

## REVIEW OF SOME CALIFORNIA FISHERIES FOR 1996

CALIFORNIA DEPARTMENT OF FISH AND GAME

Marine Resources Division  
 8604 La Jolla Shores Drive  
 La Jolla, California 92037-1508

Total 1996 annual landings of fishes, crustaceans, echinoderms, and mollusks in California increased by 8% from 1995, to 208,440 metric tons (t). Ex-vessel economic value of California commercial landings rose 16% from the prior year's level, to \$183.7 million.

Pelagic wetfish landings increased 3% from 1995. The largest share of this increase was attributed to a record level of market squid landings (78,825 t). Increases were also registered for northern anchovy, Pacific mackerel, and Pacific herring.

Groundfish fisheries declined slightly in 1996, and ex-vessel revenues remained stable at \$34 million. Statewide, Dungeness crab landings changed little from the year before, remaining 40% above the ten-year mean of 4,348 t. Sea urchin landings continued an eight-year decline, falling an additional 11% in northern and southern California to 9,105 t. The spot and ridgeback prawn fishery registered a dramatic 39% increase in annual catch, to 511 t, as did the sea cucumber fishery, which rose to a 19-year record since the fishery's inception. Commercial landings of red abalone declined by an additional 33% in 1996, to just 75 t. Commercial and recreational fisheries for pink, green, and white abalones were closed by the California Fish and Game Commission as of March 1, 1996. The black abalone fishery had closed previously because of the population effects of withering syndrome disease.

Swordfish and mako shark landings registered small decreases, but thresher shark landings rose slightly in 1996, ending a decade-long decline. Drift gill nets accounted for an increasing proportion (70%) of these landings, at the expense of longline and harpoon gears.

California's live-fish fishery continued its expansive growth in 1996 with respect to total landings (+25%), number of target species (66 species, as compared to 54 species in 1995), fishing methods, and markets. Statewide landings of live fish were estimated at 562 t, with an estimated ex-vessel value of over \$3.6 million.

### PACIFIC SARDINE

Rebuilding of the sardine fishery continued in 1996, with the year's total landings of 34,128 t ranking as the second largest since the late 1950s (table 1). In southern California the sardine quota of 23,511 t was reached on November 5, and the fishery closed the same day. When the southern California directed fishery closed, only incidentally caught sardines (35% or less by weight) were authorized. In northern California the directed quota was set at 11,353 t. Only 78% of the quota was landed, thus the directed fishery remained open until year's end.

In 1996, sardines were used for frozen whole bait (54%), fresh fish for human consumption (31%), live

TABLE 1  
 Landings of Pelagic Wetfishes in California (Metric Tons)

Year	Pacific sardine	Northern anchovy	Pacific mackerel	Jack mackerel	Pacific herring	Market squid	Total
1977	5	99,504	5,333	44,775	5,200	12,811	167,628
1978	4	11,253	11,193	30,755	4,401	17,145	74,751
1979	16	48,094	27,198	16,335	4,189	19,690	115,542
1980	34	42,255	29,139	20,019	7,932	15,385	114,764
1981	28	51,466	38,304	13,990	5,865	23,510	133,163
1982	129	41,385	27,916	25,984	10,106	16,308	121,828
1983	346	4,231	32,028	18,095	7,881	1,824	64,405
1984	231	2,908	41,534	10,504	3,786	564	59,527
1985	583	1,600	34,053	9,210	7,856	10,275	63,577
1986	1,145	1,879	40,616	10,898	7,502	21,278	83,318
1987	2,061	1,424	40,961	11,653	8,264	19,984	84,347
1988	3,724	1,444	42,200	10,157	8,677	36,641	102,843
1989	3,845	2,410	35,548	19,477	9,046	40,893	111,219
1990	2,770	3,156	36,716	4,874	7,978	28,447	83,941
1991	7,625	4,184	30,459	1,667	7,345	37,388	88,668
1992	17,946	1,124	18,570	5,878	6,318	13,110	62,946
1993	13,843	1,954	12,391	1,614	3,882	42,708	76,392
1994	13,420	3,680	10,040	2,153	2,668	55,395	85,299
1995	43,450	1,881	8,667	2,640	4,475	70,278	131,391
1996*	34,128	4,424	10,300	1,485	6,602	78,825	135,764

\*Preliminary

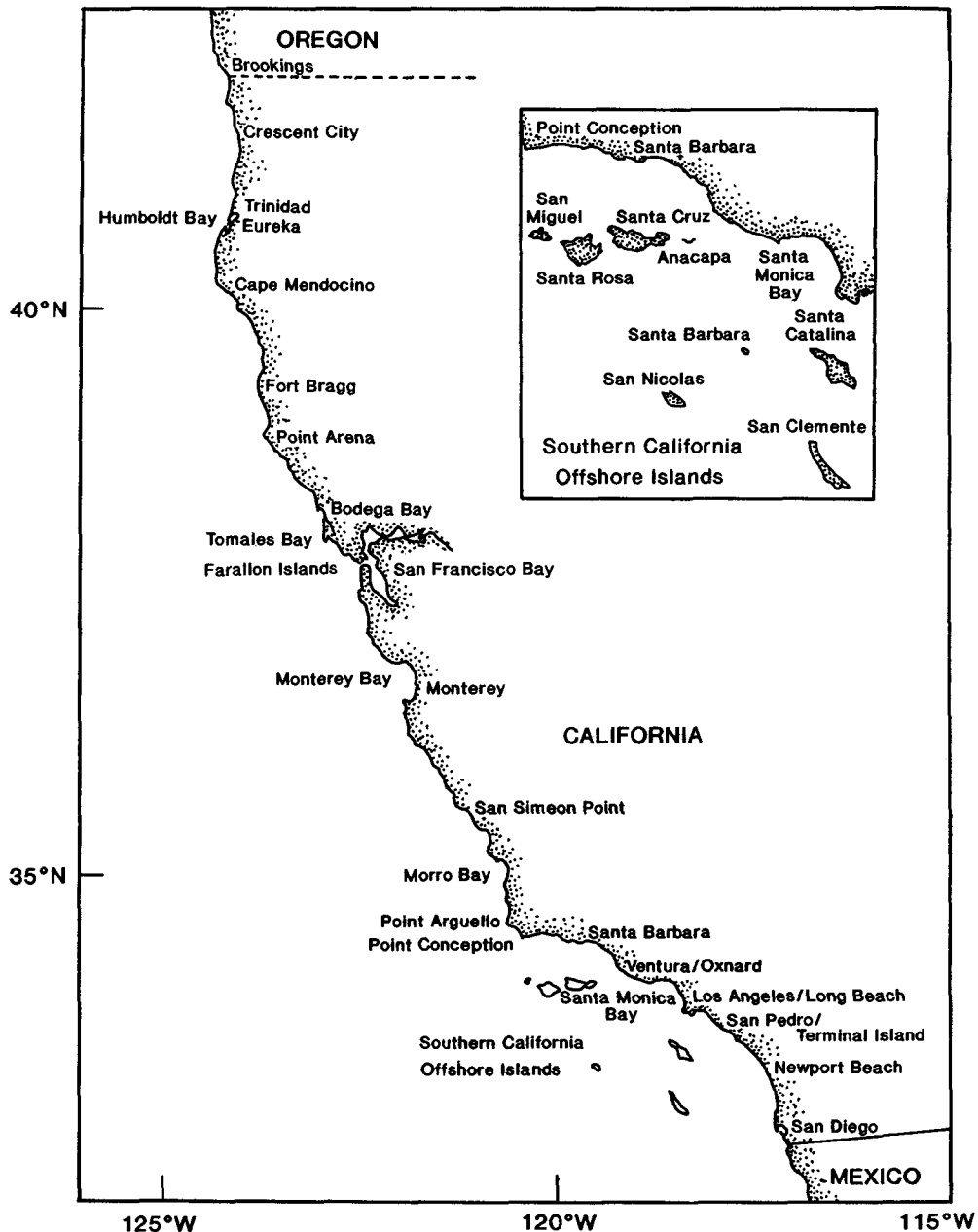


Figure 1. California ports and fishing areas.

bait (10%), and canned pet food (5%). Only 6% of the total sardines landed were canned for human consumption. No California landings were used for the production of fish meal.

Fish and Game Code (Section 8150.8) states that annual sardine quotas shall be allocated two-thirds to southern California (south of San Simeon Point, San Luis Obispo County) and one-third to northern California (north of San Simeon Point; figure 1). During 1996, the formula generated an initial southern fishery quota of 21,212 t and a northern quota of 10,606 t. At midyear, the sardine stock assessment was updated and, as a result,

the 1996 quota was increased by 3,045 t. In October, the California Department of Fish and Game (CDFG) reallocated uncaught quota portions equally between north and south (table 2).

Sardine total biomass as of July 1, 1995, was estimated at 320,909 t on the basis of output from CANSAR (Catch-at-age ANalysis of SARdines model). CANSAR, a forward-casting stock assessment model, produces biomass estimates by incorporating both fishery-dependent and fishery-independent data, including catch and weight-at-age information, landings data, egg and larval abundance, and spotter pilot observations.

TABLE 2  
 Pacific Sardine Quota Allocations (Metric Tons)  
 in California, 1996

	Initial quota	Reallocated quota	Landings
North	10,606	11,353	8,904
South	21,212	23,511	25,224
Total	31,818	34,864	34,128

Current regulations give considerable latitude to CDFG in setting annual sardine quotas. When biomass is estimated to be over 20,000 t, Fish and Game Code requires that allowable catch must be consistent with resource rehabilitation. The 1996 quota was established from a formula of 20% of total estimated biomass.

Price paid to fishermen (ex-vessel price) for sardines remained low from 1995 to 1996, at approximately \$70 per t at fresh fish markets and \$77 per t at canneries. Other important target species for the southern California wetfish fleet include Pacific mackerel (*Scomber japonicus*) and market squid (*Loligo opalescens*) in the winter, and tunas during the summer. In northern California, Pacific herring (*Clupea pallasii*) is also an important target species from January to March. Species such as squid and tuna command significantly higher ex-vessel prices than sardines: \$154–\$330 per t for market squid and a minimum of \$882 per t for tuna. During 1996 landings varied monthly due to availability, demand, and fleet participation in other fisheries.

In addition to the wetfish fishery for sardine, there is a small bait fishery that is not subject to a quota and usually takes less than 5,000 t annually. Live bait ex-vessel prices (about \$680 per t) were approximately ten times greater than those for the directed fishery. In 1996, the ex-vessel value of the bait fishery exceeded the value of the directed fishery by approximately one million dollars.

In May 1996, nine months after closing because of bankruptcy, the only remaining southern California cannery capable of packing fish for human consumption reopened under new management. The cannery began processing sardines in October.

While some fish markets plan to expand production facilities to fill increasing sardine orders, others state that they cannot rely on a U.S. quota that could fluctuate widely from year to year due to unregulated Mexican fisheries. Recent sardine landings from Mexico have equaled or exceeded California's (except in 1995) and could ultimately affect allowable catch in state waters.

Industry representatives indicate that international interest in Pacific sardine is increasing. In 1996, 12,347 t of sardines were exported, slightly less than the 1995 export total of 12,563 t and a ninefold increase from the 1990–1994 average. The top three importers of frozen

blocks of Pacific sardines are Australia, the Philippines, and Japan. Australia imports sardines to use as fish food in aquaculture facilities; the Philippines import sardines for human consumption; and Japan supplements its catch to meet consumer demand following the recent decline and near collapse of its sardine resource.

During 1996, the Pacific sardine sampling program expanded considerably. In California, sampling was extended to Monterey. Also, California scientists began a data exchange with Oregon and Washington scientists and informally with British Columbia, Canada. The Canadians tested a 200-t sardine fishery in 1996. The informal exchange of data with Ensenada, Mexico, scientists continues.

### PACIFIC MACKEREL

Pacific mackerel (*Scomber japonicus*) is a transboundary stock supporting commercial fisheries in the United States and Mexico, and both have declined since the 1980s. Concurrently, the stock has more fully used the northernmost portions of its range in response to a warm regime in the northeast Pacific Ocean, and mackerel have been found as far north as British Columbia, Canada.

California landings during 1996 totaled 10,300 t, only slightly higher than the 19-year low of 8,667 t landed in 1995 (table 1). Over 90% of the statewide landings during 1996 were made by approximately 17 purse seine vessels based in the Los Angeles area, commonly known as the wetfish fleet. Twelve additional wetfish vessels based in Monterey accounted for most of the mackerel landings in northern California. Average ex-vessel price during 1996 was \$147 per t, but large, high-quality fish such as those landed in July received better prices of \$220 per t. Ex-vessel value of the 1996 California fishery was \$1.51 million.

During the last few years, the principal causes of reduced catches have been low biomass and poor availability on the traditional fishing grounds in southern California waters. Cannery closures since 1993 may have diminished demand. In 1996, the wetfish fleet participated in lucrative winter squid and summer tuna fisheries, thus decreasing effort for mackerel during those months.

The mackerel fishing season is defined in the California Fish and Game Code as the 12-month period from July 1 through June 30 of the following calendar year. The harvest formula for mackerel specifies that when biomass is between 18,144 and 136,080 t, the season's quota shall be 30% of the total biomass in excess of 18,144 t. If total biomass is less than 18,144 t, no directed landings are allowed, and if total biomass is greater than 136,080 t, no limitation on total catch is imposed. Under the prescribed formula and the CDFG biomass projection for July 1, 1996, a commercial fishery quota of 8,700 t was established for the 1996–97 California fishing season.

When the 1996–97 season opened, abundant large mackerel off San Clemente Island and Santa Catalina Island increased landings compared to preceding months. July 1996 landings were 2,984 t—the highest monthly total since July of 1993. On March 12, 1997, the season quota was reached, and the Pacific mackerel directed fishery was closed for the first time since 1985, although regulations allowed incidental landings of mackerel mixed with landings of other wetfish species. Following the closure, the bycatch tolerance of 35% mackerel by weight limited incidental mackerel landings to about 600 t between the closure date and the end of April 1997. Incidental landings were allowed to continue at a 35% tolerance through the close of the 1996–97 season on June 30, 1997.

Examination of several information sources on the status of the mackerel stock suggests a decline in biomass compared to the late 1970s and 1980s. Landing statistics for both the U.S. and Mexican fisheries show reduced catches in recent years. Catch rates for the southern California commercial passenger fishing vessel (CPFV) fleet have also shown declining trends since the 1970s. Other fishery-independent data from aerial observations (spotter pilots) and plankton surveys (CalCOFI mackerel larvae samples) indicate lower abundance compared to the early 1980s.

A tuned virtual population analysis (VPA) model called ADEPT was used to estimate mackerel biomass and to determine the California quota for the 1997–98 fishing season. The model performs the best statistical fit between fishery-based, age-structured biomass estimates and the fishery-independent data listed above. On the basis of the estimated number of fish in each year class during the last quarter of 1996 (including the 1996 year class), and using certain assumptions for fishing mortality during the first half of 1997, mackerel biomass was projected to be 91,600 t at the beginning of the 1997–98 fishing season. Consequently, the CDFG set the 1997–98 quota at 22,000 t. There is a large degree of uncertainty in the 1997 biomass estimate because the youngest year classes made up much of the biomass.

In response to the northward range extension of recent years, in 1996 CDFG, the Oregon Department of Fish and Wildlife, and the Washington Department of Fish and Wildlife began a pilot study to examine geographic variation in growth and age composition. These studies are based on samples taken from the California directed mackerel fishery, mackerel bycatch in the Oregon and Washington whiting fishery, and mackerel caught by hook and line from Washington. Although mackerel catches in the Pacific Northwest have remained small (less than 500 t) compared to the directed fishery in California, bycatch in the whiting fishery has been notable in recent years. This higher bycatch rate lends sup-

port to the hypothesis that increased numbers of mackerel may be emigrating northward from the traditional southern California fishing grounds. Preliminary results from the pilot program suggest that mackerel in these northern waters are significantly older than those that dominate the southern California fishery.

In August 1996, CDFG conducted an ichthyoplankton survey to determine the extent and intensity of mackerel spawning in waters off northern and central Baja California. The surveyed area was chosen to encompass the primary spawning grounds for the stock that also inhabits California waters and is vulnerable to the California commercial fishery. Preliminary findings—low densities of larvae—are in agreement with other information on the status of the stock.

## PACIFIC HERRING

Annual statewide landings for Pacific herring (*Clupea pallasii*) were 6,602 t, an increase of 41.5% from the previous year (table 1). Statewide landings for the roe fisheries during the 1995–96 fishing season (December to March) totaled 6,003 t (table 1). Three gill net platoons (376 permittees) in San Francisco Bay's fishery landed 4,463 t, which was 14.8% over their 3,888-t quota. Twenty-six round haul (purse seine and lampara) permittees fishing in San Francisco Bay landed 7 tons more than their 1,123-t quota. The quota for Tomales Bay was 318 t, and the 39 Tomales Bay permittees landed 322 t. The four Humboldt Bay permittees landed 46 t, 14.8% less than their 54-t quota. Three Crescent City permittees landed 42 t, 53.6% more than their quota of 27 t.

Ex-vessel prices for herring with 10% roe recovery ranged from \$2,000 to \$2,300 per short ton during the 1995–96 fishing season; an additional \$200 to \$230 per short ton was paid for each percentage point over 10%. Total ex-vessel value of roe fisheries was \$19.8 million, more than double the average value of approximately \$9 million for the previous ten seasons.

Ten permittees participated in the San Francisco Bay herring eggs-on-kelp fishery and harvested their full quota of 97 t. Total estimated ex-vessel value of the eggs-on-kelp fishery was \$2.2 million, with prices ranging from \$10 to \$20 per pound.

CDFG biologists used hydroacoustic and spawn-deposition surveys to estimate the spawning biomass of herring in San Francisco Bay and Tomales Bay. No surveys were conducted in Humboldt Bay or Crescent City Harbor.

The 1995–96 herring spawning biomass estimate for San Francisco Bay was 89,812 t, more than twice last season's estimate and one of the two highest estimates ever made. The increase in biomass was attributed to very large numbers of two-, three-, and four-year-old fish from the 1994, 1993, and 1992 year classes. These

three year classes constituted approximately 80% of the spawning population. The 1994 and 1993 year classes are the strongest ever observed in the population, an encouraging sign for the future.

Spawning biomass estimates have fluctuated widely in Tomales Bay since the reopening of the fishery in the 1992–93 season. The 1995–96 spawning biomass estimate for Tomales Bay (1,892 t) continued that tendency by decreasing 48% from last season's estimate of 3,610 t. The spawning biomass estimate was well below the 23-season average for the fishery of 4,103 t. The 1992 and 1993 year classes were relatively strong, but this was offset by a weak 1991 year class.

A dead bait and animal food fishery for Pacific herring is conducted during the summer months in Monterey Bay. Participants in this fishery landed 248 t in 1996, nearly equal to the peak landings of 250 t in 1982 and well over the 20-year average of 82 t. The estimated ex-vessel value of the 1996 landings was \$295,000.

## MARKET SQUID

In 1996, market squid (*Loligo opalescens*) surpassed red sea urchin (*Strongylocentrotus franciscanus*) as the state's most valuable fishery resource, with ex-vessel revenues of approximately \$29.5 million. Landings were 78,825 metric tons, an increase of 12.2% over the 1995 previous record high of 70,278 t (table 1).

Squid are currently harvested by about 150 purse seine vessels, usually with a hold capacity of 35–70 t and a median length of about 15–20 meters. Fishing is done at night on spawning grounds when the squid aggregate to spawn. Squid typically spawn in semiprotected near-shore areas over sandy bottoms with rocky outcroppings. Fishing operations often involve two vessels: a light vessel with high-intensity lights to attract and hold the spawning schools near the surface, and a purse seiner to capture them.

Two distinct fisheries exist for market squid in California, separated geographically and seasonally. The southern California fishery, primarily a fall and winter fishery, historically dominates overall squid landings, accounting for 93.3% of the 1996 statewide total. The fishing grounds are nearshore areas from San Pedro to Point Conception, and around the Channel Islands. Port Hueneme was the most important southern California fishing port for market squid during 1996; San Pedro and Ventura accounted for most of the remainder. In contrast, the smaller northern and central California fishery takes place from spring through fall. Nearly all market squid in the northern fishery are landed in Monterey or Moss Landing.

Historically, market squid catches have fluctuated greatly and have been difficult to predict. Such extreme fluctuations are characteristic of a fishery that is dependent on each year's recruitment of short-lived, highly

fecund animals. The market squid fishery in California has traditionally been open-access and is largely unregulated by the CDFG, except for weekend closures in the Monterey area. Consequently, purse seine vessels from Alaska, Washington, and Oregon that may have been displaced from salmon fisheries have moved into the expanding southern California squid fishery in recent years, prompting some resident squid fishermen to press for limited-entry regulations. In 1996 several bills were introduced in the state legislature to establish market squid management and provisions for limited entry. But no major management changes were enacted by year's end.

Price paid to fishermen remained steady during the first half of 1996, averaging between \$240 and \$280 per t. Price per t increased later in the year to \$306 in August and \$356 in November. In December, mean ex-vessel price rose to \$602. Monthly landings in December reached a high for 1996 of 21,900 t, generating nearly \$12 million in ex-vessel revenue. As in previous years, most squid was exported either in frozen blocks or in canned form for human consumption. Developing markets for squid continued to increase demand, particularly in China, Europe, and Japan.

## SEA URCHIN

The 1996 statewide red sea urchin (*Strongylocentrotus franciscanus*) catch was 9,105 metric tons, with an ex-vessel value of \$18.8 million. Catch was down 11%, and value was down 15% from the previous year. The number of dive permits renewed in 1996 declined by 9%, to 502. The other commercially fished sea urchin in California, the purple sea urchin (*Strongylocentrotus purpuratus*), accounted for 25 t in 1996, compared to 37 t in 1995.

Red sea urchin landings in southern California, south of the sea otter's range, fell by 8.3% from 1995, to 7,368 t, the lowest level since the El Niño-influenced year of 1984. Underlying this continuing decline was a steep drop in landings from the northern Channel Islands. In 1991, these islands produced about 7,000 t, representing over 60% of the southern California catch. By 1995, they produced only 25% of the 8,035-t catch. A shift in effort to the other Channel Islands, notably San Clemente Island, contributed to this decline. The distribution of landings among the mainland ports through time also reflects this shift. Preliminary 1996 landings data showed a decline of almost 500 t at the more northerly ports in the Oxnard-Ventura area. However, unlike 1995, landings at more southerly ports in the Los Angeles and San Diego areas did not increase.

The situation in northern California is equally bleak, as landings fell by 21% from 1995's catch to 1,737 t—the lowest level since the fishery began there in 1985. Modeling results suggest that most of the northern California sea urchin fishery areas are overfished. A sluggish

Japanese economy and competition from foreign sea urchin fisheries have combined to keep ex-vessel prices flat or depressed, particularly in northern California. The 1996 average ex-vessel price in northern California was \$0.77 per pound, compared to \$0.96 per pound in 1994. Catch-per-receipt and catch-per-diver-hour indices have remained stable in northern California since dropping by almost 50% between 1992 and 1993. In 1996, catch per diver-hour was 121 kg/hr. Despite this recent stability, the number of urchin permittees who devote their entire fishing time to northern California waters has declined from 85 in 1994 to just 69 in 1995 (statewide, there were 551 permittees in 1995).

### GROUND FISH

The California commercial groundfish harvest for 1996 was 27,820 metric tons, with an ex-vessel value of approximately \$34 million. Total landings decreased by 4%, or 1,139 t, from 1995. Dover sole (*Microstomus pacificus*), thornyheads (*Sebastolobus* spp.), sablefish (*Anoplopoma fimbria*), rockfish (*Sebastes* spp.), and Pacific whiting (*Merluccius productus*) were the principal species harvested. Landings remained relatively steady in spite of restrictive Washington-Oregon-California (WOC) area landing regulations. Increased landings in some categories such as grenadier, other rockfish, English sole, and petrale sole were offset by decreases in bocaccio rockfish, widow rockfish, and Pacific whiting (table 3).

Most of the groundfish landed in California (83%) were taken with bottom trawl and midwater trawl gear. This is a slight decrease from the proportion landed by this gear in 1995 (85%). Line gear was used for 15% of the landings. This proportion is higher than in 1995 (11%), but below the highest proportion to date (18% in the 1992 season). Groundfish landings from gill and

trammel net gear (1%) have declined continuously since 1993 (5%), while the proportion of landings taken by trap gear has remained steady at just over 1%.

The license limitation program that the Pacific Fishery Management Council (PFMC) implemented in 1994 continued in 1996. Annual harvest guidelines were again allocated between a permitted limited-entry (LE) fleet and nonpermitted open-access (OA) fleet, and separate trip limits were established for each geographical area. The PFMC harvest guidelines affected the California fishery for Dover sole, shortspine thornyhead (*Sebastolobus alascanus*), longspine thornyhead (*Sebastolobus altivelis*), sablefish, the *Sebastes* complex, widow rockfish (*Sebastes entomelas*), bocaccio rockfish (*S. paucispinis*), yellowtail rockfish (*S. flavidus*), canary rockfish (*S. pinniger*), lingcod (*Ophiodon elongatus*), and Pacific whiting. The PFMC continued to use cumulative landing limits and trip limits to provide a year-round groundfish fishery while staying within the annual harvest guideline. Two-month cumulative landing limits were established for most of the limited-entry fishery.

This was the final year of a three-year Pacific whiting allocation plan that reserves 40% of the annual harvest guideline for shore-based processing after the first 60% has been taken in open competition between at-sea and shore-based components. At-sea processing of whiting was again restricted to waters north of California. The 1996 WOC-area harvest of 197,456 t was near the 212,000-t harvest guideline. California's shoreside whiting fishery landed and processed 2,901 t, a 29% decline from 1995 landings. Five midwater trawl vessels, fishing off Eureka and Crescent City, landed over 99% of California's catch.

A whiting observation program, established in 1993 to monitor the bycatch of salmon and other species in the shoreside landings, documented 0.008 salmon per metric ton of Pacific whiting. This represented a sharp decrease from the bycatch observed last year (0.017 salmon per t). All salmon observed were chinook (*Oncorhynchus tshawytscha*). The non-salmon bycatch rate in observed landings declined to 5.2 lb/t from 28.8 lb/t during 1995.

Dover sole, longspine thornyhead, shortspine thornyhead, and trawl-caught sablefish (the DTS complex) management was similar to that carried out in 1995. The PFMC also imposed two-month cumulative limits of 70,000 pounds for the DTS complex in the area north of Cape Mendocino, and 100,000 pounds in the area south of Cape Mendocino. Thornyhead landings were further restricted to 20,000 pounds within the overall DTS two-month limits, of which no more than 4,000 pounds could be shortspine thornyhead. Trawl-caught sablefish was limited to 12,000 pounds per period. These limits remained in effect throughout 1996. To reduce Dover sole landings in the Columbia area, the PFMC

TABLE 3  
 California 1996 Groundfish Landings (Metric Tons)

Species	1995	1996	Percent change
Dover sole	6,043	6,379	6
English sole	499	585	17
Petrале sole	593	817	38
Rex sole	691	502	-27
Other flatfish	1,253	995	-21
Widow rockfish	1,712	1,060	-38
Bocaccio	785	478	-39
Other rockfish	5,902	5,922	7
Thornyhead	3,609	3,270	-9
Lingcod	538	477	-11
Sablefish	2,716	3,172	17
Pacific whiting	4,091	2,901	-29
Grenadier*		1,133	
Other groundfish	527	129	-76
Total	28,959	27,820	-4

\*Grenadier landings were reported previously in the "other groundfish" category.

established a 38,000-pound, two-month limit for the area north of Cape Mendocino effective July 1.

The coastwide catch of Dover sole was 12,129 t, an increase of 1,585 t from 1995 landings and higher than the 1996 11,050-t harvest guideline. California's 1996 landings (6,379 t) represented a 6% increase over last year's total and were 53% of total WOC Dover sole landings, compared with last year's 57% share.

The longspine harvest guideline for 1996 remained at 6,000 t, and the shortspine thornyhead harvest guideline at 1,500 t. Total WOC-area landings of longspine thornyhead were 4,813 t; shortspine landings were 1,705 t. Shortspine landings exceeded the harvest guideline by 12%. California fishermen landed 3,270 t, or 50% of the total WOC thornyhead catch.

The total nontribal, WOC-area catch of sablefish (LE trawl, LE nontrawl, and OA) in 1996 was 8,226 t, 426 t over the combined LE/OA 7,800-t harvest guidelines. California fishermen accounted for 3,172 t, or 38% of the total WOC-area nontribal catch. The LE trawl sablefish allocation (3,803 t) was unchanged from 1995. WOC-area trawl sablefish landings were 4,126 t, about 8% over the harvest guideline. California trawl vessels landed 1,445 t, or about 35% of the WOC-area trawl landings.

The nontrawl LE sablefish fishery, except for the derby and mop-up fisheries, was again managed under a daily limit of 300 pounds north of 36°N latitude and 350 pounds south of 36°N. The LE derby opening date was moved from early August to September 1. The fishery, open for only five days, captured 2,381 t, or about 87% of the LE 2,754-t nontrawl allocation. The remainder of the allocation was used by the daily-trip-limit fishery and a cumulative-vessel-limit mop-up fishery following the derby. Total WOC area LE fixed-gear landings of 3,432 t were about 25% higher than the LE nontrawl allocation. California fishermen landed 1,231 t, or 36%, of the WOC, LE nontrawl sablefish harvest.

The OA sablefish fishery, under a daily trip limit of 300 pounds north of 36°N and 350 pounds south of 36°N, landed approximately 668 t, exceeding the 463-t open-access harvest guideline by 44%. California fishermen landed 496 t of the total WOC harvest.

On January 1, LE two-month cumulative limits were set at 200,000 pounds south of Cape Mendocino and 100,000 pounds north to Cape Lookout, Oregon, for the *Sebastes* complex (including yellowtail, canary, and bocaccio rockfishes, and excluding widow rockfish and shortbelly rockfish). Within the 200,000-pound limit, no more than 60,000 pounds could be bocaccio rockfish and no more than 18,000 pounds could be canary rockfish. Within the 100,000-pound limit, no more than 70,000 pounds could be yellowtail rockfish and no more than 18,000 pounds could be canary rockfish.

The OA cumulative limit was set at 40,000 pounds per month, and no more than 10,000 pounds per trip were authorized for line and pot gear. Bocaccio, yellowtail, and canary rockfish monthly limits were 50% of the two-month LE limits. California's *Sebastes* complex landings dropped from 8,863 t in 1992 to 6,293 t in 1994. In 1995, total landings increased to 6,687 t, but dropped again in 1996 to 6,400 t. The 1996 *Sebastes* complex harvest included 478 t of bocaccio, a 39% drop from 1995 landings (785 t).

The widow rockfish harvest guideline (6,500 t) remained unchanged from 1995, with a two-month cumulative limit set at 70,000 pounds. This continued in effect until September 1, when the limit was reduced to 50,000 pounds. The total 1996 catch in the WOC area (5,571 t) was 929 t below the harvest guideline. California landings of 1,060 t constituted 19% of the WOC total.

The lingcod WOC-area harvest guideline remained unchanged, at 2,400 t. The PFMC allotted 900 t within this guideline for recreational fisheries. The 22-inch size limit remained in effect for 1996, but trawlers were given a 100-pound allowance for fish under 22 inches. A two-month cumulative limit of 40,000 pounds for all commercial gear was in effect through 1996. Total WOC-area commercial lingcod landings (1,556 t) were slightly over the 1,500-t commercial allocation. California commercial fishermen landed 477 t, or 31%, of the WOC-area commercial allotment.

In 1997, the PFMC will consider (1) a capacity-reduction program for the groundfish industry, (2) the appropriateness of using  $F_{35\%}$  as the proxy for maximum sustainable yield, and (3) amendments to provisions required by the Magnuson-Stevens Fishery Conservation and Management Act. The PFMC will also reassess widow rockfish, chilipepper rockfish, lingcod, Pacific whiting, and all four components of the DTS complex as a preliminary step in reevaluating harvest guidelines for 1998.

## SWORDFISH AND SHARKS

Swordfish (*Xiphias gladius*) landings were 714 metric tons in 1996, 10% less than in 1995 (table 4). During the past decade the drift gill net fishery accounted for most of the catch. This year, 70% of the catch was taken with drift gill nets, up from last year's 65%. Longline landings constituted 22% of the catch. Fourteen vessels used longline gear outside the U.S. Exclusive Economic Zone (EEZ) and landed swordfish in southern California ports in 1996, but only three were based in California. As usual, harpoon landings constituted 8% of the catch. Fifty-seven percent of the swordfish catch was landed in southern California ports.

Gear type affected swordfish ex-vessel prices; typically, fishermen landing drift gill net-caught swordfish

TABLE 4  
 Landings of Swordfish and  
 Selected Shark Species (Metric Tons)

	Swordfish	Common thresher shark	Shortfin mako shark
1986	1,749	276	215
1987	1,246	239	274
1988	1,129	250	222
1989	1,296	295	177
1990	851	210	262
1991	711	344	151
1992	1,068	179	97
1993	1,218	162	84
1994	1,165	194	88
1995	796	155	66
1996*	714	179	64

\*Preliminary

received \$3.00 to \$5.50 per pound, whereas longline-caught fish commanded only \$2.00 to \$4.00 per pound. Fishermen landing harpoon-caught swordfish received the highest prices: \$4.00 to \$6.50 per pound.

Landings of common thresher shark (*Alopias vulpinus*) increased by 15%, ending a decade-long trend of decline. Thresher shark (*Alopias* spp.) are taken primarily with drift gill nets (73%), followed by set gill nets (17%), and assorted other gears (10%). Most landings (87%) continued to be made in southern California. Typically, ex-vessel price varied from \$1.00 to \$2.00 per pound, with an average of \$1.50.

Shortfin mako shark (*Isurus oxyrinchus*) landings in 1996 were 64 t (table 4), a decrease of 2%. Most of the catch (83%) was landed in southern California ports, at ex-vessel prices between \$0.50 and \$1.75 per pound, with an average of \$1.25. Mako sharks are caught primarily by the drift gill net fishery (85%). The remainder of the catch was landed with set gill nets (5%), hook and line gear (4%), longline vessels operating outside the EEZ (4%), and as incidental catch with other gears (2%).

#### LIVE-FISH FISHERY

The 1996 statewide landings for live fish were estimated at 562 metric tons, 25% more than in 1995 (table 5).

TABLE 5  
 Preliminary 1996 Landings of Live Fish (Metric Tons)

	Southern California	Northern California
Rockfish	132	65
Cabazon	92	13
California sheephead	89	<1
California halibut	65	<1
Lingcod	20	16
Thornyhead	27	<1
All others	35	6
Total	460	102

Sixty-six fish species were landed in live form and had an ex-vessel value of over \$3.6 million. Field observations indicate that the documented landings underestimate the activity of this fishery. In addition, there is a new market for premium quality fresh fish (dead), which allows fishermen to sell their dead catch along with their live counterparts for virtually the same price. Future reviews will report on all premium quality landings in an attempt to more accurately describe the current demand for nearshore finfish species.

Ex-vessel prices averaged between \$2.00 and \$9.00 per pound. Larger fish previously sold at considerably reduced prices but are now gaining popularity as "large party" specialties at local restaurants. Prices fluctuated with market demand, fish size, fish condition, and weather conditions. Hook and line gear was used to capture 63% of the live fish landed statewide; trap gear landed 22%. These values are consistent with those from 1995.

Live-fish landings in southern California (Morro Bay southward) totaled 460 t, 22% more than in 1994. Target species for all gear types included California sheephead (*Semicossyphus pulcher*), California halibut (*Paralichthys californicus*), cabazon (*Scorpaenichthys marmoratus*), California scorpionfish (*Scorpaena guttata*), rockfishes (*Sebastes* spp.) and thornyheads (*Sebastolobus* spp.). Most of the 1996 catch was taken with hook and line (56%) and trap (26%) gears. Trapping accounted for 81% of all live California sheephead taken. Catches of these fish increased dramatically again this year: 323% for sablefish, 172% for thornyheads, 95% for cabazon, 50% for gopher rockfish (11% for the entire rockfish group), and 44% for lingcod. Grass rockfish was the only species with decreased landings (16%), and the California sheephead catch was virtually the same as last year. Live California halibut were caught with trawl and net gear and kept alive to ensure optimum freshness, then bled, iced, and quickly shipped overseas. Eighty percent of all live landings were delivered to Morro Bay and Santa Barbara/Ventura.

Live-fish landings in northern California (north of Morro Bay) totaled 102 t, 42% more than in 1994. Most landings (98%) were made by hook and line vessels employing vertical, horizontal, and troll longlines to harvest primarily rockfish along nearshore rocky reefs and offshore banks. Fishing pressure for these nearshore rockfish species continued to be intense, with landings increasing by 28% from the previous year. Principal species caught were gopher (*Sebastes carnatus*), China (*S. nebulosus*), and brown (*S. auriculatus*) rockfishes. Another notable landing increase from 1995 was cabazon (33%).

A total of 277 finfish trapping permits were sold in 1996 through the limited-entry program effective south of Point Arguello, Santa Barbara County.



## ABALONE

Commercial landings for the red abalone were estimated at 75 metric tons during 1996, down from 1995 landings of 111 t. Four species (pink, green, white, and black abalone) are now prohibited from harvest throughout California. At the end of 1996, recreational fishery groups proposed a closure of recreational and commercial red abalone fisheries in waters south of San Francisco. This proposal will be considered by the Fish and Game Commission in 1997.

Abalone resources have declined to record lows since the present fishery was established in the early 1900s. The black abalone fishery was closed in 1993 because withering syndrome (WS) was causing mass mortalities throughout the black abalone range in California and Mexico. The closure was initiated to allow the potential development of natural resistance to WS, an unknown pathogen at that time. This strategy appears to have worked: researchers are finding continued black abalone recruitment and a few old, large individuals in some areas where WS was virulent. Future studies are planned to document persistence, and, it is hoped, the recovery process of some black abalone populations. Withering syndrome itself came under considerable study in 1996, and researchers are confident that the pathogen has been identified. Pathological studies of this rickettsial-like procaryote (RLP) are continuing.

Green abalone populations are also low in many parts of southern California. Green abalone have also been found to have symptoms of WS. This species' habitat overlaps that of black abalone. Researchers have observed large numbers of shells from abalone that appeared to have died in place. (Normally, shells are not left by human harvesters, so excessive numbers can indicate unusual natural mortality.)

Pink abalone inhabit subtidal areas to over 30-m depth. Withering syndrome is also known to occur in this species, but it appears not to have been as virulent as in other species. The broad depth distribution and low density of pink abalone may have reduced the spread of WS. This species' broad bathymetric and geographic distribution, as well as some areas of limited abundance at several Channel Islands locations may increase the probability that pink abalone may be the best candidate for natural recovery of the species now prohibited from harvest.

The white abalone population is at an exceedingly low level. Diving surveys covering about three hectares of habitat over a several-year period found only five individuals, a density far below that necessary to assure successful reproduction. Surveys from the research submersible *Delta* at Anacapa and Santa Cruz Islands, also covering about three hectares, found only five white abalone in depths deeper than 50 m. More surveys are planned in other areas during 1997. This species may be

a candidate for listing under the federal or California Endangered Species Acts.

Red abalone populations and the fishery have been spatially compressed in southern California. The red abalone is adapted to cooler water, maintaining its populations in locations where there is frequent upwelling or in areas influenced by cool, southerly-flowing currents. Populations in former locations such as the San Diego-La Jolla kelp beds and the Palos Verdes Peninsula have been adversely affected by ENSO conditions, reduced kelp availability, competition, and intensive harvest. These conditions also affect the remaining areas of red abalone harvest (e.g., around Point Conception and San Miguel Island). Concentrated fishery effort in these few remaining "productive" areas has raised concern for further protecting these stocks as a source of recruitment to other formerly productive areas.

## SEA CUCUMBER

Statewide, sea cucumber landings were 376 metric tons in 1996, an increase of 108 t over 1995 landings (figure 2). This was the largest harvest of sea cucumbers in California since landings were first recorded in 1978. Much of the increase was due to a substantial increase in the numbers taken by divers. Commercial trawlers in southern California primarily harvested the giant red sea cucumber (*Parastichopus californicus*); divers harvested warty sea cucumbers (*P. parvimensis*) almost exclusively. The catch comprised 176 t of diver-harvested sea cucumber and 200 t taken by trawl vessel.

Most of the sea cucumbers were landed in the ports of Terminal Island, Ventura Harbor, and Santa Barbara Harbor. The main fishing grounds for the giant red sea cucumber were the Santa Barbara Channel and the Santa Catalina Channel at depths of 30 to 90 fm. The warty sea cucumber was harvested as far south as San Diego, but most of the harvest came from waters off the four northern Channel Islands at depths of 6 to 20 fm.

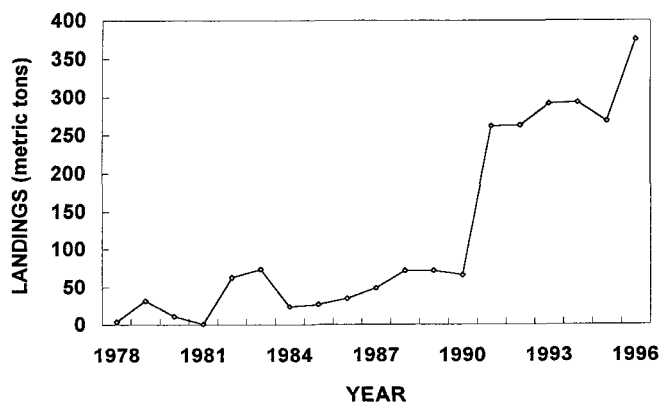


Figure 2. Commercial landings of sea cucumbers in California, 1978-96.

The average price for both warty and giant red sea cucumbers was \$0.70 per pound and ranged from \$0.40 to \$1.20 per pound. Most of the sea cucumbers were dried and exported to Korea, Hong Kong, Taiwan, and mainland China. The end product, called *trepang*, can sell for \$20 or more per pound. A small portion of the landings was distributed and sold within the United States.

The sea cucumber fishery began in California near Los Angeles around 1978, and averaged under 15 t annually until 1982, when a trawl fishery developed near Santa Barbara. During the next ten years, annual landings increased gradually. In 1991, an influx of trawlers, predominately out of the Los Angeles port area, greatly expanded the fishing effort and catch. From 1991 through 1996, landings exceeded 260 t. Since the 1992–93 season, the sea cucumber fishery has been a limited-entry fishery based on a previous minimum landing of 50 pounds. There were 129 sea cucumber permittees in 1996. Landing receipt data indicate that 84 permittees on 23 trawlers and 43 dive boats participated in the fishery during 1996.

Warty sea cucumbers inhabit the ocean bottom from the intertidal zone to 27 meters, and range from Monterey Bay to Baja California. The species is uncommon north of Point Conception. Giant red sea cucumbers inhabit the subtidal zone out to 90 meters, and range from the eastern Gulf of Alaska to Baja California. Both species feed on surface organic nutrients from mud, sand, and detritus. Warty sea cucumbers migrate annually between their shallow- and deep-water depth limits. Fishermen claim that giant red sea cucumbers make similar, large-scale movements over varying depth ranges, but this has not been verified by research.

Sea cucumbers have a short life span, low age of maturity, sporadic recruitment, and high natural mortality. Species with these characteristics can be vulnerable to overfishing, but it is expected that the southern California populations of warty and giant red sea cucumber can sustain current harvest levels, thanks to the effort-limiting permit restrictions placed upon the fishery.

## DUNGENESS CRAB

California Dungeness crab (*Cancer magister*) landings during the 1995–96 season totaled 6,861 metric tons, an increase of 930 t over the previous season, well above the ten-year average of 4,348 t.

In northern California, the crab season opened on December 1, and fishing commenced on December 5 after a price settlement of \$1.25 per pound. Initial catches were very good; however, dealers terminated market orders on December 8 because of soft market conditions. On January 1, crab fishermen settled for a renegotiated price of \$1.15 per pound. A fleet of 509 vessels landed approximately 5,935 t at Crescent City, Trinidad,

Eureka, and Fort Bragg. Crescent City accounted for 3,673 t, followed by Eureka (1,520 t), Trinidad (588 t), and Fort Bragg (154 t).

San Francisco-area Dungeness crab fishing opened on November 15, with fishermen agreeing to a price of \$1.50 per pound. Total landings decreased by 445 t from the previous season, to 859 t. Crab fishermen landed 318 t at Bodega Bay and 541 t at ports in San Francisco Bay. Monterey and Morro Bay contributed 67 t to the statewide landings.

The Sustainable Fisheries Act, an amended version of the Magnuson Act authorized in October 1996, gave the states of Washington, Oregon, and California regulatory authority over their crab fisheries out to 200 miles, excluding any crab fishery limited-entry restrictions. The act also encouraged the development of a federal fishery management plan (FMP) for Dungeness crab to be completed by 1999. Not later than December 1, 1997, the Pacific Fisheries Management Council shall provide a report to the Committee on Commerce, Science, and Transportation of the Senate, and to the Committee on Resources of the House of Representatives describing progress in developing the FMP.

## CALIFORNIA SPINY LOBSTER

The fishery for California spiny lobster (*Panulirus interruptus*) is one of California's oldest; catch records date from the late 1800s. Total landings for the 1995–96 season (first Wednesday in October through the first Wednesday after March 15) were 265 metric tons. This total is 13% greater than the 1994–95 season total of 238 t. Landings have generally increased since 1974–75, reaching a peak of 332 t in 1989–90. The average for the past ten seasons is 259 t.

Landings typically are highest early in the season. In the 1995–96 season 67% of the landings were made during the first two months, 12% in December, and the remaining 20% from January through March. Ports in San Diego County received 40% of the total landings; the remainder was equally divided between Los Angeles–Orange and Santa Barbara–Ventura counties. The coastal waters off Orange and San Diego counties are the most heavily fished and produced the highest capture-per-trap ratios.

There was a moratorium on new (additional) lobster operator permits for the season. The Fish and Game Commission has directed the CDFG to meet with the California Lobster and Trapfishermen's Association to develop proposals for a formal limited-entry lobster fishery. For the 1995–96 season only 366 lobster operator permits were issued by the CDFG, 97 fewer than for the previous season.

Ex-vessel price ranged from \$6.50 to \$10.00 per pound, and averaged \$7.50 per pound. The season's catch

was worth approximately \$4.4 million to the fishermen. A robust export market to Asian destinations has created increased demand and higher prices for California spiny lobsters. Consequently, high retail prices have nearly curtailed local consumption. A plentiful market exists for lower-priced Mexican product and East Coast American lobster.

### SPOT AND RIDGEBACK PRAWN

The 1996 prawn fishery landings totaled 511 metric tons, a 39% increase from the 368 t landed in 1995. Approximately 419 t were landed in southern California ports, and 92 t in central/northern California ports. The statewide total is a combination of landings for two commercially important species of prawn: ridgeback prawn (*Sicyonia ingentis*) and spot prawn (*Pandalus platyceros*). Ridgeback prawn landings accounted for 54% (275.5 t) of the statewide total, and spot prawn landings accounted for 46% (235.5 t). Landings for both species increased in 1996: ridgeback prawn by 46% and spot prawn by 32%. All but 0.5 t of the ridgeback prawn landings were made in southern California ports. The spot prawn fishery was more widespread, with 144 t landed in southern California ports and 91.5 t in central/northern California.

Sixty-one vessels (48 trawl and 13 trap) landed most (84%) of the southern California combined-species catch at Santa Barbara area ports. Los Angeles area ports accounted for 12%, captured by 14 trawl and 19 trap vessels. Nineteen San Diego area vessels (2 trawl and 17 trap) landed the remaining 4% of the southern California total. Twelve San Francisco Bay area vessels (6 trawl and 6 trap) landed 60% of the central/northern California catch. Monterey Bay area vessels (12 trawl and 5 trap) landed 34%, with Eureka/Fort Bragg area vessels (2 trawl and 1 trap) landing 6% of the central/northern California total.

Spot prawn landings commanded the higher ex-vessel prices, averaging \$6.77 per pound (\$8.45 per pound for live and \$5.58 per pound for dead prawns). Average ex-vessel prices increased by \$0.52 per pound over the 1995 value of \$6.25 per pound. The average ex-vessel price for ridgeback prawn landings was \$1.33 per pound (\$1.73 per pound for live and \$1.20 per pound for dead prawns), a \$0.17 rise from the 1995 price.

The San Francisco Bay area spot prawn fishery grew phenomenally in 1996 to an annual catch of 55.5 t, compared with a ten-year (1986–95) mean annual harvest of only 0.2 t. A major reason for the increased landings was an influx of trawl vessels to participate in the lucrative live-prawn fishery. Several of these shrimp vessels came from the Santa Barbara area and at least two from out of state. During August alone, two of these shrimp trawlers landed approximately 5.5 t—more than the catch for the previous ten years. Market receipt data revealed

that approximately 70% of the San Francisco Bay area spot prawns were landed live.

Regulation changes implemented in 1995 continued for the 1996 period. The Fish and Game Commission continued to allow the use of Fathom Plus traps. Additionally, Fish and Game Code Section 8842, which expired on April 1, 1997, was extended until April 1, 1999. This statute regulates the use of trawl nets for taking shrimp or prawns.

### OCEAN SALMON

In 1996, the Pacific Fishery Management Council (PFMC) again enacted restrictive commercial and recreational ocean salmon regulations in California to (1) protect endangered chinook (*Oncorhynchus tshawytscha*) stocks—Sacramento River winter chinook and Snake River fall chinook, (2) ensure fall chinook spawner escapement goals for Klamath, Sacramento, and Oregon coastal rivers, and (3) protect depressed coho (*Oncorhynchus kisutch*) stocks coastwide. The regulations included increased minimum size limits, reduced seasons, and specific gear restrictions for the area between Horse Mountain and Point Conception. Under authority of the Endangered Species Act, NMFS required the PFMC to take specific action to reduce harvest impacts on the endangered Sacramento River winter chinook to increase the stock's spawning escapement by 35%.

In 1996, commercial fishing for ocean salmon in California was allowed everywhere except between Humboldt South Jetty and Horse Mountain, with various time and area closures (May 1–September 30). The minimum size limit was 26 inches through June 30, and 27 inches thereafter. Approximately 1,773 metric tons (365,300 fish) of dressed chinook were landed by commercial trollers, who fished approximately 19,900 days during 1996. Ex-vessel prices for dressed salmon averaged \$1.44 per pound, and total ex-vessel value exceeded \$5.6 million. Commercial fishing for coho salmon was not allowed in 1996.

Recreational fishing regulations in California were more restrictive than in 1995, with various time and area closures enacted (February 17–November 17). The fishing season south of Point San Pedro was shortened by more than two months (March 2–August 25) compared to 1995. Sport anglers could not retain coho salmon at any time during 1996. In the Klamath Management Zone (KMZ: Horse Mountain, California, to Humboldt Mountain, Oregon) season management, rather than quotas, was enacted for the first time since 1991 because of improved chinook abundance in the fall. Statewide, recreational landings were less than half those of the previous year, but still totaled 164,200 chinook during 225,400 angler trips (CPUE: 0.73 fish/angler). Most salmon were caught south of the KMZ, where sport

anglers landed 153,300 chinook during 200,000 trips on CPFVs and private skiffs. Anglers were limited to two salmon per day, with a minimum size limit of 24 inches (total length) through July 1 and 26 inches thereafter, except in state waters (0–3 miles), where the 26-inch limit was not enacted until July 15.

In the KMZ, two separate seasons were provided: May 12–July 7 and August 18–September 21. The bag limit was one salmon per day and no more than four fish in seven consecutive days; a 20-inch size limit was in effect north of Horse Mountain. In the California portion of KMZ, anglers landed 10,800 chinook during 25,500 trips made primarily on private skiffs.

### WHITE SEABASS

White seabass (*Atractoscion nobilis*) has been an important commercial and recreational species for more than a century. In 1959, more than 1,556 metric tons were landed commercially. Since then landings have decreased substantially (figure 3). Prior to 1982, Mexican waters often supplied much of the catch. Since 1982, U.S. fishermen have been unable to obtain fishing permits for Mexican waters, and less than 1% of the total catch per year since then has been reported from Mexico. Commercial landings of white seabass since 1987 have averaged 50 t. White seabass landings in 1996 were 43 t, a 30% increase over 1995.

Nearshore gill nets have taken the bulk of the commercial catch since purse seine nets became uneconomical in the 1920s. Set and drift gill nets are generally deployed in shallow waters along the mainland coast and around offshore islands. The Marine Resources Protection Act of 1990 restricted the use of gill nets inside three miles along the mainland coast south of Point Arguello and around the Channel Islands. After January 1, 1994, gill nets were prohibited inside those areas. In 1996, 19 commercial vessels expended 258 days of gill net effort to

take white seabass. That compares to 912 days fished in 1992, 700 in 1993, 326 in 1994, and 261 days in 1995. The primary gear was 6.5-inch multifilament drift gill net. In 1996, drift gill nets accounted for 65% of the total pounds landed; set gill nets and hook and line gear each captured 16%. The average ex-vessel value for white seabass in 1996 was \$2.00 per pound.

Commercial landings in June and July accounted for 71% of the year's catch. Gill net log information indicates that most of the nets were fished offshore of San Diego County and around the Channel Islands. Although small populations of white seabass are known to occur around Santa Cruz and Morro Bay, less than 2% of the catch in 1996 was reported to be landed north of Point Conception.

Recreational catches reported from fishing logs for commercial passenger fishing vessels (CPFVs) have also decreased over time (figure 4). An average of 1,970 white seabass has been taken per year since 1987 by recreational anglers on CPFVs. In 1996, 1,605 fish were reported.

In 1983, the Ocean Resources Enhancement and Hatchery Program was created by the California legislature to promote basic and applied research into the artificial propagation of adversely affected marine fish species important to commercial and recreational fishing in southern California. In 1995, the California Marine Hatchery Institute in Carlsbad began producing young white seabass for eventual release into the ocean. Fish are raised to approximately three inches at the hatchery, then transferred to grow-out pens in marinas and harbors from San Diego to Santa Barbara. When the fish reach nine inches, 10% are tagged with external tags and released. All fish are injected with coded-wire tags before leaving the hatchery. Tag returns will provide information for assessing whether the hatchery is successful in significantly augmenting white seabass stocks in California waters.

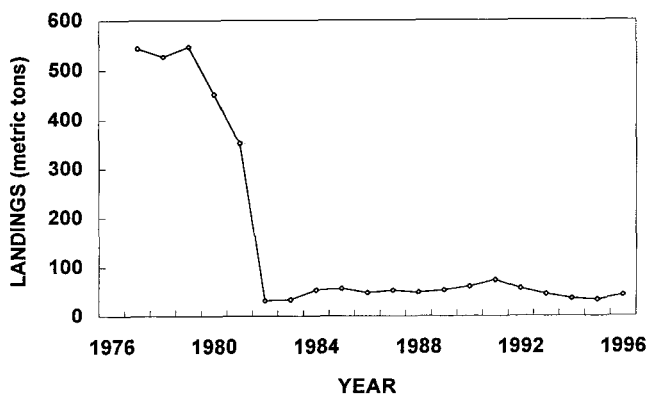


Figure 3. Commercial landings of white seabass in California (California and Mexican waters catch combined), 1977–96.

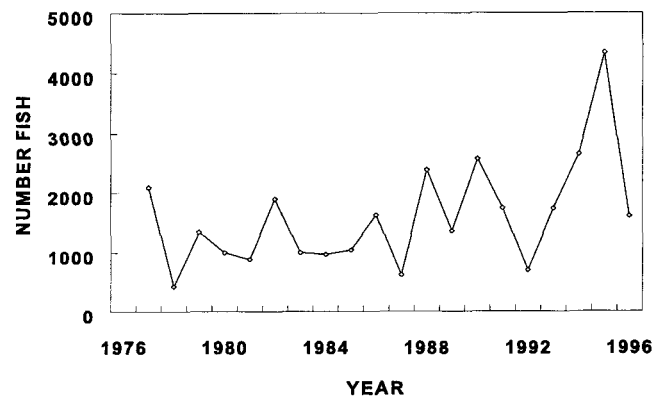


Figure 4. Numbers of white seabass reported caught by California commercial passenger fishing vessels, 1977–96 (California and Mexican waters).

## RECREATIONAL FISHERY

### Southern California

Southern California's large marine recreational fishery includes private recreational boat, beach-and-bank, pier, and CPFV modes. Approximately 40% of California's marine recreational landings come from CPFVs. In southern California and Baja California, traditional CPFV target species include California barracuda (*Sphyræna argentea*), barred sand bass (*Paralabrax nebulifer*), bluefin tuna (*Thunnus thynnus*), Pacific bonito (*Sarda chiliensis*), halfmoon (*Medialuna californiensis*), California halibut (*Paralichthys californicus*), kelp bass (*Paralabrax clathratus*), Pacific mackerel (*Scomber japonicus*), rockfishes (*Sebastes* spp.), spotted scorpionfish (*Scorpaena guttata*), California sheephead (*Semicossyphus pulcher*), skipjack tuna (*Euthynnus pelamis*), wahoo (*Acanthocybium solanderi*), ocean whitefish (*Caulolatilus princeps*), white seabass (*Atractoscion nobilis*), yellowfin tuna (*Thunnus alalunga*), and yellowtail (*Seriola lalandi*).

In 1996, 2,556,372 fish were landed south of Point Conception by CPFV anglers (table 6). Southern California CPFV catch represented 77% of the 3,294,935 fish landed statewide. Reported CPFV landings increased

17% in southern California, while increasing 5% statewide. Angler participation on CPFVs increased both statewide (1%) and in southern California (8%) in 1996. Approximately 494,091 CPFV anglers fished off southern California, representing 78% of statewide participation (632,236) for 1996.

The top ten ranking species comprised 93% of total landings by CPFV anglers in southern California (table 6). Barred sand bass dominated the landings in southern California, with reported catch increasing 72% from 1995. Approximately half of all barred sand bass were caught in the Huntington Flats area adjacent to Huntington Beach and Newport Beach. Rockfish landings increased 12% in 1996, but rockfishes dropped in relative importance from first to second rank for the first time in many years. Pacific mackerel reversed a recent downward trend, increasing 23%. Kelp bass returned to fourth rank in 1996. California barracuda dropped from third to fifth rank in relative importance. Spotted scorpionfish landings increased 27%. Ocean whitefish, primarily targeted on rockfish trips, dropped in importance to rank seven. Pacific bonito landings increased 82%, moving this species from rank eleven to eight. Yellowfin tuna landings were down. Yellowtail landings increased

TABLE 6  
 Southern California CPFV Landings (Number of Fish) in 1996 and 1995

Species/species group	1996 landings		1995 landings		Percent change
	Number	Rank	Number	Rank	
Barred sand bass	604,132	1	350,539	2	+72
Rockfishes, unspecified	455,040	2	407,678	1	+12
Pacific mackerel	329,146	3	267,731	4	+23
Kelp bass	282,673	4	231,687	5	+22
California barracuda	271,856	5	326,792	3	-17
Spotted scorpionfish	119,492	6	94,398	7	+27
Ocean whitefish	108,282	7	133,655	6	-19
Pacific bonito	72,664	8	39,995	11	+82
Yellowfin tuna	72,449	9	87,347	8	-17
Yellowtail	66,763	10	29,445	12	+127
Halfmoon	43,555	11	54,656	9	-20
White croaker	25,654	12	16,916	14	+52
California sheephead	23,450	13	23,735	13	-1
Dolphinfish	21,939	14	5,022	20	+337
Flatfishes, unspecified	11,052	15	4,664	22	+137
Lingcod	6,970	16	4,823	21	+45
Skipjack tuna	6,356	17	43,043	10	-85
California halibut	5,829	18	5,681	18	+3
Jack mackerel	5,403	19	5,330	19	+1
Blacksmith	4,926	20	3,150	24	+56
Wahoo	3,680	21	5,733	17	-36
Bluefin tuna	2,477	22	14,646	15	-83
Cabezon	1,501	23	769	26	+95
White seabass	1,448	24	4,264	23	-66
All others	9,635	—	26,064	—	—
Total number of fishes	2,556,372		2,187,763		+17
Number of anglers	494,091		455,545		+8
Reporting CPFVs	208		205		+1

TABLE 7  
 Central and Northern California CPFV Landings (Number of Fish) in 1996 and 1995

Species/species group	1996 landings		1995 landings		Percent change
	Number	Rank	Number	Rank	
Rockfishes, unspecified	621,070	1	767,313	1	-19
King salmon (chinook)	60,650	2	124,489	2	-51
Lingcod	22,764	3	25,719	3	-11
California halibut	13,263	4	13,664	4	-3
Striped bass	6,096	5	3,102	6	+49
Pacific mackerel	6,094	6	3,419	5	+44
Flatfishes, unspecified	2,285	7	3,099	7	-26
Cabezon	1,502	8	1,041	8	+44
Albacore	1,337	9	135	14	+890
Jack mackerel	1,226	10	765	9	+60
White croaker	669	11	168	13	+298
Shark, unspecified	363	12	613	10	-41
Sturgeon, unspecified	308	13	281	12	+10
Leopard shark	179	14	468	11	-62
All others	757	—	484	—	—
Total number of fishes	738,563		944,760		-22
Number of anglers	138,145		173,093		-20
Reporting CPFVs	121		121		0

127% in 1996, making this the tenth most frequently landed species. Yellowtail had a strong spring season (10,817 fish in May), with catch peaking again in August at 22,996 fish. Dolphinfish landings increased 337% in 1996, moving this favored species from rank 20 to 14.

### Northern California

Northern and central California anglers fished aboard CPFVs, targeting chinook (king) salmon (*Oncorhynchus tshawytscha*), rockfishes (*Sebastes* spp.), lingcod (*Ophiodon elongatus*), striped bass (*Morone saxatilis*), California halibut (*Paralichthys californicus*), albacore (*Thunnus alalunga*), or white sturgeon (*Acipenser transmontanus*). Salmon, rockfish, lingcod, cabezon (*Scorpaenichthys marmoratus*), and other nearshore species were caught from coastal waters. Striped bass, leopard shark (*Triakis semifasciata*), and white sturgeon live mainly in estuarine waters and were caught almost exclusively in San Francisco Bay. Most California halibut were caught by CPFV anglers in San Francisco Bay, although some were caught along the coast. In previous years salmon catches included coho (silver) salmon (*Oncorhynchus kisutch*), but in 1996 coho salmon were prohibited. Albacore were caught primarily during summer in waters offshore (>20 nmi) of the Morro Bay and Monterey areas, where ocean temperatures are warmer than in nearshore areas.

The rockfish species group continued to dominate catches by northern and central California CPFV anglers, constituting 84% of the total number caught (table 7). Approximately 50% of the total rockfish catch was landed in the Monterey and Morro Bay areas. Order of rank abundance has changed slightly within the top eight species or species groups, which have remained consis-

tent since 1994. The top four represented 95% of total reported landings. Albacore constituted 2% of the catch, increased 890% over the previous year, and increased in rank abundance to ninth from fourteenth.

Total catch in absolute numbers, as reported in logbooks, decreased by 22% over the previous year, primarily because of decreased landings of the top three species or species groups. The CDFG requires that CPFV captains report their catches in CDFG-provided logbooks and submit completed logbooks. Although compliance is less than 100%, the overall rate has not varied much among years, so it is likely that this apparent decrease in total catch represents a real decline. It is not clear if decreasing rockfish landings since 1992 reflect decreased abundance, because there has been a coincident increase in salmon landings, a preferred species. Total number of anglers decreased by 20% from 1995, and there was no change in the number of CPFVs reporting catches.

The high catch of California halibut in 1996 was 97% of the 1995 reported value and accounted for 2% of the total CPFV catch in 1996. These two years represented an average sixfold increase in landings over the average catch from 1980 to 1994. Recent warm-water years (related to an El Niño event) along the central and northern coast, high abundance of juvenile halibut in 1993, and the elimination in 1993 of alternative gear permits for commercial halibut fishing have probably contributed to this increase. Increases were also observed in catches of other important species or species groups, including striped bass, Pacific mackerel, cabezon, jack mackerel, white croaker (*Genyonemus lineatus*), and sturgeon. Catches of leopard sharks decreased by 62% from 1995 reported values.

**Editors:**

*F. Henry and D. Hanan*

**Contributors:**

*T. Barnes, Pacific mackerel*

*K. Barsky, swordfish/shark*

*D. Ono, sea cucumber*

*S. Owen, white seabass*

*R. Dixon, salmon*

*P. Haaker, abalone*

*K. Hill, S. Calif. recreational*

*P. Kalvass, sea urchin*

*R. Leos, prawns*

*K. McKee-Lewis, live fish*

*C. Ryan, Pacific herring*

*D. Thomas, groundfish*

*R. Warner, Dungeness crab*

*D. Wilson-Vandenberg,*

*N. Calif. recreational*

*M. Yaremko, market squid*

•