

REVIEW OF SOME CALIFORNIA FISHERIES FOR 1990

CALIFORNIA DEPARTMENT OF FISH AND GAME

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Total landings of fishes, crustaceans, echinoderms, and mollusks decreased 19% from 1989. This is the second consecutive year that California has experienced a decline in total landings. The 1990 landings exceeded the 1985 low by only 7%, and are 33% below the 10-year average.

Pelagic wetfish landings declined 29% from last year. This marked the first drop since the recent upward trend in wetfish landings began in 1985, and the lowest total since 1986. Landings decreased for all species except northern anchovy (table 1).

Groundfish landings declined slightly, but the species composition was similar to last year's. California halibut landings were the lowest in ten years.

Landings of swordfish declined to an 8-year low, and landings of the common thresher shark to a 12-year low, but the mako shark catch increased about 33%. Albacore landings increased slightly over last year's record low, but were still only 12% of the 25-year average.

The red sea urchin fishery continued as one of the major fisheries in the state; landings in northern California decreased 17% from 1989, while southern California landings increased.

The sport catch increased slightly from 1989, with record high catches of dolphinfish, yellowtail, and

tropical tunas. The high availability of these fish was related to the warmer oceanic conditions that prevailed off southern California for the latter part of the year.

PACIFIC SARDINE

In 1989 the California Department of Fish and Game (CDFG) conducted two sea surveys to assess the spawning biomass of the Pacific sardine (*Sardinops sagax*). The egg production area method (EPAM) was used to determine if the observed spawning area exceeded the critical spawning area of 2,300 nautical miles² (n.mi.²), which is considered indicative of a 20,000-ton spawning biomass. The presence of sardine eggs indicated spawning in an area of 3,280 n.mi.² Because current state regulations allow a directed sardine fishery when the spawning biomass exceeds 20,000 tons, the survey results made possible the January 1, 1990, opening of the fifth consecutive 1,000-ton directed fishery since the current sardine management law went into effect in 1974.

The 1,000-ton quota was divided between northern California (20% reserved for landings north of Point Buchon; figure 1) and southern California (80% reserved for landings south of Point Buchon).

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

Year	Pacific sardine	Northern anchovy	Pacific mackerel	Jack mackerel	Pacific herring	Market squid	Total
1971	149	44,853	78	29,941	120	15,759	90,900
1972	186	69,101	54	25,559	63	10,080	105,043
1973	76	132,636	28	10,308	1,410	6,031	150,489
1974	7	82,691	67	12,729	2,630	14,453	112,577
1975	3	158,510	144	18,390	1,217	11,811	190,075
1976	27	124,919	328	22,274	2,410	10,153	160,111
1977	6	111,477	5,975	50,163	5,827	14,122	187,570
1978	5	12,607	12,540	34,456	4,930	18,899	83,437
1979	18	53,881	30,471	18,300	4,693	22,026	129,389
1980	38	47,339	32,645	22,428	8,886	16,957	128,293
1981	31	57,659	42,913	15,673	6,571	25,915	148,762
1982	145	46,364	31,275	29,110	11,322	17,951	136,167
1983	388	4,740	35,882	20,272	8,829	2,001	72,112
1984	259	3,258	46,531	11,768	4,241	622	66,679
1985	653	1,792	38,150	10,318	8,801	11,326	71,040
1986	1,283	2,105	45,503	12,209	8,405	23,454	92,959
1987	2,309	1,595	45,890	13,055	9,258	22,028	94,135
1988	4,172	1,618	47,278	11,379	9,721	41,040	115,208
1989	4,308	2,700	39,825	21,820	10,134	45,076	123,863
1990*	3,445	3,528	35,047	5,144	8,938	31,304	87,406

*Preliminary

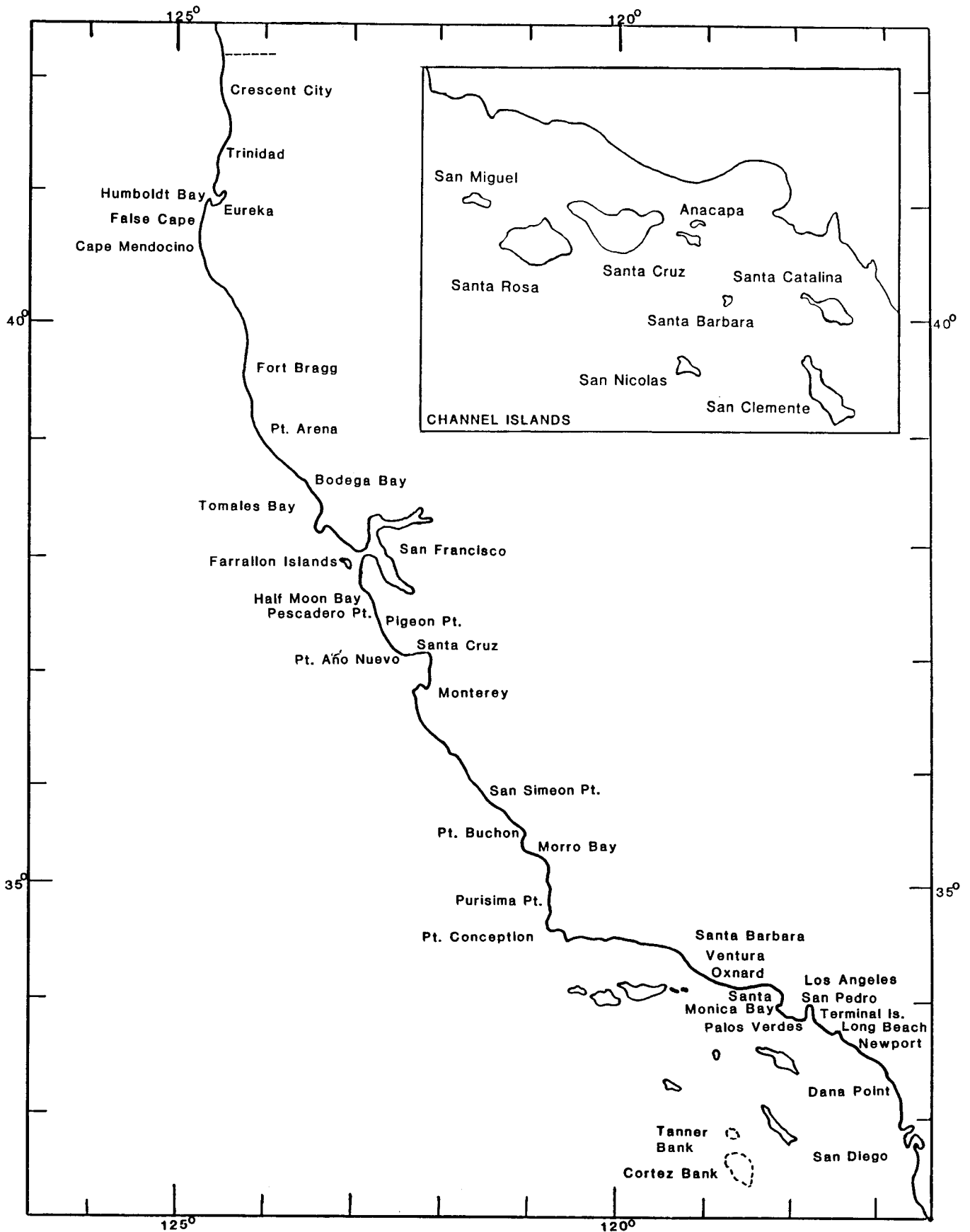


Figure 1. California ports and fishing areas.

In addition to the directed fishery, there was a 350-ton quota for live bait (opened January 1, 1990) and a 250-ton quota for dead bait (opened March 1).

The southern California allocation of the directed fishery was landed in six days, and the fishery was closed on January 6, six days earlier than in 1989. The period was shortened because many sardines were caught close to the Los Angeles Harbor. The catch totaled 1,181 tons, with 84% of the landings consisting of pure loads of sardines. In 1989, only 34% of the landings contained 100% sardines. Most of the catch was used for human consumption, the remainder for dead bait and pet food.

The northern California directed fishery began in late January and was closed on April 25. The catch totaled 217 tons. The proportion of pure loads of sardines in the catch (88%) was lower than during the 1989 fishery, when almost all landings were pure loads.

The dead bait fishery quota is allocated among three geographic areas: 75 tons are reserved for landings north of Pescadero Point, 50 tons for landings between Pescadero Point and Point Buchon, and the remaining 125 tons for landings south of Point Buchon. The southern dead bait fishery was closed on March 2, 1990, after two days of fishing. Most of the catch (188 tons) comprised pure loads of sardines. The central dead bait allocation was met on April 10, and the landings (50 tons) consisted entirely of pure loads. No landings were made toward the northern dead bait allocation in 1990.

The occurrence of sardines in the live bait fishery, as estimated from bait haulers' monthly logbooks, amounted to 595 tons. Sardines represented 10.5% of the total take for live bait. Approximately 90% of the sardine live bait catch was landed in July, August, and September, with young-of-the-year sardines most abundant during July. Total landings exceeded the annual 350-ton live bait quota by 70% because of an error in tallying the logbook catch.

The tolerance limit for sardines landed incidentally in the mackerel fishery remained at 35% by weight throughout the year. The incidental sardine catch totaled 1,214 tons, and represented 2.9% of total mackerel fishery landings. This was the third consecutive year that the proportion of sardines in the mackerel catch decreased. In 1989, sardines made up 4.5% of the mackerel catch; in 1988, 5.5%. Incidental sardine landings decreased 65% from 1989.

The total 1990 landings of sardines from all sources (directed, dead bait, live bait, and incidental) was 3,445 tons (table 1). This was the second year in which total landings of sardines declined. The decrease in 1990 was largely due to a 34% de-

cline in total mackerel landings (mackerel were unavailable to southern California fishermen during the first part of the year, and there was also a lengthy price dispute).

In July 1990, the CDFG conducted an EPAM survey to evaluate the sardine spawning biomass. The survey covered the waters off southern California from Purisima Point to the Mexican border, from close to shore to as far out as 200 miles. The observed spawning area of 1,480 n.mi.² was 62% smaller than the area observed in 1989. During 1990, spawning occurred along the coast from Santa Barbara to Long Beach, and inshore of the Santa Barbara Channel Islands. No spawning was observed at the Tanner and Cortez banks (figure 1). The absence of spawning at the banks, and decreases in overall spawning may be due in large part to an early (before the survey) increase in water temperature in the Southern California Bight.

A sardine management workshop involving state, federal, industrial, and Mexican federal biologists was held by the CDFG in September 1990. A review of the status of the sardine resource led to an estimate that the current biomass of age two and older fish is 100,000 tons, and to a recommended harvest level of 5% (including all sources of catch). As a result, a 2,499-ton directed quota (with about 3,000 tons reserved for other sardine quotas and incidental landings) was scheduled for 1991.

Legislation was enacted in 1990 to change the allocation of the directed fishery quota: one-third is reserved for landings north of San Simeon Point, and the remaining two-thirds are reserved for landings south of the point. Additionally, the northern portion may not be taken until August 1; this provision was included because sardines are usually not available in that area until later in the year.

PACIFIC MACKEREL

At the start of 1990, there were 15,447 tons of Pacific mackerel (*Scomber japonicus*) already landed towards the total for the 1989-90 fishing season (July 1 through June 30). There were no quota restrictions, since the biomass was estimated at 263,000 tons. Current legislation allows an open fishery when the biomass exceeds 150,000 tons.

Landings were low during the first three months of the year, totaling only 5,633 tons. The presence of bluefin tuna (*Thunnus thynnus*) off Santa Barbara, the directed sardine (*Sardinops sagax*) fishery, and a call for squid (*Loligo opalescens*) by the southern California canneries accounted for decreased effort and low catch during the month of January. Landings remained low in February and March despite fishing

effort being directed back to mackerel. Unpredictable weather in March, coupled with complaints from fishermen of a high abundance of incidental sardines (over 35%), which prevented them from landing their catch, and low availability of mackerel, kept the total landings small.

Rough weather and the high incidence of sardines continued to keep the landings low during the first two months of the second quarter. Few vessels left port during May, but those that did brought in several landings of large (300–500 mm FL) Pacific mackerel. In June more Pacific mackerel were available, and fishing effort increased, raising the catch over the previous months. Mostly large mackerel were caught, and 4,100 tons were landed during this quarter.

The 1989–90 season closed on June 30, with a total catch of 25,908 tons of Pacific mackerel. The 1989–90 landings decreased 44% from the previous season. The species composition of the total statewide mackerel landings was 54% Pacific mackerel, 41% jack mackerel, and 5% Pacific sardines. During the 1988–89 season, the total landings had comprised 80% Pacific mackerel, 16.5% jack mackerel, and 3.5% Pacific sardines. Landings in northern California made up only 0.3% of the total, compared with 1% during the 1988–89 season.

The 1990–91 season opened on July 1, 1990, with no quota restrictions, since the biomass was estimated to exceed 150,000 tons. In fishery samples from January through June 1990, the 1989 year class made up 14% of the landings, the 1988 year class, 48%. From July through December 1990 these two year classes dropped to 8% and 21% of the landings. Many Pacific mackerel continued to be available during the third quarter, and landings totaled 17,395 tons. Most of the landings were pure Pacific mackerel.

High landings continued through October, with 5,313 tons landed for the month. The catch decreased in November, due in part to rough seas and a maintenance shutdown of the United Food Processors cannery. In addition, the fleet actively fished for mackerel for only two days in December before directing its effort to squid. The holiday season may also have reduced the fishing effort at the end of the quarter. Only 7,190 tons were landed during the quarter.

By year's end, 24,586 tons of Pacific mackerel had been landed toward the 1990–91 season total. Pacific mackerel landings for 1990 totaled 35,047 tons (table 1), with 93% of the landings made in southern California. The total was a 12% decrease from 1989. When compared to the average landings over the

previous five years, the 1989 catch decreased 20%. The reduced availability of Pacific mackerel during 1990 may have been due to warmer-than-usual water conditions that displaced mackerel farther to the north, particularly during the first half of the year.

MARKET SQUID

Market squid (*Loligo opalescens*) landings in 1990 were 31,304 tons (table 1): 22,451 tons (72%) were from the southern California fall–winter fishery, and 8,710 (28%) were from the central California (Monterey Bay area) spring–summer–fall fishery (table 2). The remainder (143 tons) came from areas north of the Monterey Bay area. This is a 31% decrease in statewide landings from the 45,076 tons landed in 1989. Southern California landings in 1990 were 40% below those in 1989; landings in the Monterey Bay area were 11% higher; and landings from north of Monterey Bay were up dramatically from the 4 tons landed in 1989. The total 1990 ex-vessel value was approximately \$4.3 million, 27% below the \$5.9 million ex-vessel value recorded in 1989.

Ex-vessel prices typically fluctuate from year to year and during the year. In 1990, prices in southern California remained lower than those paid in central and northern California. Southern California prices ranged from \$110 to \$150 per ton and averaged about \$130 per ton. Monterey Bay area ex-vessel prices ranged from about \$130 to \$200 per ton and averaged \$160 per ton. In the past twenty years the ex-vessel price has been as high as \$600 per ton.

TABLE 2
 California Market Squid Landings (Tons)

Year	Monterey	Southern California	Other	State total
1970	4,314	7,982	0	12,296
1971	8,323	7,435	trace	15,758
1972	6,129	3,950	0	10,079
1973	620	5,410	0	6,030
1974	7,248	7,205	0	14,453
1975	2,495	9,316	trace	11,811
1976	2,511	7,642	0	10,153
1977	2,234	11,887	1	14,122
1978	10,326	8,571	trace	18,897
1979	14,183	7,842	1	22,025
1980	7,856	9,100	1	16,957
1981	14,134	11,779	2	25,915
1982	11,670	6,276	5	17,951
1983	542	950	509	2,001
1984	431	84	107	622
1985	4,202	7,039	85	11,326
1986	6,049	16,488	917	23,454
1987	5,269	16,665	94	22,028
1988	5,329	34,634	426	40,389
1989	7,877	37,195	4	45,030
1990*	8,710	22,451	143	31,304

*Preliminary

Most squid were frozen for human consumption, while some were sold fresh or used for dead and live bait. The squid live bait fishery is centered in southern California. Much of the squid processed in California is exported.

Annual squid landings since 1970 have averaged 17,748 tons. Landings during years characterized by El Niño Southern Oscillations (ENSO), such as 1973, 1983, and 1984, were unusually low. However, large increases in southern California landings in recent years, and increased fishing effort in other areas suggest that the resource has been underutilized.

During 1970–85, southern California landings averaged 54% of total statewide landings. Since 1986, they have risen dramatically, averaging nearly 79% of total landings. But in 1990, southern California landings decreased for the first time in six years. This may be because many of the squid landed in 1990 were very small, averaging over 15 per pound. Some dealers had difficulty marketing these small squid and set trip limits for their boats, or quit buying small squid altogether. Squid landings were 11,650 tons in the Santa Barbara area in 1990, very close to the post-ENSO annual average of 11,700 tons. Thus the overall decrease in southern California landings was primarily at Terminal Island and San Pedro ports.

Since the 1983–84 ENSO, annual landings in Monterey Bay have averaged approximately 6,240 tons, slightly above the 20-year average of 6,213 tons, but well below average annual landings of 11,600 tons during the peak period of 1978–82. Of the 8,710 tons landed in Monterey Bay in 1990, 978 tons were landed at Santa Cruz. Most of these squid were caught north of Santa Cruz near Año Nuevo Island, an area that has been fished only sporadically since the ENSO years.

Attracting lights were approved for southern Monterey Bay in 1989 and are used by most of the Monterey Bay fleet. However, they continue to be controversial. Fishermen opposed to the lights contend that they disrupt squid spawning and that small boats cannot compete with large boats with large light systems. Those in favor of the lights note that southern California fishermen have used them for many years without any apparent adverse effects on spawning. They also claim that lights allow them to use shallower nets that can be fished off the bottom, thus protecting squid eggs attached there.

Continuing low ex-vessel squid prices and difficulties in finding enough crew have heightened interest in half-purse drum seines in the Monterey Bay area. Only a few boats switched to half-purse drum

seines when they were first allowed in 1989, primarily because major capital outlay that year was for powerful and expensive systems of attracting lights. In 1990, however, more boats switched to half-purse drum seine gear.

PACIFIC HERRING

Annual statewide landings for the 1990 roe herring fishery (*Clupea harengus*) were 8,938 tons, a 10.8% decrease from 1989 (table 1). Statewide landings for the 1989–90 season (November to March) totaled 8,962 tons. San Francisco Bay gill net permittees landed 6,723 tons, approximately 6% over the established quota of 6,321 tons. Round haul permittees fishing in San Francisco Bay landed 2,239 tons, which was roughly 82% of the 2,736-ton quota. In Bodega Bay, permittees landed 95 tons (200-ton quota); Humboldt Bay permittees landed 61 tons (60-ton quota); and Crescent City landings totaled 33 tons (30-ton quota). Ex-vessel prices for roe herring ranged from \$800 to \$1,400 per ton.

San Francisco Bay eggs-on-kelp permittees had a very good 1989–90 season. They processed 107 tons (110-ton quota) of eggs-on-kelp; in 1988–89, landings were 47 tons (64-ton quota). The number of permittees allowed in this fishery increased from six to ten for the 1989–90 season.

Spawning biomass estimates were determined for San Francisco, Tomales, and Bodega bays. The 1989–90 season estimate for San Francisco Bay was 64,500 tons, a 2% decline from the previous season. The Tomales Bay spawning biomass was estimated at 345 tons from spawning-ground surveys. Hydroacoustic surveys in Bodega Bay resulted in a biomass estimate of 350 tons. Tomales Bay and Bodega Bay herring are considered one stock; therefore the total spawning biomass, including the catch missed by hydroacoustic surveys (95 tons), is estimated at 790 tons. This is roughly double the 1988–89 estimate of 380 tons.

This was the third consecutive poor season in Tomales Bay. However, the age structure of the sampled catch has remained relatively stable, which does not suggest a population in decline. Drought conditions, which have persisted for four years and have resulted in low freshwater runoff into Tomales Bay, may be the primary reason why herring have not spawned near historic levels in the bay.

Results of young-of-the-year (YOY) surveys in San Francisco Bay suggest a weak 1990 year class. Very few YOY herring were found in midwater trawl tows at stations located throughout the bay.

The 1990–91 roe herring quotas statewide remained unchanged from the 1989–90 season. The

current regulations will continue while the Department of Fish and Game is complying with California Environmental Quality Act requirements to assess the fishery's effects on other resources.

GROUND FISH

California's 1990 commercial groundfish harvest was 38,849 metric tons (MT), with an ex-vessel value of approximately \$30,347,000. All-species 1990 landings decreased approximately 4%, or 1,661 MT, from the 1989 level (table 3). Rockfish (*Sebastes* spp.), Dover sole (*Microstomus pacificus*), sablefish (*Anoplopoma fimbria*), and thornyheads (*Sebastolobus* spp.) were the principal species harvested in 1990. Increases in harvest were noted for rockfish and thornyheads, while decreases occurred in most of the other categories.

The general historical pattern of landings by gear changed during 1990. Bottom and midwater trawl landings continued to dominate total landings, but their contribution dropped from 86% in 1989 to 77% in 1990. While the trap component remained about the same (2%), both the line and setnet components almost doubled, to 12% and 8%.

Federal and state regulations for 1990 affected the harvest of widow rockfish (*Sebastes entomelas*), sablefish, Dover sole, and thornyheads. Trip limits were again used as the primary means of limiting landings. At current levels of fishing effort, trip limits offer the most viable method of meeting the Pacific Fishery Management Council (PFMC) objective of a year-round groundfish fishery.

In late 1989, the PFMC set the 1990 Washington-Oregon-California (WOC) widow rockfish quota at 9,800–10,000 MT, with the intention to manage for 9,800 MT. The allowed catch represented a considerable drop from the 1989 quota of 12,000 MT. Trip limits of 10,000 pounds per week or 25,000

pounds per two weeks were the most restrictive ever imposed. On October 11, the trip limit was reduced to 3,000 pounds, and on December 12 the fishery closed. Because of a late-season surge in effort, the total 1990 landed catch of 10,533 MT in the WOC area was 8% over the quota. California landings of 1,975 MT were 19% of the WOC total.

Nontrawl sablefish management underwent several changes in 1990. The PFMC initially recommended revising the trawl:nontrawl allocation from 58%:42% to 62%:38%, and delaying the opening of the nontrawl season from January 1 to April 1. The secretary of commerce did not approve these management measures before the fishery opened on January 1. Therefore the nontrawl trip limit in effect at the end of 1989 remained in effect until the PFMC recommendations were formally disapproved. On January 31 the trip limit was rescinded, and nontrawl fishing was unrestricted. The 1990 nontrawl allocation, using the 1989 ratio of 58%:42%, was 3,612 MT. A trip limit went into effect in June and was adjusted in July and again in September. The total landed catch of sablefish by nontrawlers in 1990 was 3,519 MT, approximately 3% less than the quota. California landings accounted for 1,329 MT, or 38% of the nontrawl total.

The 1990 trawl quota for sablefish was 4,998 MT, and landings were restricted to 1,000 pounds or 25% per trip of the deepwater complex (sablefish, Dover sole, thornyheads, and arrowtooth flounder — *Atheresthes stomias*). Fleet size was similar to that of 1989 except that substantial effort from the shrimp fishery shifted to the groundfish fishery in August and September. This caused an increase in the deepwater complex fishery where effort targeted on thornyheads. However, the landings of trawl-caught sablefish also increased, and in September the PFMC was notified that sablefish would become a prohibited species as early as November 8, 1990, if landings were not reduced by 50% during the last quarter. The PFMC responded by changing the definition of the deepwater complex (removing arrowtooth flounder) and placing a 15,000-pound trip limit on the deepwater complex while retaining the sablefish restrictions. The total landed WOC catch of sablefish by trawl in 1990 was 5,199 MT, which exceeded the quota by 4%. California trawl sablefish landings of 2,202 MT made up approximately 44% of WOC landings.

Despite 1990 limits on trip poundage and frequency for the deepwater complex, thornyhead landings were considerably higher than last year, increasing from 7,925 MT to 10,126 MT. The increase resulted from a continuing Asian demand for

TABLE 3
 California Groundfish Landings (Metric Tons)

Species	1989	1990	Percent change
Dover sole	7,713	6,419	-17
English sole	1,015	912	-10
Petrale sole	840	691	-18
Rex sole	735	570	-22
Other flatfish	858	1,429	67
Widow rockfish	1,566	1,975	26
Other rockfish	9,978	11,019	10
Thornyheads	5,319	5,391	1
Lingcod	1,262	1,118	-11
Sablefish	3,583	3,531	-1
Pacific whiting	7,302	5,519	-24
Other groundfish	339	275	-19
Total	40,510	38,849	-4

headed and gutted longspine thornyheads (*Sebastes altivelis*). In response to this increase, the PFMC set a 1991 harvest guideline of 7,900 MT and a weekly trip limit of 7,500 pounds. California landed 5,391 MT, or 53%, of the WOC catch. The coast-wide catch of Dover sole was 15,795 MT, a decrease of 1,328 MT, which reflects both additional regulations and reduced demand. California landings of 6,419 MT were 41% of total WOC landings. A harvest guideline of 22,500 MT was established for 1991.

A stock assessment of bocaccio rockfish, completed in 1990, indicated a declining resource. Trawl landings of bocaccio were about 2,000 MT annually during the late 1970s. Landings increased to about 4,700 MT by 1981 with the recruitment of the large 1977 year class, but have fallen to just over 1,000 MT since 1985. In 1989 the total landed catch of about 1,800 MT comprised about two-thirds trawl catch, one-sixth setnet catch, and one-sixth recreational catch. The model used in the assessment indicated that the biomass had decreased from about 75,000 MT in 1978 to 7,000 MT in 1990. A significant fraction of the observed decline is due to poor recruitment since 1978. In response to concerns for bocaccio, the PFMC set a 1991 harvest guideline of 1,100 MT and established a trip limit for rockfish of 25,000 pounds with no more than 5,000 pounds of bocaccio south of Coos Bay, Oregon.

PACIFIC WHITING

The combined U.S. and Canadian coastal whiting (*Merluccius productus*) catch for 1990 was 269,500 MT, down from a high of 309,000 MT in 1989. The U.S. portion of the harvest for 1990 was about 183,200 MT: 171,000 MT were taken by domestic joint venture (JV) trawlers; 4,100 MT were taken by

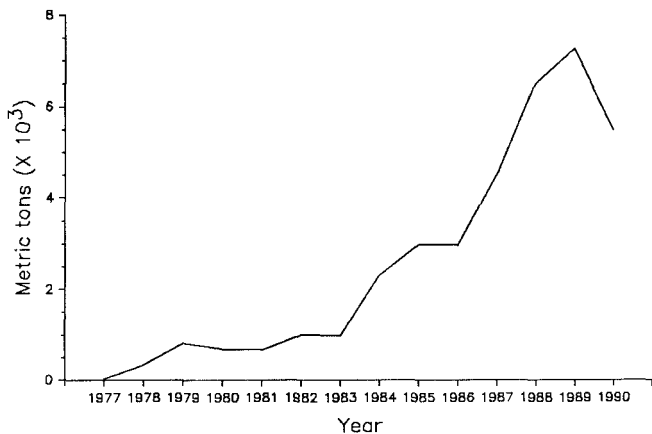


Figure 2. California landings of Pacific whiting, 1977–90.

domestic at-sea catcher/processors; and 8,100 MT went to shoreside processors. An estimated 68,000 MT of the JV catch were taken off California.

California shore-based landings of Pacific whiting totaled 5,519 MT in 1990, a 24% decline from the 7,302 MT landed in 1989 (figure 2). The California total accounted for 69% of all shore-based whiting landings made in Washington, Oregon, and California during 1990. The most significant portion of the California catch (5,516 MT) was harvested by five targeting midwater trawl vessels, which delivered whiting at Eureka (1,033 MT) and Crescent City (4,483 MT) over a four-month period (April through July). Five northern California midwater trawlers also took most of the 1989 California harvest, but over a six-month period (March through August). Domestic shore-based processing of whiting in 1990 accounted for only 4% of the U.S. share of the allowable catch for the year.

DUNGENESS CRAB

California Dungeness crab (*Cancer magister*) landings during the 1989–90 season totaled 4.6 million pounds, slightly less than half of the 1988–89 landings of 9.6 million pounds.

The northern California ports of Crescent City, Trinidad, Eureka, and Fort Bragg (figure 1) received 2.34, 0.54, 0.78, and 0.06 million pounds, respectively, for a total of 3.72 million pounds. This is 4.25 million pounds below the catch of the previous season.

The season opened December 1 in northern California, with the price per pound set at \$1.25, similar to the year before. Catch per trap declined rapidly after the first week, and by the middle of the month many fishermen had quit. Most of the landings (86%) were made in December. The season ended on July 15; approximately 375 vessels participated in the fishery.

Reports from trawlers and from fishermen examining stomachs of fishes caught in nearshore waters indicate that the 1989 year class of Dungeness crab is strong. This year class should begin recruiting to the fishery in the 1991–92 season.

The San Francisco area Dungeness crab season opened on November 14. Landings for Bodega Bay were 0.34 million pounds; San Francisco, 0.19 million pounds; and Half Moon Bay, 0.20 million pounds, for a total of 0.73 million pounds. This is less than half of the previous season's total of 1.5 million pounds. Seventy-nine percent of the total landings were taken in November and December. Approximately 200 vessels participated in the fishery.

The ports of Monterey and Morro Bay contributed 0.10 million pounds to the total statewide landings.

PACIFIC OCEAN SHRIMP

For the first time in seven years the statewide landings of Pacific Ocean shrimp (*Pandalus jordani*) declined. The 1990 landings of 8.6 million pounds decreased 35% from the 13.3 million landed in 1989 (table 4). In spite of this decrease, the 1990 landings were still the fifth largest on record. Areas of production were Area A (Oregon border to False Cape) and Area B-1 (False Cape to Point Arena) (figure 1). Area C (Pigeon Point to the Mexican border) reported no catch for the first time since 1978.

Shrimp landings at Area A ports totaled 8.2 million pounds, a 4.3 million-pound decrease from 1989. Like the statewide landings, Area A's landings were the fifth largest ever. Total Area A landings comprised 7.4 million pounds from Area A waters, 18,000 pounds from Area B-1 waters, and 730,000 pounds from Oregon waters. The season opened April 1, with fishermen receiving \$.45 per pound. The price paid to the shrimpers increased \$.05 per pound approximately every two months until the price reached \$.60 per pound, where it remained.

A total of 58 boats (39 single-rigged and 19 double-rigged) delivered shrimp to Area A ports during 1990, an increase of two boats over 1989. Single-rigged vessels had an average seasonal catch rate of 350 pounds per hour, a decrease of 193 pounds per hour from 1989. Double-riggers averaged 634

pounds per hour, down from 842 pounds per hour in 1989.

The 1990 catch exhibited several biological anomalies that seemed to be in response to an extremely weak 1989 year class. Two-year-old males made up 62.7% of the males in the 1990 catch, although they averaged only 0.1% of the males during the previous 10-year period. The 1990 landings had only 18.8% one-year-old shrimp, compared to the 1980-89 average of 80.5%. Primary females (one-year-olds) constituted an average 39.5% of the females during the 1980-89 period but were totally absent from the 1990 catch.

Area B-1 landings were 519,000 pounds, down 38% from 1989. Over 50% of the season's landings occurred in the first two months of the season, and one vessel accounted for 44% of the total. During the 1990 season, 62% of the catch was sold at an ex-vessel price of \$0.45 per pound, with the balance bringing \$0.50 to \$0.60 per pound.

A total of 72 landings were made by six single-rigged vessels. These vessels had an average seasonal catch rate of 441 pounds per hour. The CPUE started at 607 pounds per hour in April and declined to 175 per hour in August. Count per pound was below 100 for the first three months of the season and slightly over for the remainder. One-year-old shrimp made up 21% of the sampled catch in April, and steadily increased to 80% by August. No samples were taken in September or October. The percentage of females declined from a high of 35% in April to 17% in August. Gravid females made up 3% of the females in April and 29% in May.

SWORDFISH AND SHARKS

Landings of swordfish (*Xiphias gladius*) in 1990 fell to 1.9 million pounds, a 32% decline from the previous year's total, and the lowest level in eight years (table 5). Since swordfish are highly migratory and occur off Baja California, this species is harvested by both Mexican and American fishermen. The decline in recent landings may be the cumulative effect of increased effort from both fishing groups, although current Mexican landing data are unavailable. Harpoon fishermen again reported a dismal year, with only 410 fish taken; this catch nearly equals last year's. Drift gill netters saw the catch drop to 9,000 fish, a decline from 11,000 in 1989.

Catch-per-unit-effort (CPUE) for gill net gear declined slightly from 2 fish per day in 1989 to 1.6 fish per day in 1990, while CPUE for harpoon gear remained unchanged at 0.3 fish per day. Major fishing areas were similar to last year: the three main ones were off San Francisco, Morro Bay, and San Diego.

TABLE 4
 California Pacific Ocean Shrimp Landings
 (1,000s of Pounds)

Year	Area A	Area B-1	Area B-2	Area C	Total
1974	1,674	517	166	5	2,362
1975	3,395	348	1,188	62	4,993
1976	2,674	721	<1	5	3,400
1977	13,026	585	2,029	0	15,640
1978	12,473	2,061	0	0	14,534
1979	4,236	0	4	865	5,105
1980	3,340	174	<1	1,582	5,096
1981	2,945	41	2	1,112	4,100
1982	3,967	12	0	437	4,416
1983	232	0	0	945	1,177
1984	1,340	0	0	154	1,494
1985	3,373	0	0	23	3,396
1986	5,876	0	0	840	6,716
1987	6,599	653	0	671	7,923
1988	10,272	379	0	380	11,031
1989	12,458	833	0	24	13,315
1990*	8,165	519	0	1**	8,685

*Preliminary

**Landed in Area C, but caught in Area A-1.

TABLE 5
Landings of Selected Shark Species and Swordfish
(Pounds)

Year	Shortfin mako shark	Swordfish	Common thresher shark	Pacific angel shark
1977	19,911	511,388	129,522	366
1978	26,765	2,604,233	302,054	82,383
1979	35,079	586,529	735,726	128,295
1980	154,529	1,197,187	1,805,978	110,037
1981	274,217	1,142,897	1,973,411	268,640
1982	527,006	1,677,020	2,396,960	317,953
1983	322,854	2,601,600	1,722,056	351,344
1984	239,687	4,429,540	1,662,587	632,937
1985	225,535	5,196,685	1,540,770	1,237,810
1986	473,608	3,845,932	606,583	1,241,130
1987	602,718	2,741,015	525,076	940,187
1988	488,136	2,484,428	549,516	487,278
1989	388,322	2,850,734	649,174	268,252
1990*	576,428	1,872,910	466,217	250,810

*Preliminary

Common thresher shark (*Alopias vulpinus*) landings in California totaled 466,000 pounds, a decline of 28% from 1989 totals and a twelve-year low. Thresher sharks were taken all along the California coast, with more than 53% of the landings in southern California. Market sampling data indicate that the fishery continues to harvest juvenile fish, but very few adults.

Shortfin mako shark (*Isurus oxyrinchus*) landings increased by 33% over last year's figures, reaching over 576,000 pounds. Of this total, 30% (173,000 pounds) was taken by the experimental drift longline fishery, and 70% (403,000 pounds) by the drift gill net fishery. The experimental drift longline fishery targets directly on shortfin mako shark, while the drift gill net fishery captures these fish incidentally with swordfish and thresher sharks. Drift longline length-frequency data indicate that the catch consists of one-, two-, and three-year-old fish. Because of CDFG fiscal problems, the drift gill net fishery was inadequately sampled for a length-frequency distribution.

Pacific angel shark (*Squatina californica*) landings were 251,000 pounds, the lowest level in ten years. Landings continued to be affected by a number of factors, including low market demands, reduced availability, and a minimum size limit. The Santa Barbara-Ventura area continued to be the major fishing location.

CALIFORNIA HALIBUT

California halibut (*Paralichthys californicus*) landings in 1990 were 419 MT, 24% below the 550 MT recorded in 1989 (table 6). The 1990 landings are 6% below the 14-year average of 446 MT and are the lowest recorded since the 1980 landing of 321 MT.

TABLE 6
California Halibut Landings (Metric Tons)

Year	North of Pt. Conception	South of Pt. Conception	Total
1977	25	186	211
1978	34	165	199
1979	54	205	259
1980	90	231	321
1981	163	409	572
1982	206	339	545
1983	256	248	504
1984	153	345	498
1985	144	429	573
1986	240	312	552
1987	192	347	530
1988	229	276	505
1989	305	245	550
1990*	189	230	419

*Preliminary

During 1990, 55% of the landings were made south of Point Conception. The remaining 45% were made north of Point Conception, a 38% decrease from 1989. This large decrease in central and northern California landings is most likely due to increased restrictions on the use of entangling (gill and trammel) setnets, and more restrictive seasonal and landing conditions for the nearshore experimental trawl fishery for California halibut. The experimental trawl fishery began in 1986 as an effort to mitigate the effects of increasing nearshore closures on the use of setnets in central California.

The highest landings of California halibut in 1990 occurred during July (29 MT) and August (33 MT). Entangling nets brought in 62% of all halibut taken, followed by trawl (27%), hook-and-line (10%), and less than 1% for remaining miscellaneous and unspecified gears. Most of the trawl-caught halibut (84%) and hook-and-line-caught halibut (89%) were taken off central California. Most of the halibut caught in entangling nets (79%) were taken off southern California. Ex-vessel prices for California halibut typically ranged from \$1.00 to \$3.50 per pound and averaged \$2.37 per pound. Total ex-vessel value was approximately \$2.2 million, compared to \$2.7 million in 1989.

CALIFORNIA SPINY LOBSTER

The southern California spiny lobster (*Panulirus interruptus*) fishery landed 729,000 pounds during the 1989-90 season (first Wednesday in October to first Wednesday after March 15), making it the highest season since 1955-56, when 790,000 pounds were landed.

The highest recorded landings of lobster from California waters were 1.1 million pounds, taken in the 1949-50 season. Seasonal landings generally de-

clined over the next 25 years, reaching a low of 152,000 pounds in 1974–75. Since then, there has been a general upward trend.

Landings were fairly stable for the first eight of the past ten seasons, ranging between 400,000 and 500,000 pounds. The catch then increased to 668,000 pounds for the 1988–89 season, and this season was 61,000 pounds (9.1%) greater, raising the 10-year average to 511,000 pounds.

A special permit is required to fish commercially for lobsters. The number of permittees peaked at 440 during the 1984–85 season and then declined to 303 in 1988–89. Last year there was a slight increase, to 341 permittees. The average number for the past ten seasons has been 361.

Although the number of permittees has declined, there are indications that fishing efforts have increased. According to CDFG wardens, the average number of traps per fisherman has been increasing. Also, the bulk of the catch is being made earlier in the season, which suggests an abundance of fishing gear. Since 1980–81, the portion of the catch taken in the first two months of each season has increased from 51% to 68%.

In 1989–90, the ex-vessel price averaged \$5.50 per pound. With landings of 729,000 pounds, the fishery was worth \$4 million to the fishermen; this was a \$400,000 (12%) increase over the previous season.

ALBACORE

In 1990, albacore (*Thunnus alalunga*) landings in California totaled 971 tons. This was a 6% increase from 1989's record low of 914 tons, but only 12% of the 25-year average (7,997 tons). The number of California boats participating in the 1990 fishery decreased by 30% from 1989. However, fishing success for the fleet was good: 63 out of 157 boats landed over one ton of albacore during the season.

The 1990 season had a false start in late April when an intrusion of warm water created a corridor along the coast and brought albacore up from the Guadalupe Islands. By mid-May, albacore were being caught as far north as Bodega Bay. Unfortunately, strong winds developed, the corridor collapsed, and fishing stopped at the end of May. As in recent years, the true start occurred in July, when sport boats located albacore off northern Baja California, primarily around Geronimo Island and Cape Colnett. The fish ranged in size from 10 to 16 pounds, with 25-pound fish taken occasionally. In addition, a number of purse seine vessels caught albacore, as well as subtropical species such as skipjack and bluefin tuna, around the Coronado Islands and Sixty-Mile Bank. Although a good sport fishery developed in

southern California, and several commercial fishing boats had limited success, there was clearly not enough albacore to maintain a strong commercial effort south of Point Conception. In August, most albacore boats were working between Newport, Oregon, and the Columbia River, and offshore 400 miles. In September, jig boats worked farther north to the Queen Charlotte Islands, British Columbia, and stayed in the vicinity until weather drove most of them south in October. Vessels that headed south in September and October ran across large schools of albacore between Fort Bragg and Cape Mendocino, and caught 50 to 100 fish per day. But these schools were transitory, and disappeared after a day or two.

Pan Pacific Cannery and the Western Fishboat Owners Association (WFOA) set the 1990 price for albacore at \$1,100 per ton for fish 7–9 pounds and \$1,700 per ton for fish greater than 9 pounds. The WFOA also agreed to a \$100 per ton shipping fee for fish landed at buying stations. The 1990 agreement increased last year's prices by \$100 and \$200 per ton. The increase may have resulted partly from a decreased catch by the Japanese longline fleet, and, in turn, the uncertainty of albacore availability in the eastern Pacific.

Although the 1990 season was slightly better than the 1989 season, total California landings fell short of the historically high numbers experienced before 1985 (figure 3). The causes for this were two-fold. First, the migration path seems to have shifted, moving most albacore into northern Pacific waters and shifting fishing effort and landings away from California. Second, the albacore population on both sides of the Pacific seems to be declining, as evidenced by the lack of three- and four-year-old fish. These fish normally make up most of the commercial catch.

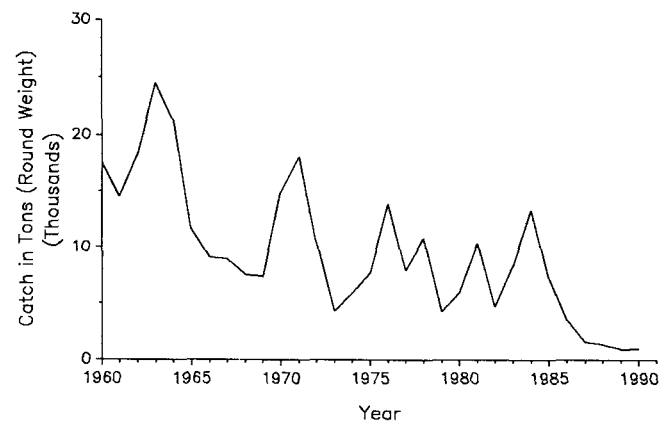


Figure 3. Annual albacore landings for California, 1960–90.

RIDGEBACK AND SPOT PRAWN

Ridgeback prawn (*Sicyonia ingentis*) are taken primarily with trawl nets. Trawling is allowed by permit from October 1 through May 31. An incidental catch of 50 pounds per load is allowed during the closed period. Landings for 1990 were approximately 82,800 pounds, or one-half the previous year's catch (figure 4). Most of the catch came from the Santa Barbara Channel. Log data showed a CPUE of 30 pounds per hour in the first part of the year, and 70 pounds per hour at the end of 1990. The CPUE for the previous two years was 66 pounds per hour. The ex-vessel price in the Santa Barbara region was \$1.30 to \$1.40 per pound.

Spot prawn (*Pandalus platyceros*) used to be caught mainly by trawl gear, but are now taken primarily with traps. By permit, spot prawns may be harvested year-round by trap. They may also be taken by trawl with a permit from February 1 through October 31; an incidental catch of 50 pounds per load is allowed during the closed season. Landings for 1990 were approximately 314,600 pounds, about 66% more than last year. This represents an increased demand for live product, rather than increased abundance of spot prawn. Trapping took place in the Santa Barbara Channel and Santa Monica Bay, and off Los Angeles, Santa Catalina Island, and San Diego (figure 1). The spot prawn is a much larger shrimp than the ridgeback, and brings a significantly higher price. Ex-vessel prices in the Santa Barbara region ranged from \$3.50 (dead) to \$5.00 (live) per pound.

SEA URCHIN

In 1990 the red sea urchin (*Strongylocentrotus franciscanus*) fishery continued as one of the major fisheries in the state. Landings for 1990 were estimated to be over 42 million pounds, a 17% decrease from

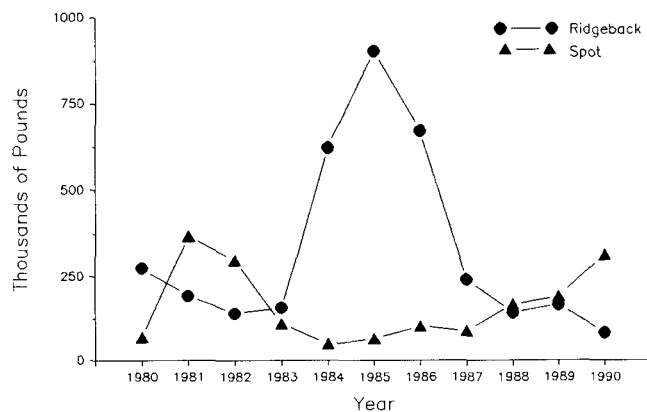


Figure 4. Ridgeback prawn and spot prawn landings in California, 1980–90.

TABLE 7
 Sea Urchin Landings (1,000s of Pounds)

Year	Northern California	Southern California	Total
1971	0	<1	<1
1972	<1	76	76
1973	18	3,594	3,612
1974	51	7,056	7,107
1975	3	7,323	7,326
1976	95	11,012	11,107
1977	386	16,208	16,594
1978	34	14,394	14,428
1979	237	20,307	20,544
1980	103	21,196	21,299
1981	194	24,720	24,914
1982	92	19,347	19,439
1983	61	17,207	17,268
1984	59	14,920	14,979
1985	1,921	18,074	19,995
1986	10,174	23,957	34,131
1987	23,600	22,500	46,100
1988	30,525	21,463	51,988
1989	26,745	24,168	50,913
1990*	18,627	23,370	41,997

*Preliminary

1989 (table 7). Northern California landings were down 30.4% from 1989, while those from southern California increased 10.4%. The northern California ports of Fort Bragg, Point Arena, and Bodega Bay had 16%, 11%, and 10% of the statewide landings, respectively. In the south, Oxnard-Ventura had 22% of the statewide total; Santa Barbara had 16%; and San Pedro–Los Angeles, 12%. The decrease in northern California is attributed to the continued reduction of high-density virgin stocks, more restrictive regulations, reduced effort, and poor weather. The increase in southern California resulted from effort shifts from the north, strong market prices, and prolonged periods of mild weather.

Divers, using surface-supplied air, harvest sea urchins by raking them into mesh bags, which are air-lifted to the surface and winched aboard the vessel. CPUE is measured as pounds harvested per diving hour as reported on daily harvesting logbooks. The northern California average was 507 pounds per hour in 1990, compared to 570 pounds per hour in 1989. In southern California the 1990 average CPUE was 294 pounds per hour, ranging from 166 at the Palos Verdes Peninsula to 407 at San Nicolas Island; in 1989, the average was 323 pounds per hour and ranged from 166 to 516.

Size distributions of sea urchins landed in northern California in 1990 have changed somewhat, with a mean of 106 mm (103 mm in 1989). This reflects the larger minimum size of 90 mm that was adopted for northern California in June 1990. The mean size

of sampled sea urchins from the southern California fishery was 96 mm (94 mm in 1989). The percentage of sea urchins below the 76-mm minimum size in southern California declined to 6% (from 10% in 1989, and 17% in 1988), reflecting a change in harvesting practices in response to the minimum size regulations.

The sea urchin fishery is likely to come under added restrictive management in 1991. The objective of the new measures will be to further reduce harvesting pressure, especially in southern California. Resource surveys and fishery monitoring programs will continue to be important for evaluating management changes.

RECREATIONAL FISHERY

Catches from the California commercial passenger fishing vessel (CPFV, or partyboat) fleet (table 8) can generally be considered indicative of nearshore and offshore sport angler success. The CPFV fleet can locate and catch any species available within the fishing area. Catches can vary widely for latitudinally migratory species such as barracuda (*Sphyrna argentea*) and yellowtail (*Seriola lalandei*), and for highly migratory transoceanic species like albacore. Catches of resident species in nearshore areas may also show fluctuations associated with warmer oceanic regimes.

Partyboat landings for 1990—4.7 million fish—were 3% higher than in 1989. The 1990 year was a bonanza for the fleet, with tropical tunas coming well within overnight range of San Diego, and some

other migratory species like yellowtail (68,308 fish, ninth ranked) and barracuda (196,000 fish, sixth ranked) abundant. In addition, dolphinfish (also known as dorado) catches were at a record high of 31,000, ranking fifteenth. A sailfish was caught off Dana Point in late summer, representing a northerly range extension of about fifty nautical miles.

The rockfish complex ranked first, with 2.27 million fish, followed by Pacific mackerel, with just under a half million logged. Kelp bass ranked third, with catches increasing 64% over 1989; sand bass followed, with a slightly higher catch than last year.

The bonito catch was off 23% from 1989. Sculpin catches were about the same as last year. Salmon fishermen registered a moderate season of 87,000 fish. The lingcod take ranked tenth with 60,000 fish, a 22% decrease from last year. The yellowfin tuna catch was excellent (47,000 fish), ranking eleventh and making 1990 the second highest year on record for this species. The catch of highly desirable albacore was poor (3,600 fish) and just made the top twenty list. The striped bass sport fishery had another poor year (2,356 fish), with almost 200 fish over 1989 but far below the 10,000 fish in 1988. The catch of popular California halibut retained nineteenth place, although it declined 27%.

The high dolphinfish catch, the proximity of tropical tunas, and good catches of barracuda and yellowtail undoubtedly were related to a warmer oceanic climate. Sea-surface temperature anomalies were consistently positive off southern California from April through the end of the year, and coupled with negative upwelling indices, may partially account for the biological phenomena in the CPFV fishery of 1990.

TABLE 8
 1990 Commercial Passenger Fishing Vessel Catch

Species/species group	Thousands of fish	Rank
Rockfish	2,272	1
Pacific mackerel	468	2
Kelp bass	438	3
Sand bass	423	4
Bonito	260	5
Barracuda	196	6
Sculpin	159	7
Salmon	88	8
Yellowtail	68	9
Lingcod	60	10
Yellowfin tuna	47	11
Halfmoon	46	12
Ocean whitefish	45	13
Sheephead	34	14
Dolphinfish	31	15
Skipjack tuna	16	16
Flatfish (misc.)	15	17
Jack mackerel	8	18
California halibut	6	19
Albacore	3	20
Others	57	—
Total	4,740	

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Mary Larson, albacore

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Malcolm Oliphant, recreational fishery

David Parker, sea urchin

Larry Quirollo, Pacific whiting

Paul Reilly, Dungeness crab

John Sunada, swordfish and shark

Phillip Swartzell, California spiny lobster

David Thomas, groundfish

Paul Wild, California halibut

Compiled by Patricia Wolf and Terri Dickerson