

REVIEW OF SOME CALIFORNIA FISHERIES FOR 1989

California Department of Fish and Game
 Marine Resources Division
 330 Golden Shore, Suite 50
 Long Beach, California 90802

Total landings of fishes, crustaceans, echinoderms, and mollusks decreased slightly (3%) this year, after three years of increase. The 1989 landings remained well below the ten-year average, by approximately 20%. However, they exceeded the 1985 low by nearly 32%.

Pelagic wetfish landings continued the upward trend that began in 1985, with a 2% gain over last year (table 1). Jack mackerel landings nearly doubled from last year, and market squid landings continued to be high. Pacific herring landings increased to the highest level since 1982, and the take of northern anchovy and Pacific sardine also increased. Pacific mackerel landings decreased by 16%.

Groundfish landings increased slightly, but differed markedly in species composition from last year. California halibut landings increased slightly but have remained fairly constant over the last nine years.

Landings of swordfish and the common thresher shark increased in 1989. However, landings for both

the shortfin mako shark and the Pacific angel shark continued to decline.

Dungeness crab landings showed a slight increase, and Pacific Ocean shrimp landings continued to rise for the sixth straight year. Landings of the southern California spiny lobster were the highest since the mid-1950s.

Landings of the California red sea urchin decreased slightly, and the fishery is likely to come under increasingly restrictive management measures in 1990.

Albacore landings declined for the fourth consecutive year and reached an all-time low in 1989. Only 10% of the previous 25-year average was landed.

The sport catch increased, and rockfish retained the first-rank position.

PACIFIC SARDINE

The California Department of Fish and Game (CDFG) conducted sea surveys in May of 1988 to assess the spawning biomass of the Pacific sardine

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

Year	Pacific sardine	Northern anchovy	Pacific mackerel	Jack mackerel	Pacific herring	Market squid	Total
1966	439	31,140	2,315	20,431	121	9,513	63,959
1967	74	34,805	583	19,090	136	9,801	64,489
1968	62	15,538	1,567	27,834	179	12,466	57,646
1969	53	67,639	1,179	26,961	85	10,390	106,307
1970	221	96,243	311	23,873	158	12,295	133,101
1971	149	44,853	78	29,941	120	15,579	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	39,725	21,820	10,134	38,288	116,975

*Preliminary

(*Sardinops sagax*). The egg production area method (EPAM) was used to determine if the observed spawning area (based on the occurrence of sardine eggs) exceeded the minimum critical spawning area of 2,300 nautical miles² (n.mi.²), which is considered to indicate a 20,000-ton spawning biomass. A 20,000-ton spawning biomass is needed before a directed fishery for sardine can be permitted. Results indicated spawning activity over an area of about 2,508 n.mi.² As a result, on January 1, 1989, a 1,000-ton directed fishery for sardines was opened for the fourth consecutive year.

Of the 1,000-ton quota, 800 tons were allocated for landings south of Point Buchon, and 200 tons were allocated for landings to the north. Also established were a 350-ton quota (beginning on January 1) for live bait, and a 250-ton quota (beginning on March 1) for use as dead bait.

The southern allocation of the 1989 directed fishery closed on January 12, three days earlier than the previous year, with total landings of 924 tons. Of these landings, 34% were pure loads and another 32% contained at least 70% sardines. The fish were caught by the southern California mackerel purse seine fleet and were almost exclusively canned for human consumption.

The northern California directed fishery saw no landings until late February, and remained open until early April. The 23 landings totaled 258 tons, and almost all were pure loads of sardines. The fish were all purchased by a single processor and marketed for human consumption.

The 250-ton dead bait quota proved difficult to monitor. Processors were not required to specifically declare the intended use of purchased sardines. Unless a landing exceeded the allowable incidental tolerance limit (35% sardines by weight, mixed with other fish), sardines within that load were generally not declared as dead bait. The quota was reached on March 20, when an estimated 250 tons had been landed. Live bait landings reported by fishermen amounted to 111 tons, with an additional 194 tons estimated by Department observers on sport-fishing partyboats. As in 1988, young-of-the-year sardines did not make a strong showing in the 1989 live bait fishery.

Incidental landings of sardines in the mackerel fishery totaled 2,876 tons, down 7% from 1988 and reflecting the overall decrease of activity within the mackerel fishery. Sardines composed just under 6% of the mackerel landings, up slightly from the 5% observed in 1988. Fishermen continued to complain that the abundance of sardines interfered with mackerel fishing, and that sardines are displacing the

mackerel from traditional fishing grounds. The tolerance limit for incidentally landed sardines mixed with other fish remained at 35% by weight.

Landings from all sources, excluding live bait, totaled 4,308 tons in 1989, as compared to 4,172 tons in 1988 and 2,309 tons in 1987 (table 1). Of this year's catch, 93% can be attributed to southern California landings, and just under 7% to the northern California allocation of the directed fishery. Sardine sold for approximately \$100 per ton.

AB 2351, which became effective in September 1989, allocates the 250-ton dead bait quota among three geographic regions: 125 tons are reserved for landings south of Point Buchon, 50 tons for landings north of Point Buchon and south of Pescadero Point, and 75 tons for landings north of Pescadero Point. In addition, all sardine fishing for dead bait purposes must be accompanied by a written order from a processor; all fish landed must be kept in a whole condition; and the receipts must be labeled "For Dead Bait Only." This is to ensure that no fish allocated for dead bait will be used for other purposes, and to facilitate monitoring of landings against the quota.

Biomass estimation cruises using the EPAM were again conducted in 1989, and were expanded to include, for the first time, areas off northern Baja California as far south as Bahía de San Quintín. The area off central California north of Point Conception was not sampled in 1989 because no spawning activity was observed in this area during the 1988 cruise.

During the 1989 cruise, evidence of spawning was observed along the California coast out to the Channel Islands, from Santa Barbara south to Dana Point, and offshore in a large area west of Tanner and Cortez banks (figure 1), over a total area of 3,280 n.mi.² Evidence of spawning off Baja California was limited to a small area totaling 400 n.mi.² As in 1988, the total area over which spawning was observed exceeded what is considered to indicate a 20,000-ton spawning biomass; as a result, a 1,000-ton directed fishery for sardines was scheduled for 1990.

On December 7, the CDFG held a meeting for members of the sardine industry. The occasion provided an opportunity for the CDFG to present the methods and results of the fishery research that have led to the current and proposed management directives. The meeting also provided a forum for the industry to express its concerns and intentions regarding the sardine resource.

MARKET SQUID

Market squid (*Loligo opalescens*) landings in 1989 were 38,288 short tons (table 1): 31,011 tons (81%)

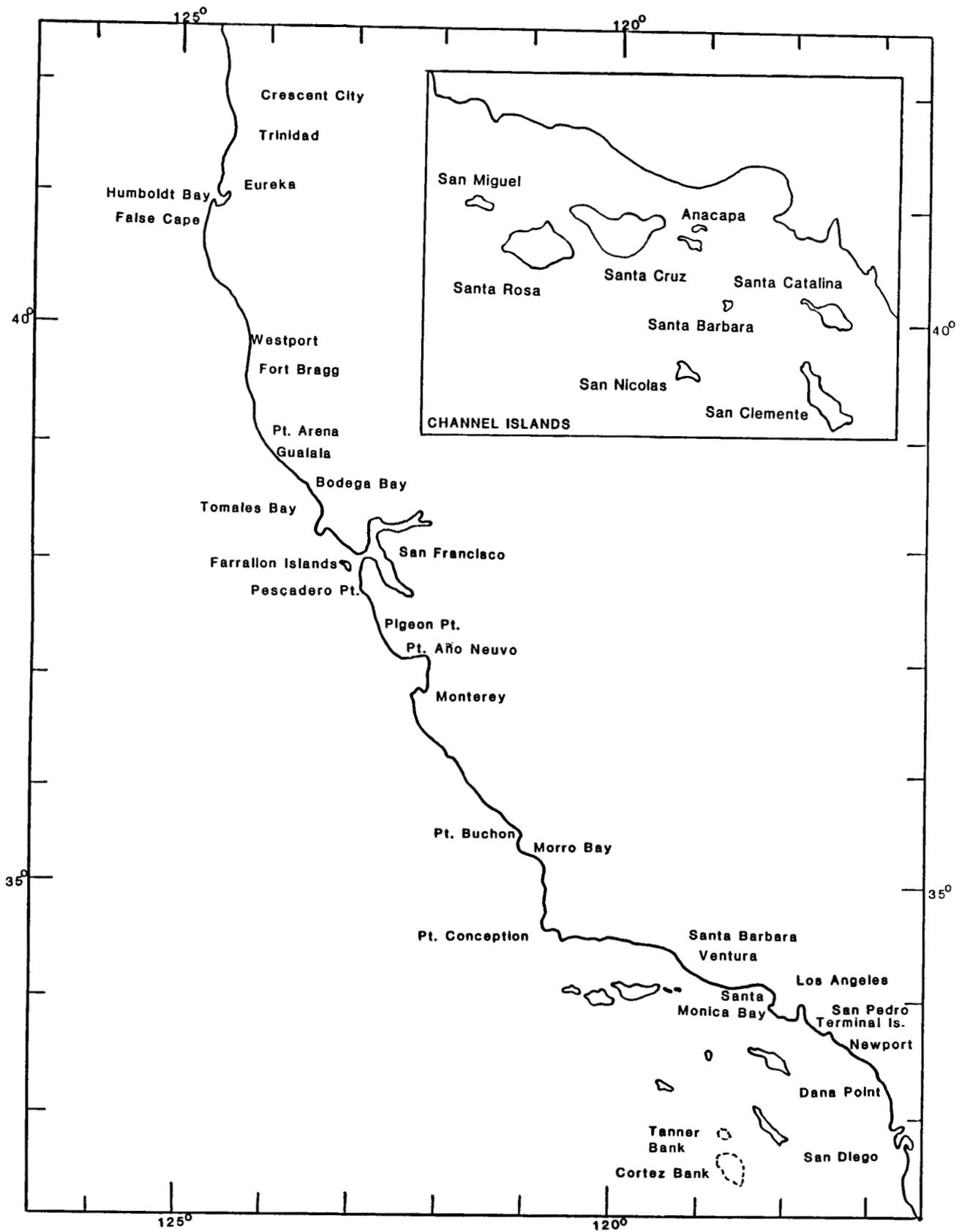


Figure 1. California ports and fishing areas.

were from the southern California fall-winter fishery; 7,274 tons (19%) from northern California (Monterey Bay area) spring-summer fishery; and 3 tons from other areas. The total ex-vessel value was approximately \$5.9 million. Ex-vessel prices typically fluctuate from year to year and during the year. The ex-vessel price paid in southern California continued to be lower than that paid in the Monterey area. Southern California fishermen were paid from \$120 to \$200 per ton, while Monterey's ex-vessel price started at \$200 per ton and increased to \$260 per ton after a mid-April strike. Within the past 20 years, the ex-vessel price has been as high as \$600 per ton.

Most squid were frozen for human consumption; some were sold fresh; some were used for dead bait; and some were used for live bait. Exported squid accounted for a large percentage of the total processed.

Annual squid landings during the last 20 years averaged 16,740 tons. Landings during years characterized by El Niño Southern Oscillation (ENSO), such as 1973, 1983, and 1984, were unusually low. However, large increases in landings in southern California and increased fishing effort in other areas in recent years suggest that the resource has been underutilized.

Before 1986, annual southern California landings averaged less than one-half of total statewide landings; since 1986, southern California landings have risen dramatically, averaging nearly 80% of the total. One reason for southern California's dramatic rebound following the 1983-84 ENSO is an increase in squid fishing effort around the Channel Islands off the coast of Santa Barbara (figure 1). During the 20 years before the 1983-84 ENSO, Santa Barbara area landings averaged about 1,500 tons per year; since then, landings have averaged about 11,700 tons per year. Several large Monterey-based boats now regularly participate in this fishery and deliver to Santa Barbara area ports. These squid are trucked to Monterey for processing.

During the last 20 years, Monterey Bay area annual landings averaged 6,060 tons. Since the 1983-84 ENSO, annual landings have averaged approximately 5,600 tons, slightly below the 20-year average and well below the annual average of 11,600 tons per year during 1978-82 (table 2). Landings of 7,274 tons in 1989 made this an above-average year. Of this total, 975 tons were landed at the port of Santa Cruz. These squid were caught north of Santa Cruz near Año Nuevo Island, an area fished only sporadically during post-ENSO years.

The Monterey Bay area fishery experienced major changes in 1989. Attracting lights were allowed for the first time in many years in the southern bight of Monterey Bay. Also, purse seiners were allowed to fish in this area, which before had been restricted to the use of lampara nets. By the end of the season, the Monterey Bay area round haul fleet had all converted to purse seine gear.

Despite the widespread use of attracting lights by nearly all the Monterey Bay fleet, the fishing community appears to be split on the issue of using lights. Many fishermen contend that lights disrupt squid spawning, which could adversely affect the fishery in the future. Others point out that southern California fishermen have used lights for many years without any apparent effects on spawning. They also claim that lights allow the fishermen to use shallower nets, which can be fished off the bottom, thus protecting squid egg clusters attached there.

In 1987 and 1988, the CDFG authorized three Monterey boats to experiment with purse seines in southern Monterey Bay to test their effectiveness relative to lampara nets, and their effects on squid egg clusters and bottom habitat. As a result of this study, all round haul nets were authorized in this area in 1989. Many fishermen were especially interested in the half-purse drum seine, which allows a smaller crew to work the gear. Continuing low ex-vessel squid prices and difficulties in finding enough crew have heightened interest in drum seines. Few boats,

TABLE 2
 California Market Squid Landings (Short Tons)

Year	Monterey	Southern California	Other	State total
1970	4,314	7,982	0	12,295
1971	8,323	7,435	trace	15,759
1972	6,129	3,950	0	10,080
1973	620	5,140	0	6,031
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	10,328	8,571	trace	18,899
1979	14,183	7,842	1	22,026
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	16,381	378	22,028
1988	5,330	35,348	363	41,040
1989*	7,274	31,011	3	38,288

*Preliminary

however, switched to drum seines this year, primarily because a major capital outlay this year was for powerful (and expensive) attracting light systems that typically cost from \$16,000 to \$20,000. More boats will probably convert to drum seines in the future.

PACIFIC MACKEREL

The year began with 19,120 tons of Pacific mackerel (*Scomber japonicus*) already landed through the first half of the 1988–89 season (July 1 through June 30). Current law allows an open fishery when the biomass exceeds 150,000 tons. Since the biomass was estimated to be 220,000 tons, no quota restrictions were in effect.

During the first three months of the year, mackerel landings were high, even though the sardine fishery in early January and poor weather throughout the period threatened to interfere with mackerel effort. Large Pacific mackerel, which had been relatively uncommon since the previous October, became more available in March. Landings declined during April, May, and June, as fishermen were occasionally hampered by rough weather and sometimes turned their attention to Pacific bonito (*Sarda chiliensis*). Catches of small and large fish were made, although large fish were reportedly difficult to find.

The 1988–89 season closed on June 30, 1989, with a total catch of 43,398 tons of Pacific mackerel. This is only slightly below the previous five-year season average. Although mackerel landings were lower than in the last two years, revenues for the San Pedro purse seine fleet from all fish species increased over last year, primarily because of higher landings of bluefin tuna (*Thunnus thynnus*) and record landings of squid. Pacific mackerel contributed 79% to statewide landings of mackerel, and nearly 99% of all Pacific mackerel landings were made in southern California.

The 1989–90 season opened on July 1, 1989, with no quota restrictions, based on a biomass estimate of 263,000 tons. Landings during the third quarter, which were only fair, were comparable to the previous quarter. Effort was often directed toward bluefin tuna, and in September, jack mackerel (*Trachurus symmetricus*) began to dominate landings. Fourth-quarter landings of Pacific mackerel were low. Jack mackerel dominated landings in October and November, and price disputes between fishermen and United Food Processors (UFP), a Terminal Island cannery, inhibited fishing and persisted through the quarter. UFP reportedly wanted to reduce the price paid to fishermen from \$135 to \$80

per ton for fish used for pet food. The purse seine fleet has seen the mackerel price decline steadily: in the early 1980s the canneries paid \$200 per ton, and over the last few years the price declined to \$155 per ton.

By the end of the year, only 15,447 tons of Pacific mackerel had been landed toward the 1989–90 season total. Landings of Pacific mackerel for the year totaled 39,725 tons (table 1). These are the lowest annual landings since 1985 and are 11% lower than the previous five-year average. Northern California landings contributed less than 1% to the year's total. This continues a steady decline in the proportion of the catch occurring in Monterey.

In general, market conditions were stable through the year. Processors continued to impose landing limits, which sometimes were as low as 20 tons per boat, per day, to limit landings of small fish. Two changes in southern California mackerel processing occurred in 1989. Coast Cannery, a pet food canning facility operated by Pan Pacific, ceased operation in October. In September, Starkist Seafoods' pet food production operation was renamed Heinz Pet Products, after the parent company.

The CDFG continued to conduct "night-light" surveys in which mackerel were sampled by hook and line, in an effort to develop an early, fishery-independent index of year class strength. Two cruises, one in April and another in May, were conducted this year. Results suggest that the 1988 year class is at least similar in strength to the 1986 year class. Fishery data support this conclusion: the 1988 year class—which as yearlings contributed nearly 50% by weight of the catch this year, and which appears to be very strong—and the 1986 year class—which contributed 13%—together made up most of the landings.

NORTHERN ANCHOVY

Landings of northern anchovy (*Engraulis mordax*) for reduction purposes in 1989 were limited primarily by poor market conditions. As in the 1987–88 reduction season, high fish meal prices during the 1988–89 season were not reflected in the price offered to local fishermen. California processors thought that an increase in price to \$35 per ton would attract some fishermen away from other species to anchovy, but few fishermen considered the price to be fair. For this reason, northern processors issued no orders during the latter half of the 1988–89 season. Although processors in the southern region issued orders for anchovy, local purse seine fishermen continued to concentrate on more lucra-

TABLE 3
Anchovy Landings (Short Tons) for Reduction

Season	Southern area	Northern area	Total
1967-68	852	5,651	6,503
1968-69	25,314	2,736	28,050
1969-70	81,453	2,020	83,473
1970-71	80,095	657	80,752
1971-72	52,052	1,314	53,366
1972-73	73,167	2,352	75,519
1973-74	109,207	11,380	120,587
1974-75	109,918	6,669	116,587
1975-76	135,619	5,291	140,910
1976-77	101,434	5,007	106,441
1977-78	68,467	7,212	75,679
1978-79	52,696	1,174	53,870
1979-80	33,383	2,365	35,748
1980-81	62,161	4,736	66,897
1981-82	45,149	4,953	50,102
1982-83	4,925	1,270	6,195
1983-84	70	1,765	1,835
1984-85	78	0	78
1985-86	0	1,595	1,595
1986-87	0	42	42
1987-88	0	122	122
1988-89*	0	258	258

*Preliminary

tive mackerel and squid. Consequently, no reduction landings took place in either the northern or southern regions after December. The 1988-89 season closed on June 30, with six landings totaling 258 tons (234 MT; table 3).

National Marine Fisheries Service biologists estimated the 1989 spawning biomass of northern anchovy to be 235,892 tons (214,000 MT) and the total biomass to be 1,111,118 tons (1,008,000 MT). Normally when the spawning biomass is less than 300,000 MT, the Anchovy Fisheries Management Plan allows for zero take of northern anchovy for reduction purposes. However, spawning biomass was low because cold sea-surface temperatures caused one-year-old fish to mature more slowly and not be actively spawning when the surveys were conducted. Because of this anomaly, the Pacific Fisheries Management Council (PFMC) determined that an emergency existed in the northern anchovy fishery and requested the secretary of commerce to approve regulations that would allow a 5,000-MT reduction fishery during the 1989-90 season. The secretary approved the emergency rule, which went into effect on September 25, 1989.

For the first time since the 1984-85 season, reduction landings were recorded in southern California. Two landings totaling 120 tons (109 MT) were delivered to a Terminal Island cannery in December 1989. The price paid was \$40 per ton. However,

southern California processors stated that there were no plans to reduce anchovies for the rest of the 1989-90 season. No landings were made in the northern area through December 1989, and orders are not anticipated before the season's end.

Total anchovy landings during 1989 included 120 tons for reduction, 2,580 tons for nonreduction purposes (table 1), and 5,064 tons for live bait. Although live bait landings increased from 1988, most live bait fishermen rated 1989 as only slightly better than average.

PACIFIC HERRING

The 1989 annual roe herring catch (*Clupea harengus pallasii*) increased 4%, to 10,134 tons (table 1), and the 1988-89 seasonal (December-March) roe herring catch also increased 4%, to 10,022 tons. California's 1988-89 roe herring quota of 9,990 tons was taken, because of a quota overrun of 236 tons in San Francisco Bay. Even though the 1988-89 Tomales Bay roe herring quota was reduced from 750 to 400 tons, there was a quota shortfall of 187 tons in Tomales Bay. In Crescent City Harbor, the 30-ton quota was taken; in Humboldt Bay there was a 16-ton shortfall on the 60-ton quota.

The 1988-89 San Francisco Bay herring spawning biomass estimate was 66,000 tons; hydroacoustic and spawn survey estimates agreed. The population declined about 5% from the 1988 estimate because average recruitment of the 1987 year class was not strong enough to maintain the increasing trend in abundance apparent since the 1982-83 El Niño.

In Tomales Bay the herring biomass continues to decline. The 1988-89 spawning-ground surveys estimated spawning escapement of only 167 tons. Spawning biomass, which includes the catch, was only 380 tons. Both are historic lows for Tomales Bay. The average structure of the Tomales Bay herring catch — primarily age 4- through 7-year-olds — appears normal. This does not support the decline in abundance of the Tomales Bay population. It is believed that most of the Tomales Bay population is avoiding the bay because of the recent drought and lack of freshwater runoff near historic spawning areas.

Based on 1988-89 spawning biomass estimates, the 1989-90 San Francisco Bay roe herring quota remained at 9,500 tons. However, because of the lack of spawning escapement in Tomales Bay, further restrictions were placed on the 1989-90 season. A spawning threshold of 2,000 tons was established for

the 1989–90 Tomales Bay season, with no fishing allowed until 2,000 tons of herring had spawned. If 2,000 tons escapement was reached before January 31, the fishery would open with a 400-ton quota.

The 1989–90 season began quickly in San Francisco Bay, and the December quota of 1,999 tons was taken easily. In the Tomales Bay area no herring were caught in December, and there was no spawning activity.

At the beginning of the 1989–90 season herring buyers were offering \$1,000 per ton for gill net herring, the same as last season. However, the price offered for round haul herring dropped to \$400 per ton. Japanese buyers are willing to pay more for the larger, better-quality herring caught by gill nets.

GROUND FISH

California's 1989 commercial groundfish harvest was 40,510 MT, with an ex-vessel value of approximately \$28,879,000. All-species 1989 landings increased only 3%, or 1,090 MT, from 1988 but differed markedly in species composition (table 4). Setnet landings continued their recent decline, contributing less than 5% of all 1989 groundfish landings. The general historical pattern of landings by gear continued during 1989. Bottom and midwater trawl landings accounted for 86.2% of total landings, followed by line gear (6.6%), setnets (4.8%), and traps (2.4%). The size and composition of the trawl, trap, and longline fleet did not differ markedly from recent years. Rockfish (*Sebastes* spp.), Dover sole (*Microstomus pacificus*), Pacific whiting (*Merluccius productus*), and thornyheads (*Sebastolobus* spp.) were the principal species harvested in 1989.

The domestic shore-based Pacific whiting fishery in California achieved record landings during its six-

month season. This midwater-trawl fishery, located off Eureka and Crescent City, has grown from approximately 3,000 MT in 1987 to 7,300 MT in 1989. In the 1989 Pacific whiting fishery a conflict occurred between shore-based and joint venture (JV) operations; the shore-based trawlers testified before the PFMC that the large and highly efficient JV fleet dissipated whiting schools within the small operating radius of the shore-based fleet. The JV fishery involves U.S. trawl vessels delivering whiting to foreign processing vessels at sea. The fleet concentrated its effort off northern California early in the season. Although CDFG scientists and others could not verify this alleged JV impact, it was cited by processors as the cause for failure to meet a domestic 1989 production goal of 15,000 MT. A reduced whiting optimum yield (OY) and an increased JV demand in 1990 are expected to intensify conflicts within the industry.

Despite limits on trip poundage and frequency for deepwater-assemblage landings of sablefish (*Anoplopoma fimbria*), Dover sole, arrowtooth flounder (*Atheresthes stomias*), and thornyheads, a robust Asian market drove thornyhead landings to a record high of 5,319 MT. Much of the 70% increase in thornyhead landings since 1987 is due to the development of a market for headed-and-gutted long-spine thornyheads (*Sebastolobus altivelis*), which are typically too small to fillet for domestic consumption. Additional regulations and reduced demand apparently contributed to a 6% drop from 1988 in Dover sole landings.

Federal and state regulations for 1989 affected the harvest of sablefish, Dover sole, thornyheads, and widow rockfish (*Sebastes entomelas*). A coastwide, Washington-Oregon-California (WOC), widow rockfish OY of 12,400 MT (300 MT greater than in 1988), with a 30,000 pound-per-week trip limit was imposed. Excellent fishing conditions in the first quarter of 1989 accelerated widow rockfish landings. As a result, the PFMC's Groundfish Management Team projected that a 51% reduction in rate of landings would be required to extend the fishery to year's end. Consequently, the PFMC reduced the trip limit to 10,000 pounds per week, or 20,000 pounds biweekly, effective April 26, 1989. In early October a by-catch-only trip limit of 3,000 pounds was imposed to further slow the fishery. The widow rockfish quota was eventually filled, and the fishery was closed in mid-December. The midseason restrictions undoubtedly contributed to the 15% reduction in California's widow rockfish catch; fishermen reported that fishable aggregations were

TABLE 4
 California Groundfish Landings (Metric Tons)

Species	1988	1989	Percent change
Dover sole	8,176	7,713	-6
English sole	1,062	1,015	-4
Petrale sole	785	840	7
Rex sole	840	735	-13
Thornyheads	4,524	5,319	17
Widow rockfish	1,847	1,566	-15
Other rockfish	9,846	9,978	1
Lingcod	873	1,262	45
Sablefish	3,784	3,583	-5
Pacific whiting	6,541	7,302	12
Other groundfish	1,142	1,197	5
Total	39,420	40,510	3

available and quite vulnerable to trawl gear during most of the year off northern California.

Regulation of the WOC sablefish fishery increased in complexity during 1989. The year began with an OY range of 10,400 to 11,000 MT. The intent was to manage toward 10,400 MT, with a 600-MT reserve to accommodate by-catch and gear other than trawl if OY was attained before year's end. Initial allocations, after a set-aside of 22 MT for Native Americans, were 5,397 MT (52%) for trawl and 4,981 MT (48%) for other gear. To maintain a year-round trawl fishery, a trip limit was imposed of 1,000 pounds, or 45% of the deepwater assemblage of sablefish, Dover sole, thornyheads, and arrow-tooth flounder — whichever was greater. The intent was to discourage targeting on sablefish, while allowing sablefish landings from the deepwater assemblage fishery. However, this trip limit did not slow landings sufficiently. At its April 1989 meeting, the PFMC modified the trip limit and transferred the 600-MT reserve and 400-MT other-gear quota to the trawl fishery in order to minimize trawl discards late in the year. The revised trip limit restricted the deepwater assemblage to one landing per week of not more than 30,000 pounds total. Of this total, sablefish could constitute 1,000 pounds or 25% by weight, whichever was greater. On October 4, PFMC removed the assemblage restrictions but retained the sablefish limits until year's end. Preliminary analysis revealed that the assemblage trip-frequency and percentage restrictions effectively prevented premature quota attainment. California trawl sablefish landings of 2,200 MT accounted for approximately 40% of WOC landings.

Directed nontrawl sablefish fishing was terminated on July 17, when only 200 MT of quota remained for incidental catches. A 100-pound trip limit subsequently was imposed and remained in effect until early October. In response to testimony from the Newport, California, dory fleet and northern California rockfish longline representatives, PFMC increased the limit to 2,000 pounds per trip, or 20% of all groundfish aboard. California accounted for 1,383 MT, or 31%, of the 4,500 MT landed by nontrawl gears.

DUNGENESS CRAB

California Dungeness crab (*Cancer magister*) landings during the 1988–89 season totaled 9.2 million pounds, only slightly more than the 1987–88 landings of 8.7 million pounds.

Landings for the northern California ports of Crescent City, Trinidad, Eureka, and Fort Bragg

(figure 1) were 5.42, 0.90, 1.28, and 0.24 million pounds, respectively. Production in Crescent City almost doubled, and total northcoast landings exceeded 1987–88 seasonal landings by 2.22 million pounds. A total of 318 vessels made 5,436 trips and averaged 1,399 pounds per trip. The price paid to the fisherman on December 1, opening day, was \$1.25 per pound.

The 1988–89 season in the San Francisco/Bodega Bay area ended with a landing total of 1.44 million pounds. This is slightly less than half of the total for the previous season. Approximately 215 boats made a total of 2,866 trips for an average of 501 pounds per trip.

PACIFIC OCEAN SHRIMP

Statewide landings of Pacific Ocean shrimp (*Pandalus jordani*) in 1989 increased to 13.3 million pounds, from 11.1 million pounds landed in 1988. This was the second largest total ever and the sixth consecutive rise in statewide landings. Areas of production were Area A (Oregon border to False Cape) Area B-1 (False Cape to Point Arena), and Area C (Pigeon Point to the Mexican border; figure 1).

Shrimp landings at Area A ports totaled 12.5 million pounds — a 2.2 million pound increase over 1988 deliveries. These landings tie with 1978 as the second largest ever. The total landings comprised 11.74 million pounds from Area A waters, 250,000 pounds from Area B-1, and 465,000 pounds from Oregon waters. The season opened on April 1, with fishermen receiving a split price of \$0.40 per pound for shrimp at or below 140 per pound and \$0.25 per pound for smaller shrimp. Shrimpers were on strike for 26 days in July over a price disagreement, which was finally settled at \$0.35 per pound for the larger size group (140 count or better), with no guarantee of any payment for smaller shrimp.

A total of 56 boats (36 single-rigged and 20 double-rigged) delivered shrimp to Area A ports during 1989, down one boat from 1988. Single-rigged vessels had an average seasonal catch rate of 543 pounds per hour, an increase of 55 pounds per hour over 1988. Double-riggers averaged 842 pounds per hour, up from 758 pounds per hour in 1988.

One-year-old shrimp made up 65% of the catch in April and 85% in October during 1989. This was approximately a 10% decrease in one-year-olds from 1988. There were no incoming year-class (zero-aged) shrimp found in the sampled catch, the first year-class failure since the total fishery failure in 1983.

Landings in area B-1 were 833,000 pounds this season, compared to 379,000 pounds in 1988. Four local single-rigged boats, along with one double-rigged and two single-rigged vessels from Crescent City and one single-rigged boat from Santa Cruz, fished the B-1 area this year. Ninety-one percent of the catch was landed at Noyo Harbor in Fort Bragg. Forty percent of the Fort Bragg landings occurred in April and 73% in April, May, and June combined. One local boat accounted for 54% of the Fort Bragg landings.

Catch-per-unit-of-effort (CPUE), measured as pounds landed per delivery, started at 14,600 pounds per delivery in April. CPUE declined to 9,000 pounds in May and June, climbed back to 14,200 pounds in August, and declined again to 4,000 pounds in October. One-year-olds made up 27% of the sampled catch in April, when ovigerous females were also noted. In May, one-year-olds composed 73% of the sampled catch and ranged from 40% to 52% of the catch through the end of the season. There were no zero-aged shrimp noted during the season. The count per pound increased in May, causing several fishers to return to groundfish trawling until the count improved.

The total shrimp catch for Area C in 1989 was 24,000 pounds, down considerably from the 380,000 pounds landed in 1988. This was the least productive year since 1978, when no shrimp were landed in Area C. Four single-rigged vessels made five trips and averaged 314 pounds per hour.

SWORDFISH AND SHARK

Landings of swordfish (*Xiphias gladius*) for 1989 rose to 2.8 million pounds, a 15% increase from 1988 (table 5). Harpoon fishermen reported landing

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*	388,312	2,850,734	647,865	267,577

*Preliminary

only 422 fish, making 1989 one the poorest harpoon years on record. Drift gillnetters reported landing 11,190 fish, nearly the same number reported in 1988.

Fish taken early in the season (August–September) were much larger (averaging 150 pounds) than fish caught later in the year (averaging 125 pounds). Catch locations were centered off San Francisco, Morro Bay, and San Diego (figure 1).

CPUE for gill net boats remained nearly identical to 1988. Both years had a catch rate of two fish per day, per boat. The CPUE for harpoon gear was 0.33 fish per day, per boat in 1989 and 0.40 fish per day, per boat in 1988.

Common thresher shark (*Alopias vulpinus*) landings in California during 1989 reached 647,865 pounds, 17% more than the 550,000 pounds in 1988. No thresher sharks were landed in Oregon or Washington during 1989 because these states ended their permit fishery, mainly because of decreased interest by local fishermen, higher incidental catch of marine mammals and leatherback turtles, and concern for the status of the resource. Currently, the Pacific States Marine Fisheries Commission is coordinating the development of a coastwide management plan.

Shortfin mako shark (*Isurus oxyrinchus*) landings decreased 20% from 1988. Of the 388,312 pounds taken, 46% was caught by the experimental drift longline fleet and the remainder by drift gill net boats. Most of the fish were taken off central and southern California during the summer and fall. The California Fish and Game Commission reauthorized the use of drift longline gear for 1990 under the conditions of a 175,000-pound quota and the development of a market for blue shark (*Prionace glauca*), specifying that 40,000 pounds be marketed for human consumption.

Pacific angel shark (*Squatina californica*) landings in 1989 continued their decline for the third straight year, reaching only 267,577 pounds. A management plan establishing a minimum size limit was enacted in 1989 to protect juveniles and a portion of the spawning stock. Reduced availability, decreased market demand, and the size limit appear responsible for the lower landings. The fishery continued to be centered off Santa Barbara and Ventura counties, although some landings occurred in San Diego and San Pedro (figure 1).

CALIFORNIA HALIBUT

California halibut (*Paralichthys californicus*) landings for 1989 were 550 MT, 9% more than the 505 MT recorded in 1988 (table 6). Catches over the last

five years have remained fairly constant, averaging 542 MT, with landings for 1989 exceeding the 13-year average of 448 MT. During 1989, 55% of the halibut landings occurred north of Point Conception. Landings south of Point Conception accounted for the remaining 45%, a 7% decrease from 1988.

The highest landings occurred during winter and fall, with peak catches in February (58 MT) and October (60 MT). Entangling nets (trammel and set gill nets) accounted for 51% of all halibut taken, followed by trawl (20%), unknown gear (16%), hook and line (11%), and other gears (2%). Most of the trawl-caught (91%) and hook-and-line-caught (93%) halibut were taken off central California. The southern California area accounted for nearly 61% of all halibut taken by entangling nets; 39% came from north of Point Conception. Ex-vessel prices for California halibut ranged from \$0.45 per pound in San Francisco to \$5.35 per pound in Ventura, and averaged \$2.25 per pound statewide.

CALIFORNIA SPINY LOBSTER

The southern California spiny lobster (*Panulirus interruptus*) fishery landed 650,000 pounds during the 1988–89 season (first Wednesday in October to first Wednesday after March 15), making it the best season since 1955–56, when 790,000 pounds were landed.

Historically, landings of lobster from California waters peaked at 1.1 million pounds in the 1949–50 season. Seasonal landings generally declined over the next 25 years, reaching a low of 152,000 pounds in 1974–75. Since then, there has been a general upward trend.

The 1988–89 season's total is an increase of 173,000 pounds (36%) from the 1987–88 season, in spite of a slight decrease in participating fishermen.

Only 303 permits were issued, down 5.6% from the 1987–88 level of 321. The number of permittees has decreased each season since 1984–85.

The remaining fishermen, however, may be fishing a greater number of traps, keeping effort high. Most of the catch was taken early in the season: 50% in October, 19% in November, and 12% in December. The remaining 19% was caught from January to March.

Ex-vessel price ranged from \$5.00 to \$7.00 per pound, averaging about \$5.50. With landings at 650,000 pounds, the fishery was worth \$3.6 million to the fishermen, a \$1.1 million (43%) increase over the previous season.

ALBACORE

In 1989, albacore (*Thunnus alalunga*) landings in California reached an all-time low. Only 914 tons of albacore were brought in; this is approximately 10% of the previous 25-year average. For the past five years, commercial catches of albacore have declined substantially. From 1984 to 1987, season totals decreased by 50% each year. In 1988 and 1989, the rate of decline slowed to 20% per year (figure 2). Fishing effort this year was moderate, with 225 boats participating in the fishery. Of these, 78 landed over a ton of albacore.

The season had a promising start in July. Catches were reported at Rosa Bank and Geronimo Island, off southern Baja California, as well as off the central California coast. In addition, toward the end of July, a good sport fishery developed off southern California. As the season progressed, however, it became apparent that the center of fishing activity was once again off the Washington coast. Seventy percent of California's albacore fleet spent August through September in the north. A few vessels even followed the albacore as far north as the Queen

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

*Preliminary

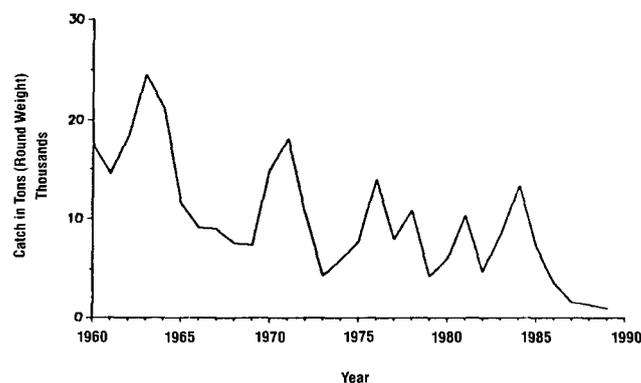


Figure 2. Annual albacore landings for California, 1960–89

Charlotte Islands, Canada, before returning home in October. Drift gill net boats fishing primarily off central California had incidental catches of four albacore per day throughout the season. The fish caught off California ranged between 11 and 15 pounds on the average. Very few large fish (greater than 25 pounds) were seen.

Price agreements between the Western Fishboat Owners Association and Pan Pacific and Starkist canneries began at \$1,500 per ton for fish over 9 pounds and \$1,000 per ton for fish 9 pounds and under. This was a drop of \$200 per ton from the 1988 price and was due mainly to the large quantities of albacore coming in from Japan. In addition, vessels landing at ports other than Terminal Island were charged a shipping fee, which reduced the price paid by another \$200 per ton. By the end of August, the shipping fee was eliminated to encourage fishermen to sell their loads to the canneries instead of directly to the public. Overall, dockside sales increased 3% in 1989.

Oceanic and market conditions did not appear to influence the poor season in California this year. A strong corridor (warm water/cold water front) developed in June and should have led albacore into southern California waters and then along the coast. The salmon season was poor, so albacore fishermen were not drawn away to that fishery. The poor albacore season in California can generally be attributed to a lack of large albacore off southern California and an above-average season off Washington. Fishermen had a different opinion: many considered foreign high-seas drift gillnetting to be the cause.

RIDGEBACK AND SPOT PRAWN

Ridgeback prawn (*Sicyonia ingentis*) are fished commercially, primarily by otter trawl. They may be trawled by permit from October 1 through May 31. During the restricted period an incidental catch of 50 pounds is allowed. Landings for 1989 were approximately 176,104 pounds, 23% greater than the previous year's catch (table 7). Most of the catch came from the Santa Barbara Channel (figure 1). Log data showed a CPUE of 66 pounds per hour, virtually unchanged from last year. The average ex-vessel price in the Santa Barbara region was \$1.25 per pound.

Spot prawn (*Pandalus platyceros*) landings increased to 179,718 pounds in 1989, about 8% more than in 1988 (table 7). The spot prawn is a larger shrimp and brings a higher price than the ridgeback.

TABLE 7
 Ridgeback Prawn and Spot Prawn Landings (1,000s of Pounds)

Year	Ridgeback prawn	Spot prawn
1980	276	69
1981	193	369
1982	141	300
1983	157	109
1984	623	49
1985	905	64
1986	672	102
1987	242	88
1988	143	167
1989*	176	179

*Preliminary

Originally caught in traps, spot prawns were predominantly caught by trawl by the mid-1970s. With the recent increasing demand for live products, trapping is on the increase. For the second year, log data indicate that just over half the catch is taken by traps.

Spot prawns may be trawled by permit from February 1 through October 31. During the restricted period, an incidental catch of 50 pounds is allowed. Spot prawns can be harvested by trap year-round. Log data from 11 boats showed a healthy CPUE of 75 pounds per hour. Trawling took place in the Santa Barbara Channel, Santa Monica Bay, and off Santa Catalina Island (figure 1). Trapping occurred in the same locations and also off San Diego. Ex-vessel price in the Santa Barbara region was \$3.50 to \$5.00 per pound.

SEA URCHIN

In 1989 the red sea urchin (*Strongylocentrotus franciscanus*) fishery continued to be one of the major fisheries in the state. Landings for 1989 are estimated to be 50.9 million pounds, a 2.1% decrease from 1988 (table 8). Northern California landings are down 12.4% from 1988, whereas those from southern California increased 12.6%. Once again, Fort Bragg led all ports, with 30% of the statewide total. The southern California ports of Santa Barbara, Ventura-Oxnard, and San Pedro-Los Angeles had 11%, 16%, and 15% of the statewide total. The reduction in northern California landings is also reflected by a 20% drop in average pounds per landing from 1988. These decreases are attributed to the continued reduction of high-density, virgin stocks in northern California.

Divers, using surface-supplied air, harvest sea urchins by raking them into mesh bags, which are then air lifted to the surface and winched aboard the vessel. CPUE is measured as pounds harvested per

TABLE 8
 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

*Preliminary

diving hour. The northern California average was 570 pounds per hour in 1989, compared to 505 pounds per hour in 1988. In southern California the 1989 average CPUE was 323 pounds per hour, ranging from 166 at the Palos Verdes Peninsula to 516 at San Nicolas Island; in 1988, the average was 286 pounds per hour and ranged from 160 to 393.

Logbook data show that the majority of harvesting effort in northern California occurred between Fort Bragg and Gualala (figure 1), but increased effort also took place in the Westport area to the north and at the Farallon Islands to the south. Over 60% of the effort in southern California was expended at the Channel Islands, with 37% at the four northern islands and 17% at three of the southern islands. The San Diego coastal area was the highest mainland zone, receiving 15% of the effort.

Size distributions of sea urchins landed in northern California have changed slightly, with a mean size of 103 mm (108 mm in 1988). Only 3.6% of the samples were smaller than the 76-mm minimum size, which was adopted in March 1989. This new size regulation appears to have affected harvesting practices in southern California. The mean size of sampled sea urchins was 94 mm (91 mm in 1988), and the overall percentage of sea urchins below the minimum size dropped from 17% in 1988 to 10% in 1989. In coastal areas such as Santa Barbara and the Palos Verdes Peninsula, percentages of undersize sea urchins decreased from as high as 38% in 1988 to as low as 10% in 1989.

The sea urchin fishery is likely to come under increasingly restrictive management measures in

1990. The objective of these new measures will be to further reduce harvesting pressure, especially in northern California. Resource surveys and fishery monitoring programs will continue and will be increasingly important for evaluating management changes.

RECREATIONAL FISHERY

Catches from the California commercial passenger fishing vessel (CPFV, or partyboat) fleet 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 (*Sphyræna 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 1989—4.4 million fish—were slightly higher than in 1988. Rockfish maintained its first-rank position, with 2.1 million fish caught; this is about a 15% increase over 1988 (table 9).

Sand bass (*Paralabrax nebulifer*) landings again exceeded kelp bass (*Paralabrax clathratus*) landings, which increased 16% over 1988. Sculpin (*Scorpaena guttata*) maintained its sixth-place ranking: 25% more fish were caught than in 1988. The barracuda

TABLE 9
 1989 Commercial Passenger Fishing Vessel Catch

Species/species group	Thousands of fish	Rank
Rockfish	2,135	1
Sandbass	415	2
Kelp bass	373	3
Pacific mackerel	350	4
Bonito	322	5
Sculpin	161	6
Barracuda	133	7
Salmon	110	8
Lingcod	75	9
Halfmoon	67	10
Yellowtail	61	11
Ocean whitefish	44	12
Albacore	29	13
Flatfish (misc.)	28	14
Sheephead	22	15
Skipjack tuna	20	16
Yellowfin tuna	17	17
White croaker	15	18
California halibut	9	19
Bluefin tuna	6	20
Others	61	—
Total	4,453	

catch was still well above the lower catches in the 15 years before 1987. Salmon (*Oncorhynchus* sp.) also had a good year. The lingcod (*Ophiodon elongatus*) take increased 19%. Albacore finally made the top 20, although mostly small fish in the eight-pound range were caught. The highly desirable California halibut retained nineteenth place with only 9,000 fish, a 25% decrease from 1988. Striped bass (*Morone saxatilis*) had a poor year: a little over 2,000 fish were caught, as opposed to over 10,000 in 1988.

Contributors:

Kristine Barsky, ridgeback and spot prawns
Patrick Collier, Pacific Ocean shrimp
Cedric Cooney, northern anchovy
Gary Galovich, Pacific sardine
Frank Henry, groundfish
Mary Larson, albacore
Robert Leos, market squid
Malcolm Oliphant, recreational fishery
David Parker, sea urchin
Jerome Spratt, Pacific herring
John Sunada, swordfish and shark
Phillip Swartzell, California spiny lobster
Patricia Velez, California halibut
Ronald Warner, Dungeness crab
Patricia Wolf, Pacific mackerel

Compiled by Terri Dickerson