).

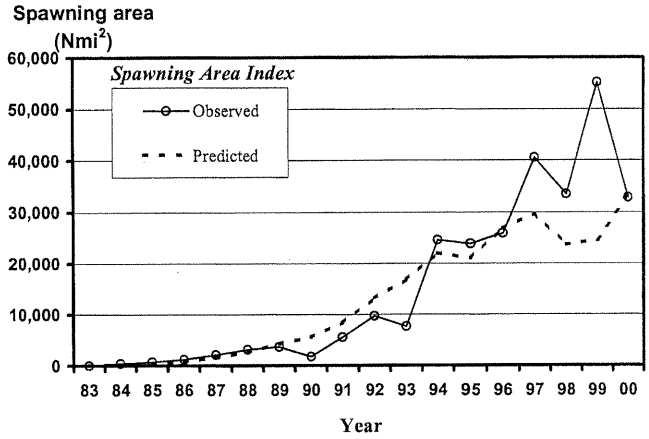

Figure 4. Index of relative abundance of Pacific sardine spawning stock size based on estimates of spawning area (Nmi^2) calculated from CalCOFI and DEPM survey data (1983-00).

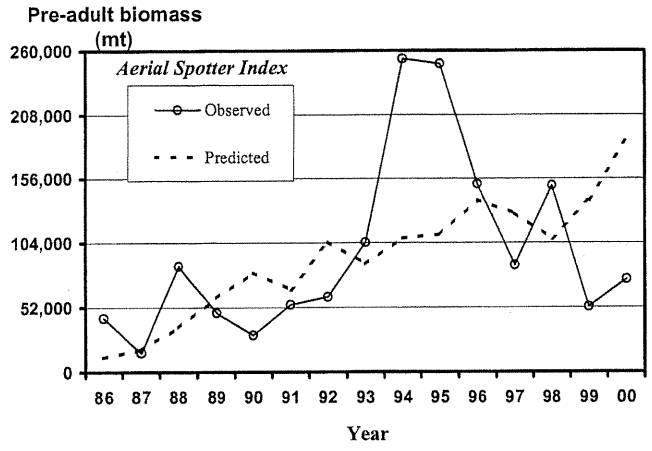

Figure 5. Index of relative abundance of Pacific sardine pre-adult biomass (mt) off California based on aerial spotter plane survey data (1986-00).

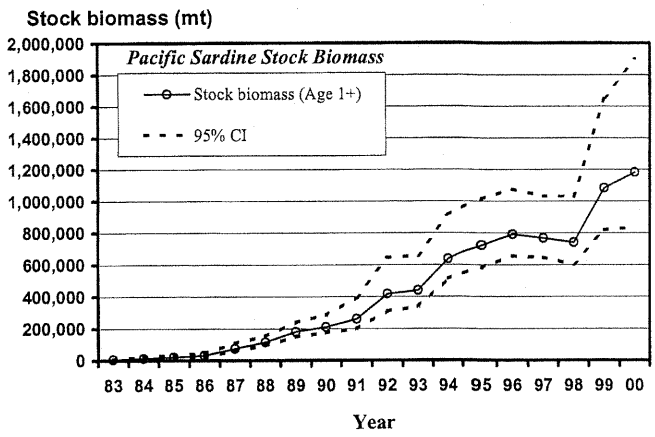

Figure 7. Time series (1983-00) of Pacific sardine stock biomass (≥1-yr old fish on July 1 of each year in mt) estimated from an age-structured stock assessment model (CANSAR-TAM, see Hill et al. 1999).

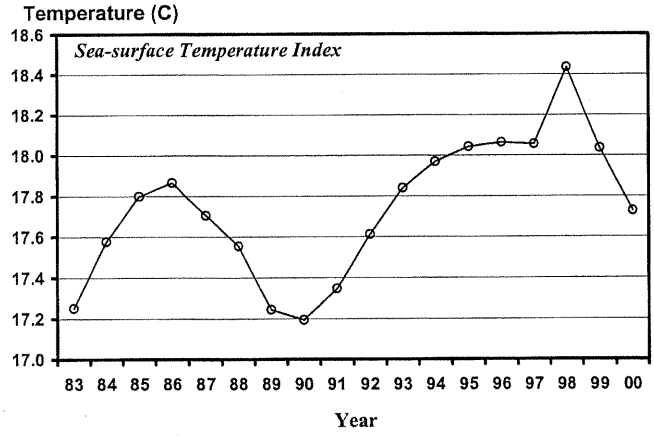

Figure 6. Time series of sea-surface temperature (C) recorded at Scripps Pier, La Jolla (1983-00). Annual estimates reflect 3-year 'running' averages, see Jacobson and MacCall (1995).

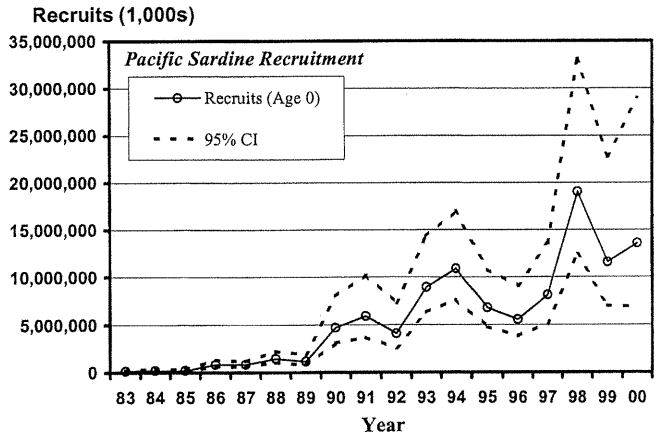

Figure 8. Time series (1983-00) of Pacific sardine recruitment (0-yr old fish on July 1 of each year in 1,000s) estimated from an age-structured stock assessment model (CANSAR-TAM, see Hill et al. 1999).

Exhibit G.2
Situation Summary
June 2001

PACIFIC MACKEREL HARVEST GUIDELINE AND OTHER SPECIFICATIONS FOR 2001-2002

Situation: Per the coastal pelagic species (CPS) fishery management plan (FMP) annual cycle, the Council is scheduled to review the Pacific mackerel stock assessment and adopt for recommendation to the U.S. Secretary of Commerce a harvest guideline for the 2001-2002 Pacific mackerel fishing season. The current year's harvest guideline for Pacific mackerel (20,740 mt) was reached and the fishery closed on March 27, 2001 (66*FR*17373). The 2001-2002 fishery opens July 1, 2001. The current stock assessment and management recommendations are summarized in Attachment 1.

The Coastal Pelagic Species Management Team (CPSMT) and the Coastal Pelagic Species Advisory Subpanel (CPSAS) have reviewed the assessment and the recommended harvest guideline. They will present their respective advice to the Council.

The CPSMT has completed the second annual *Status of the Pacific Coast Coastal Pelagic Species (CPS) Fishery Stock Assessment and Fishery Evaluation* (SAFE) document. This is included in the briefing book.

According to the annual management plan, the CPS SAFE document will be prepared and presented in two sections. The main section will be submitted at the June Council meeting. This portion of the SAFE will include the annual Pacific mackerel assessment, evaluation of the fisheries based on the calendar year, and the status of monitored species. The second (supplemental) section will include the Pacific sardine assessment and status of the sardine fishery. The supplemental section will be presented at the November Council meeting.

Council Action:

1. Adopt Pacific mackerel fishery management specifications for 2001-2002 fishing season.

Reference Materials:

1. Stock Assessment of Pacific Mackerel with Recommendations for the 2001-2002 Management Season, Executive Summary (Exhibit G.2, Attachment 1).
2. Status of the Pacific Coast Coastal Pelagic Species Fishery Through 2001 and Recommended Acceptable Biological Catches for 2002 (Exhibit G.2, Attachment 2).
3. Exhibit G.2.b, CPSMT Report.
4. Exhibit G.2.b, Supplemental CPSAS Report.

PFMC
05/25/01

Exhibit G.3.c
CPSMT Report
June 2001

MARKET SQUID MAXIMUM SUSTAINABLE YIELD METHODOLOGY REVIEW WORKSHOP

At the Council's request, the Coastal Pelagic Species Management Team (CPSMT) worked with the Scientific and Statistical Committee (SSC), National Marine Fisheries Service (NMFS), and California Department of Fish and Game (CDFG) to organize the market squid stock assessment methodologies workshop. The workshop was held May 14-17, 2001 at the NMFS, Southwest Fisheries Science Center in La Jolla, California. The workshop panel reviewed research conducted on squid life history along with enhanced fishery data relevant to any stock assessment approach. The review panel and stock assessment authors had a productive week of discussion and hands-on modeling, and the CPSMT anticipates a fruitful outcome to this process. The CPSMT would like to thank the panelists and workshop participants for their contributions of time and expertise in making this workshop a success.

A principle goal of the workshop was to integrate the research and the workshop panel's findings into the coastal pelagic species fishery management plan (CPS FMP). The CPSMT has not yet met to review the workshop panel report, but will do so at the next scheduled work session. The CPSMT respectfully requests guidance from the Council on whether to proceed with including the panel's findings in Amendment 10 to the CPS FMP.

PFMC
05/23/01

Exhibit G.3
Situation Summary
June 2001

MARKET SQUID MAXIMUM SUSTAINABLE YIELD METHODOLOGY REVIEW WORKSHOP

Situation: On May 14-17, 2001 a workshop was held to review market squid stock assessment methods. The workshop was, in part, to address disapproved provisions in the Pacific Fishery Management Council's (Council) Coastal Pelagic Species (CPS) Fishery Management Plan (FMP); specifically, maximum sustainable yield (MSY) for market squid. A principal goal of the stock assessment review (STAR) was to investigate ways to integrate squid research into the Council's CPS FMP.

The workshop chairs will present a preliminary report to the Council. The Scientific and Statistical Committee and the Council's CPS advisors will also provide information to the Council.

At the Council's discretion, the results of the Squid Workshop could be incorporated into an amendment to the CPS FMP. The Council has already requested the CPS Management Team initiate work on Amendment 10 to the FMP, which will codify the limited entry fishery capacity goal and modify transferability restrictions.

Council Action:

1. **Discussion and guidance regarding market squid MSY and its relevance to the CPS FMP amendment**.

Reference Materials:

1. Coastal Pelagic Species Management Team (CPSMT) Report (Exhibit G.3.c).
2. Preliminary Workshop Report (Exhibit G.3.b, Supplemental Workshop Report).

PFMC
05/23/01