REVIEW OF SOME CALIFORNIA FISHERIES FOR 1988

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Total landings of fishes, crustaceans, and mollusks increased (10%) for the third year in a row, following a decline from 1981 to 1985. Although still below the average of the last 10 years, 1988 landings considerably exceeded (33%) the 1983 low.

Pelagic wetfish landings continued the upward trend that began in 1985, with a gain of 19% over last year (table 1). The increase was due to a record squid catch, which ranks as the highest annual total in the history of the fishery, and exceeds the previous (1981) high by nearly 60%. Landings of Pacific and jack mackerel decreased, while the take of anchovy and Pacific herring increased slightly. Recovery of the Pacific sardine continued, although slowly; landings rose substantially over last year.

A slight decrease in groundfish landings was again noted, though it was probably due more to a decrease in effort than availability. California halibut landings also declined slightly, but still exceeded the 10-year average. Similarly, the lobster catch, though down from last year, was well above the average for the past 20 years.

Pacific ocean shrimp landings improved greatly. Dungeness crab landings also showed an increase, though slight. Albacore landings declined, for the third consecutive year, to the lowest annual total since 1934.

The sportfish catch, which increased overall, reflected an increase in rockfish and nearshore species, and a decrease in pelagic species.

PACIFIC SARDINE

The California Department of Fish and Game (CDFG) conducted sea surveys in July 1987 to determine the spawning biomass of Pacific sardines (*Sardinops sagax*). These surveys consisted of (1) evaluating the spawning biomass relative to 20,000 short tons, based on the spawning area as determined from the occurrence of sardine eggs (egg production area method), and (2) estimating adult reproductive parameters for use in an egg production method (EPM) of biomass estimation. The observed spawning area was about 1,850 nautical miles^2 (n.mi.^{2}). Eggs were found off the San Diego

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	9,512	63,958
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	15,756	90,897
1972	186	69,101	54	25,559	63	10,303	105,266
1973	76	132,636	28	10,308	1,410	6,031	150,489
1974	7	82,691	67	12,729	2,630	14,452	112,576
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	16,958	128,294
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	2,010	72,121
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	12,188	8,405	23,454	92,938
1987	2,309	1,595	45,890	13,055	9,258	22,055	94,162
1988*	4,170	1,618	44,510	10,813	9,721	40,865	111,697

*Preliminary

coast and near Tanner and Cortez banks (figure 1), where they had not been collected in surveys conducted since 1985. The critical spawning area indicative of a 20,000-ton biomass was estimated to be 500 n.mi.^{2} in 1987. The results of the egg production area survey thus provided for the opening of a 1,000-ton directed fishery on January 1, 1988. This was the third consecutive year of directed fishing allowed since the moratorium on fishing sardines was enacted in 1974.

The character of the directed fishery was very different in 1988 than in the previous two years. This year, the fishery was closed on January 15, whereas the fishery extended until April 17 in 1987, and July 11 in 1986. An estimated 1,085 tons were landed in the 1988 fishery, and 81% consisted of pure loads brought in by the southern California mackerel purse seine fleet. The fish were canned and test-marketed for human consumption and as pet food. In the previous years' fisheries, over 60% of the landings were made by a single lampara vessel, and the primary use was as dead bait for the central California striped bass recreational fishery.

Incidental landings of sardines in the mackerel fishery totaled 3,085 tons in 1988; this represents increases of 64% over landings in 1987, and 267% over 1986. Sardines constituted 5% of the mackerel catch for the year, as compared to 3% in 1987 and 1% in 1986. In 1988 fishermen complained that abundant sardines were eliminating some traditional mackerel fishing grounds, particularly around some of the northern Channel Islands. Landings of sardines from all sources totaled 4,170 tons, as compared to 2,310 tons in 1987.

Young-of-the-year sardines did not make a strong showing in the 1988 live bait fishery. Most of the sardines in the live bait were at least one year old. A total of 55 tons was reported by fishermen, with a total of 155 tons estimated by Department observers on partyboats. This compares to a reported total of 240 tons, and an estimated total of 855 tons, landed in 1987.

Several legislative changes during 1988 affect the take of sardines: the tolerance limit for incidentally taken sardines mixed with other species was increased from 25% to 35% by weight; adjustments to the tolerance limit will now be based on fish taken or wrapped, rather than fish landed; 20% of the directed fishery quota will be reserved for ports of landing north of Point Buchon (figure 1); and a special quota of 250 tons (500 tons if the directed fishery quota increases to 2,500 tons or more), established specificially for dead bait purposes, will open on March 1 of each year.

Results of the 1987 EPM biomass estimate were finalized in early 1988. Estimates of adult reproductive parameters were similar to those obtained in 1986, warranting incorporation of these new estimates into the egg production area method. The new estimate of critical spawning area is 2,300 n.mi.^{2} The biomass estimate for 1987 was 17,290 tons, with a coefficient of variation of over 90%, due primarily to the variance in the estimate of egg production rate.

Biomass estimation cruises were again conducted in May and June 1988. Surveys were made off central California (north of Monterey Bay to Point Conception), and also off southern California (Point Conception to the Mexican border), with increased coverage of the offshore banks. No eggs were collected off central California, and the adult females collected were in nonspawning or prespawning states. Spawning observed off southern California was less extensive around the northern Channel Islands than in 1987, probably because of intense upwelling and low water temperatures coinciding with the survey. However, spawning along the southern coastal portion of the survey (San Onofre to San Diego) and over the offshore banks was more extensive in 1988. The observed spawning area for 1988 was 2,560 n.mi.^{2} As a result, a directed fishery was opened on January 1, 1989.

A sardine management workshop, involving state, federal, and industrial biologists, was held by the CDFG in September 1988. A review of information on the status of the sardine resource led to the consensus that an increase in current quotas was not warranted. An EPM estimate of the spawning biomass measured in 1988 was completed by May 1989. In June 1989, egg cruises were conducted in an expanded area off southern California, and off northern Baja California as far south as Bahía de San Quintin.

NORTHERN ANCHOVY

Landings of northern anchovy (*Engraulis mordax*) for reduction purposes in 1988 were limited primarily by poor market conditions. Although fish meal prices rose dramatically during the 1987–88 reduction season, as a result of the drought-impacted domestic soybean market and the inability of local processors to obtain anchovy from South America, this increase was not reflected in the price of $25–$30 per ton offered to local fishermen. Northern processors issued no orders during the latter half of the 1987–88 season. Although processors in the southern region issued orders for anchovy, local purse seine fishermen continued to concentrate on

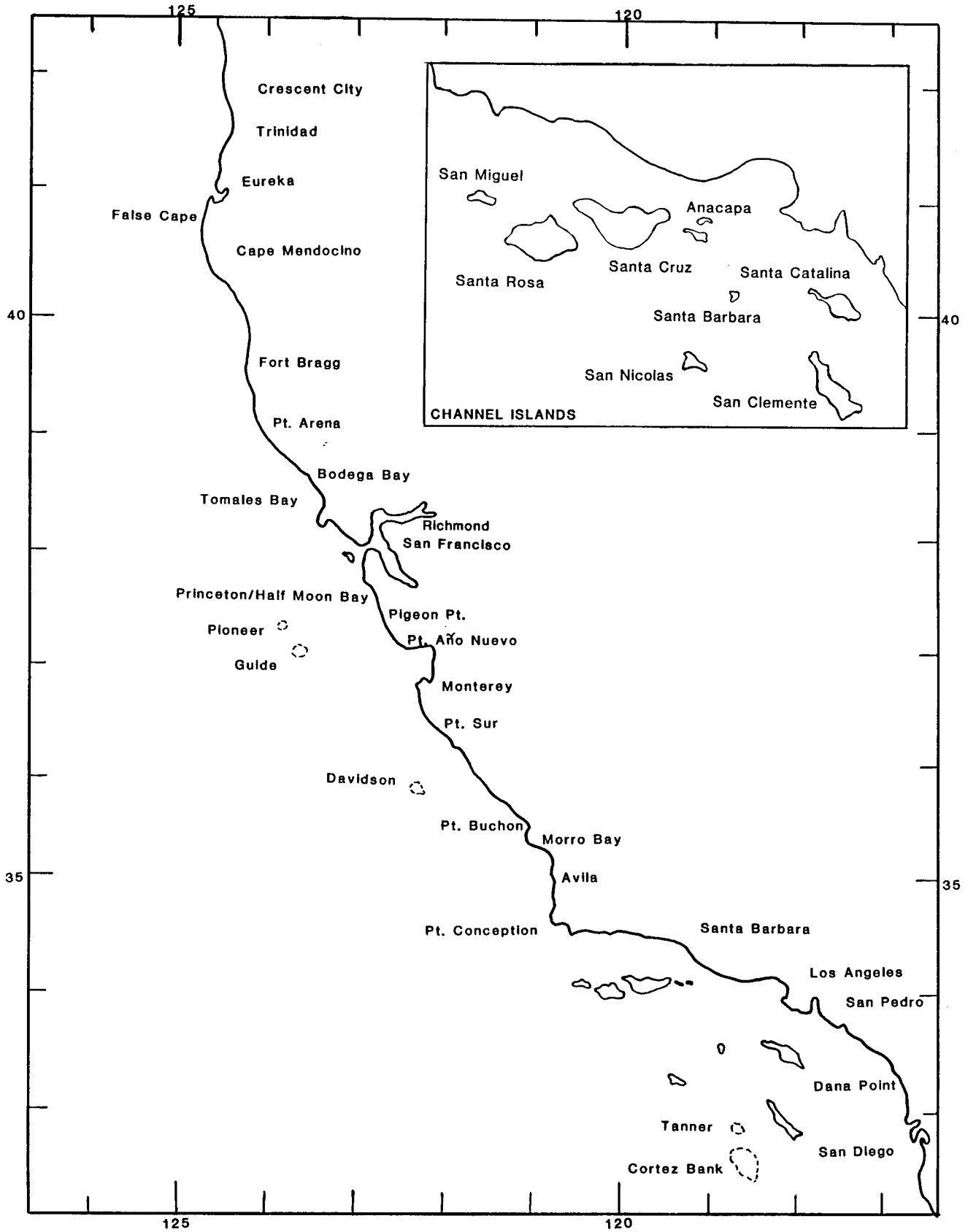

Figure 1. California ports and fishing areas.

more lucrative mackerel and squid. Consequently, no reduction landings took place in either the northern or southern regions. The 1987–88 season closed on June 30 with only one landing of 122 tons (table 2), which occurred in 1987.

National Marine Fisheries Service biologists estimated the 1988 spawning biomass of northern anchovy to be at least 1,111,119 short tons (1,008,000 MT), based on a stock synthesis model. The U.S. harvest quota for reduction was set at 154,350 tons, with allocations of 10,000 tons for the northern permit region and 144,350 tons for the southern. The 1988–89 fishery opened on August 1 in the north and on September 15 in the south. Landings totaling 258 tons were made during October and November in the northern permit area, and were delivered to the Salinas reduction facility at $35 per ton. In October, an unknown quantity of anchovy was sold to the reduction facility in Richmond by the Salinas processor because of insufficient capabilities to process the fish. Both processors indicated that they might issue orders for anchovy in the latter half of the 1988–89 season. No landings were made in the southern area through December 1988, reportedly because fishermen were unable to find anchovy large enough for reduction purposes.

Total landings of anchovy during 1988 included 258 tons for reduction, 1,360 tons for nonreduction purposes (table 1), and 4,664 tons for live bait. The live bait fishery benefited from the good availability of anchovy close to shore for much of 1988; most bait haulers considered it a good year.

TABLE 2
Anchovy Landings for Reduction Seasons in the Southern and Northern Areas (Short Tons)

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

*Preliminary

JACK MACKEREL

Approximately 19,815 tons of jack mackerel (*Trachurus symmetricus*) were landed during 1988. Jack mackerel constituted 19% of total mackerel landings, a slight decrease from 21% during each of the previous three years. Since 1979, jack mackerel have contributed less than Pacific mackerel to the California mackerel fishery. Over the last five years, the jack mackerel proportion of total annual mackerel landings has been the lowest since the fishery began in the late 1940s.

During 1988, as in the previous two years, jack mackerel never dominated statewide landings. This is probably due to unrestricted Pacific mackerel landings since 1986. In northern California, jack mackerel dominated the mackerel landings about half the time, but only 1% of the statewide jack mackerel catch was landed in northern California. The monthly proportion of jack mackerel in the total 1988 mackerel landings ranged from 4% to 42%, which is similar to the previous two years. Over the last three years, 94%, 97%, and, most recently, 99% of all jack mackerel landings occurred in southern California. Calculated throughout the year, jack mackerel made up 66% of the total mackerel landings in northern California, and 18% in southern California. This represents a change in northern California, where the catch has typically been 20% — 30% jack mackerel over recent years, but is very similar to the last three years in southern California.

A sea survey conducted during October 1988 suggested fair recruitment of the 1988 year class of jack mackerel. In comparison with surveys in earlier years, the 1987 year class appears weak, and the 1986 year class appears fairly strong.

PACIFIC MACKEREL

The year began with 24, 030 tons of Pacific mackerel (*Scomber japonicus*) already landed through the first half of the 1987–88 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 285,000 tons, no quota restrictions were established.

During the first three months of the year, mackerel landings were only fair, because weather was often rough and commercial-sized schools of mackerel were difficult to locate. Landings improved considerably during the second quarter, when the

weather was only occasionally poor. During the first half of the year, particularly when mackerel were not available, fishermen complained that abundant sardines interfered with mackerel fishing. The 1987–88 season closed on June 30, 1988, with a total catch of 49,420 tons of Pacific mackerel. This is the highest seasonal total since the fishery reopened in 1977. Pacific mackerel contributed 73% to statewide landings of mackerel, and 98% of all Pacific mackerel landings were made in southern California.

The 1988–89 season opened on July 1, 1988, with no quota restrictions, based on a biomass estimated to be about 290,000 tons. Landings during July, August, and September were fair, although effort in July was often redirected to more profitable bonito and bluefin tuna. Record-size bluefin tuna again captured the interest of the purse seine fleet in November and December; this, in combination with rough weather, resulted in lower landings during the last quarter. By the end of the year, 19,120 tons of Pacific mackerel had been landed toward the 1988–89 season total. This is only 80% of the landings made during the first half of the 1987–88 season. Landings of Pacific mackerel for the year totaled 44,510 tons. Although slightly less than the 1987 total, the 1988 catch still exceeds the annual average landings for the previous five years. Northern California landings contributed only 2% to the year's total. The proportion of the Pacific mackerel catch occurring in Monterey has declined steadily over the last several years.

Market demand remained constant throughout the year, and processors continued to impose landing limits (40–50 tons per boat per day, on average). The ex-vessel price, $155 per ton, has not changed since 1985.

Although the 1986 year class is strong and contributed 40% (by weight) of the fish landed during the year, the 1987 year class made a weak appearance as one-year-olds, and constituted only 14% of the landings. The 1988 year class dominated landings in December and may be strong. It is difficult, however, to accurately assess the strength of the incoming year class. If the 1988 year class does not prove to be substantial, the fishery will be sustained primarily by 1985 and 1986 year-class fish.

"Night-light" surveys, in which mackerel were sampled by hook and line both at night (random stations) and during the day (random and visually located stations), were conducted in 1988. Results indicated that this technique may be useful as an early, fishery-independent index of year-class strength.

MARKET SQUID

Landings of market squid (*Loligo opalescens*) in 1988 totaled 40,865 short tons. These landings greatly exceed the previous fishery high in 1981 of 25,915 tons, and are 2.5 times the previous 10-year average of 16,122 tons (table 1).

The northern California (or Monterey) fishery landed only 5,000 tons this year. Since the 1982–83 El Niño event, Monterey landings have never returned to the previous levels of 10,000 to 14,000 tons; instead, landings have ranged between 4,300 and 6,500 tons. This year, however, the proportion of landings dropped, with only 12% of the total catch landed in northern California. As is typical, most of northern California's squid was caught in the Monterey area. Unlike last year, only a small amount of squid was taken from the Año Nuevo and Pigeon Point area (figure 1).

The price in Monterey remained at $200 per ton until midseason, when a two-day strike by fishermen raised the price to $240 per ton. With the increased price, however, came buyer-imposed trip limits.

Fishing under experimental gear permits took place in Monterey Bay in 1987 and 1988. The purse seine and half-purse drum seine gear had a leadcore footrope instead of chain, and the purse rings were attached to the footrope with lines containing no metal. A Department observation program evaluated the effectiveness of this gear and the typical lampara gear relative to egg-case mortality. The results indicated that the new nets would not have a serious impact on squid eggs, and the Department recommended that fishermen be permitted to use this gear throughout Monterey Bay. Fishing with lights, which concentrates the squid at the surface, was authorized in all of Monterey Bay this year. The observation program suggested that the use of lights with the new gear could result in fewer squid egg cases being taken. In addition, the observations indicated that the use of balloons or suspenders to raise the lead line could prevent the scraping of eggs off the bottom. This gear, however, is not in widespread use. For the 1989 season, it was recommended that the experimental gear vessels not be allowed to fish during April and May. This would allow some spawning to occur in the spring, and keep the peak fishing season open during the summer and fall.

In marked contrast to the northern fishery this year, the southern fishery had tremendous success, landing 35,865 tons. Spawning squid were reported in many locations where they are not traditionally seen. The southern fishery typically follows a fall-

winter season, but this year, significant landings occurred through July. Major squid landings began again in October at much higher levels than typically seen, and continued through the end of the year. The price remained stable at $200 per ton until the end of the year, when it dropped to $180 per ton.

PACIFIC HERRING

The herring (*Clupea harengus pallasi*) roe fishery experienced a successful 1987–88 season (December–March). The statewide seasonal catch was 9,622 tons, and the 1988 annual catch was 9,721 tons (table 1). Both seasonal and annual catches are post-El Niño highs.

The economics of this fishery are complex, and are influenced by Japanese demand for herring roe. The ex-vessel value of the 1987–88 catch increased substantially from $8 million last season to over $13 million in the 1987–88 season. Japanese herring buyers offered $800 to $1,200 per ton base price for 10% roe recovery; a 25% increase in price from the 1986–87 season.

In San Francisco Bay, surveys of spawning grounds indicated a 1987–88 spawning population of 69,000 tons. This was substantiated by an independent acoustical survey, which estimated 71,000 tons of spawning biomass. The San Francisco Bay herring population increased about 20% from 1986–87. The continued increase of the population is attributed to five successive good year classes (1982–86).

The Tomales Bay population estimate declined to 2,000 tons in the 1987–88 season. Over the past five seasons, the Tomales Bay herring biomass estimates have shown an alarming variation, alternating between good years and poor years. Because there are eight year classes in the population, this pattern of sudden declines to low population levels, followed by quick recoveries, requires explanation. At this time, it is believed that herring are not using the historic spawning areas in Tomales Bay, and that this behavior was initiated by the 1983 El Niño. Abandonment of spawning grounds by herring, which has been documented in the Pacific Northwest, poses a threat to the future of the Tomales Bay fishery.

Based on biomass estimates in the 1987–88 season, catch quotas were adjusted for the 1987–88 season. The San Francisco Bay quota was raised 1,000 tons, to 9,500 tons; Tomales Bay was reduced 350 tons, to 400 tons.

The 1988–89 season began quickly, with over 2,000 tons taken in December. Herring buyers were offering $1,000 per ton for 10% roe recovery at the beginning of the season.

GROUNDFISH

California's 1988 commercial groundfish harvest was 39,946 metric tons (MT), with an ex-vessel value of $30,765,000. The 1988 catch decreased by 5%, or 960 MT, from the 1988 total, primarily as a result of decreased effort. In particular, setnet effort for groundfish decreased substantially during the year. The major share of the landings, 82.5% (32,967 MT), was harvested by trawl gear. Setnet landings constituted 8.8% (3,502 MT) of the total, followed by line gears at 6.9% (2,747 MT), and other gears at 1.8% (730 MT).

Rockfish (a multispecies group), Dover sole (*Microstomus pacificus*), Pacific whiting (*Merluccius productus*), and sablefish (*Anoplopoma fimbria*) were the leading species harvested in 1988 (table 3). Trawl landings of Dover sole dropped by 24%, partly because of a notable drop in demand from spring through fall of 1988. Trawl rockfish landings and value also suffered from a drop in demand, due to very large Canadian rockfish exports to West Coast markets in the first two quarters of the year. Continued high demand in Japan for sablefish fueled an 11% increase in ex-vessel prices, which appeared to attract additional fishing effort for this species. Demand for thornyheads (*Sebastolobus* spp.) also remained at high levels in Asian markets; 1988 landings increased by 53% to 4,524 MT.

Line catches of groundfish in 1988 remained relatively unchanged. Setnet catches, however, dropped by 13.4% from the previous year's level. Rockfish dominated both line and setnet landings, accounting for 74% and 78% of the totals, respectively.

TABLE 3
California Groundfish Landings (Metric Tons)

Species	1987	1988	Percent change
Dover sole	10,759	8,176	−24.0%
English sole	1,322	1,059	−19.9%
Petrale sole	824	780	−5.3%
Rex sole	825	839	1.7%
Thornyheads	2,955	4,524	53.1%
Widow rockfish	2,274	1,847	−18.8%
Other rockfish	11,419	9,776	−14.4%
Lingcod	841	863	2.6%
Sablefish	4,345	3,782	−13.0%
Pacific whiting	4,518	6,541	44.8%
California halibut	539	515	−4.5%
Other groundfish	1,322	1,244	−5.9%

Federal and state groundfish regulations for 1988 reduced the California harvest of sablefish and widow rockfish (*Sebastes entomelas*). Coastwide numerical optimum yield (OY) levels for sablefish were 9,200–10,800 MT; for widow rockfish they were 12,100 MT. The sablefish OY was allocated to two gear quotas: 5,200 MT for trawl and 4,800 MT for nontrawls gears. An additional 800-MT reserve was established in case the trawl fishery unavoidably exceeded its allocation. For the first time, trawl sablefish trip limits were imposed on January 1, with the objective of extending the fishery throughout the year. A trip limit of 6,000 pounds or 20% of the fish on board, whichever was greater, was employed from January 1 until August 2.

Trawl landings remained high despite these restrictions, necessitating a 2,000-pound, once-per-week trip limit effective August 3, and release of the 800-MT reserve. Although this regime slowed landings, sablefish discards increased significantly. Projections indicated that the 2,000-pound, once-per-week trip limit had slowed landings to the extent that the original 5,200-MT quota would not be achieved. The Pacific Fishery Management Council removed the trip-frequency restriction in early October, in an attempt to reduce the regulation-caused discarding. Total 1988 trawl sablefish landings were 5,483 MT, of which California landed 2,640 MT.

Unlike the trawl sablefish fishery, most nontrawl-caught sablefish do not supply fresh fish markets; thus no effort was made to extend the nontrawl fishery. As a result, the nontrawl fishery was closed on August 25, with a total catch of 5,295 MT (California portion: 1,144 MT).

The 1988 widow rockfish fishery began with a trip limit of 30,000 pounds. By September, a reduction to 3,000 pounds was necessary to keep widow rockfish landings within the OY. California accounted for 1,847 MT of the 12,100 MT landed coastwide.

DUNGENESS CRAB

California Dungeness crab (*Cancer magister*) landings during the 1987–88 season totaled 8.7 million pounds, a slight increase over 1986–87 landings of 8.4 million pounds.

The northern California ports of Crescent City, Trinidad, Eureka, and Fort Bragg (figure 1) received 2.84, 0.69, 1.41, and 0.68 million pounds, respectively, for a total of 4.94 million pounds. This is about 1.85 million pounds below the previous season.

The season opened December 1, after a price settlement of $1.25 per pound. A severe storm during the first week of the season destroyed large quantities of gear and trapped crabs. The season closed July 15; a total of 316 vessels participated in the fishery.

Commercial fishermen in the San Francisco region caught 3.1 million pounds of Dungeness crab during the 1987–88 season. This is the largest season total since the 1959–60 season, when 4.8 million pounds were landed. Landings for Bodega Bay, San Francisco, and Half Moon Bay were 1.28, 0.83, and 0.93 million pounds, respectively. Landings for November and December 1987, the first two months of the season, were 1.7 million pounds for the San Francisco region, 56% of the seasonal total. Effort remained strong until May, when many fishermen switched to salmon fishing.

PACIFIC OCEAN SHRIMP

Statewide landings of Pacific ocean shrimp in 1988 increased to 11.1 million pounds from the 7.8 million pounds landed in 1987. This was the fifth consecutive annual increase in statewide landings and the third largest ever. 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 Mexican border; figure 1). The season was open from April 1 through October 31.

Shrimp landings from Area A waters totaled 9.3 million pounds, a substantial increase over the 5.6 million pounds landed during the 1987 season. An additional 1 million pounds, which had been caught in other areas, were landed in Area A ports. The majority, 0.77 million pounds, came from Oregon waters; the remaining 0.24 million pounds came from Area B-1.

The season began with a two-week strike over price. A price of $0.50 per pound was initially agreed upon, but with the first landing, the price was changed to a $0.50 and $0.25 per pound split, with the break at 140 shrimp per pound. This was due to the large volume of small shrimp (more than 170 per pound). Another two-week strike started the first of May, when the dealers dropped the price to a $0.40 and $0.25 per pound split. The strike ended when a single price of $0.40 per pound for legal-count (160 per pound) shrimp was agreed upon. The price climbed to $0.50 per pound during October. One dealer maintained a split price throughout the season.

A total of 57 boats (40 single-rigged and 17 double-rigged) delivered shrimp to Area A ports during 1988, down 3 single-rigged vessels from 1987. Single-rigged vessels had an average seasonal catch rate of 488 lb/hr, which is an increase of 195 lb/hr over

1987. Double-rigged vessels averaged 758 lb/hr, as compared to 460 lb/hr during 1987.

One-year-old shrimp constituted a very high proportion by number (75%–95%) of the catch throughout the season. The incoming year class (0's) constituted 18.7% by number of the catch in October; this is a decrease from the 21.1% present during October 1987.

Area B-1 shrimpers landed 0.38 million pounds during 1988, about half the 1987 catch of 0.74 million pounds. Price negotiations, with strikes and settlements, followed those in Area A. Four single-rigged vessels made deliveries to Fort Bragg during 1988.

A total of 0.38 million pounds of ocean shrimp was landed in Morro Bay and Avila (Area C) during the 1988 season. This represents 57% of the 1987 shrimp total. As in past years, large amounts of salps fouled the nets, making tows unprofitable in the late summer, and causing fishermen to leave the fishery.

Fishing was delayed until the middle of April because of price negotiations. The count-per-pound in the market samples ranged from 38 to 118, with an average well below 100. Females dominatd the early samples (53%), but dropped to 20% in August and 34% in September.

PELAGIC SHARK AND SWORDFISH

During 1988, 202 permits were issued for harpooning swordfish (*Xiphias gladius*), and 231 drift gill net permits were issued for taking pelagic sharks and swordfish.

Harpoon fishermen reported landing 1,187 swordfish, making 1988 the third year of declining catches. On the other hand, drift gillnetters reported 11,138 swordfish taken during 1988, nearly equal to 1987, but still far below the peak of 25,367 fish reported for 1985. The reported average size of swordfish, taken by all gears, increased this year to approximately 190 pounds dressed weight. Variation in the annual average size and the inconsistent direction of shift in size from one year to the next seem to indicate that local availability depends strongly on fluctuating immigration rates from waters outside the California fishing grounds. The exact nature of this annual immigration and, in general, the migration of swordfish throughout the eastern Pacific Ocean, is unknown.

Common thresher shark (*Alopias vulpinus*) landings off California remained low during 1988, amounting to 0.52 million pounds. Although Oregon and Washington again allowed an experimental fishery for thresher shark during 1988, landings were low (110,084 pounds), partially because of commercial fishermen's lack of interest.

Shortfin mako sharks (*Isurus oxyrinchus*) were pursued with both drift gill nets and drift longlines; the latter gear was authorized by the California Fish and Game Commission as an experimental fishery limited to 10 permit vessels. Total landings were 481,586 pounds. Of that, 231,380 pounds were taken by the 10 permitted longline vessels.

Market sampling indicates that the mako fishery takes primarily immature one- and two-year-old fish off California. Concerns over the development of another gear, in an area that appears to be a mako shark nursery grounds, has led the Fish and Game Commission to call for a shift in emphasis by drift longline vessels from pursuit of shortfin mako to blue sharks (*Prionace glauca*). If a substantial market for blue sharks is not developed during 1989, the Commission will reevaluate the experimental fishery.

CALIFORNIA HALIBUT

California halibut (*Paralichthys californicus*) landings totaled 522 MT for 1988, 1.6% less than the 530 MT recorded for 1987. Following a low catch of 122 MT in 1973, catches have steadily increased, averaging 456 MT for the last 10 years (table 4). Landings for 1988 exceed the 10-year average by 66 MT (6.8%). During 1988, 52% of the halibut landings occurred south of Point Conception. Southern California generally lands over 50% of the state's catch. Exceptions to this occurred during the warm-water year of 1982, when southern California's landings dropped to 47.5%.

The traditional winter-spring and summer-fall fishing seasons were again followed in 1988 by both northern and southern California halibut fishermen, with peak landings in March (44.5 MT) and

TABLE 4
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*	249	273	522

*Preliminary values as of March 15, 1989

October (36.9 MT). Entangling nets (trammel and set gill nets) accounted for 48.2% of all halibut taken, followed by trawl (30.4%), unknown gear (13.6%), and hook and line (7.8%). In northern California, the majority of the halibut are taken by trawl (57.6%); in southern California, entangling nets account for 75.8%. Average ex-vessel prices ranged from $1.00 per pound in Bodega Bay to $5.00 per pound in Princeton/Half Moon Bay, and averaged $2.20 per pound statewide.

CALIFORNIA SPINY LOBSTER

The 1987–88 (first Wednesday in October to first Wednesday after March 15) commercial fishery for California spiny lobster in southern California was well above the average for the past 20 years. A total of 477,000 pounds was landed, representing only a 3.5% decrease from the previous season.

Forty-two percent of the catch was made in October, and 23% in November. December effort was reduced by stormy weather, and the month produced only 11% of the season's catch. January accounted for 16%, and 8% was landed in February and March combined. The San Diego County area accounted for about 39% of the landings, with the Los Angeles-Orange and Santa Barbara-Ventura county areas contributing about 37% and 24%, respectively.

The ex-vessel price was up 15% from the previous season. At an average value of $5.25 per pound, fishermen received an estimated $2.5 million for the 1987–88 season. During the season, 321 permittees participated in the fishery, representing a 15% decrease from the 1986–87 season.

ALBACORE

Albacore (*Thunnus alalunga*) landings for 1988 totaled 1,330 tons, the lowest annual total since 1934. Historically, California contributed 53% of all albacore landed in Washington, Oregon, and California. In 1988, the California total fell 30%, while Oregon and Washington totals rose substantially.

The season started in late July when several fishing vessels landed albacore from the Midway Islands. A few albacore were caught in southern California; they were not, however, abundant enough to sustain a commercial or sport fishery. In August the albacore fleet moved northward to Oregon and Washington, where the fish were more available. Limited activity occurred in central California, where albacore were caught incidentally by drift gill net boats (DGN) fishing for swordfish at Davidson and Pioneer seamounts (figure 1). By September, fishing in California was focused off the central coasts between Monterey and Morro Bay. DGN boats and the few jig boats that remained in the area continued to take small catches of medium-to-large albacore. There was no albacore fishing effort south of Point Conception.

The sportfishing season had a slow start as well. Sportboats in San Diego began looking in July, but turned to other species when it became apparent that there were no albacore in the area. Sportboats in central California scored fair catches of albacore during September and October. These boats fished 50–100 miles west of Point Sur and around Davidson, Pioneer, and Guide seamounts.

The Westen Fishboat Owners Association and Pan Pacific cannery agreed on $1,700 per ton for fish over nine pounds, and $1,200 per ton for fish nine pounds and under. This is a 15% increase over last year's price. Fishermen who sold directly to the public charged between $1.00 and $1.25 per pound; approximately 2% of all albacore landed was sold in this manner.

The disappointing 1988 season can be attributed to three factors. First, there was a good run of salmon in the north Pacific; consequently, fishermen did not fish for albacore. Second, although there were favorable water conditions (weak upwelling and cool surface temperatures) off the central and southern coasts, the albacore never appeared as expected. Lastly, the abundance of albacore off Oregon and Washington drew the California fleet northward and away from the few scattered schools of albacore off the central coast.

RIDGEBACK AND SPOT PRAWN

Ridgeback prawn (*Sicyonia ingentis*) landings for 1988 fell to 131,000 pounds, the lowest since 1982 (table 5). Nearly all the catches occurred in the Santa Barbara Channel; some were made off Santa Monica Bay. During 1988, 15 trawlers were involved in the fishery. Catch-per-unit-effort declined from 82

TABLE 5
Ridgeback Prawn and Spot Prawn Landings (1,000s of Pounds)

Year	Ridgeback prawn	Spot prawn
1979	356	48
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	131	163

pounds per hour in 1987 to 64 pounds per hour in 1988. Even though the 1988 prawn recruitment survey indicated signs of an abundant year class, recruitment to the fishery was poor.

Spot prawn (*Pandalus platyceros*) landings increased from 88,000 pounds in 1987 to 163,000 pounds in 1988 (table 5). Most of the landings occurred off Santa Barbara, San Pedro, and San Diego. Approximately 55% was taken by trap, 30% by trawl, and the remainder by unidentified gear.

Management measures over the trawl fishery, improved environmental conditions, and development of the trap fishery have all contributed to increased landings in recent years.

SEA URCHIN

The 1988 California red sea urchin (*Strongylocentrotus franciscanus*) fishery landings represent a historical high (table 6). The statewide total of 49,395,000 pounds marks a 7% increase over 1987 landings. The northern California harvest increased 22% over the previous year, while southern California landings dropped by 8%. The 1987 northern California totals represent a 250% increase over the 1986 landings for that area. August provided the highest monthly statewide catch of 6.3 million pounds, despite a one-week-per-month coastwide fishery closure that was in effect from May through September. Fort Bragg led all ports, with 36% of the landings.

Divers, using surface-supplied air, harvest sea urchins by raking them into mesh bags, which are then air lifted to the surface. Catch-per-unit-of-effort (CPUE) can be measured as pounds harvested per diving hour. Northern California CPUE was 579 pounds per hour in 1987, compared to 505 pounds in 1988, as indicated by interviews with fishermen. This compares to a southern California CPUE ranging from less than 200 pounds per hour in the San Diego area fishery to just over 400 pounds per hour in the San Nicolas Island area.

There were 206 vessels participating in the northern California fishery in 1988, up from 159 in 1987. Only 34 vessels harvested 50% of this area's catch. About 3,600 pounds were landed per trip, which is 48% higher than the average in southern California. Higher catch rates in northern California were partly due to the relatively unexploited state of stocks. In the Point Arena area, in particular, individual single-day trip landings of 10,000 to 15,000 pounds were not unusual during the summer, when fishing conditions were optimal.

Although the southern California fishery has averaged about 20 million pounds per year since 1980, effort has shifted from the northern Channel Islands, where stocks have been fished down, to the southern islands and to northern California. The average test diameter of harvested urchins in southern California is about 20 mm smaller than in northern California, where harvested urchins averaged 107 mm in 1988. In March 1989, the Department instituted a 3-inch (76-mm) minimum size limit, partially in response to the increasing percentage of smaller urchins observed in the harvest. In the Santa Barbara area, where the fishery has a long history, urchins under 3 inches made up 35% of the sampled landings in 1988, compard to only 3% of the harvest from the southern Channel Islands and from northern California, where the fishery is relatively new.

Other management and research efforts include the establishement of a limited entry system for sea urchin diving permits in 1989, as well as the continuation of underwater studies to assess stock size composition and relative abundance. These studies were begun by the Department in 1988 in northern California.

TABLE 6
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	28,660	20,735	49,395

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 is capable of locating and catching any species available within the fishing area. Catches can vary widely for latitudinally migratory species, such as barracuda (*Sphyraena argentea*) and yellowtail (*Seriola lalandi*), and for highly migratory transoceanic

TABLE 7
1988 Commercial Passenger Fishing Vessel Catch

Species/species group	Number of fish (thousands)	Rank
Rockfish	1,851	1
Kelp/sand bass	730	2
Pacific mackerel	406	3
Bonito	245	4
Barracuda	140	5
Sculpin	128	6
White croaker	121	7
Salmon	113	8
Halfmoon	80	9
Yellowtail	66	10
Lingcod	63	11
Ocean whitefish	56	12
Queenfish	33	13
Sheephead	31	14
Jack mackerel	21	15
Yellowfin tuna	20	16
Pacific hake	19	17
Flatfish (misc.)	16	18
California halibut	12	19
Striped bass	9	20
Others	43	
Total	4,203	

species like albacore (*Thunnus alalunga*). Catches of resident species in nearshore areas may also show fluctuations associated with warmer oceanic regimes.

The total 1988 partyboat landings, 4.2 million fish, were slightly higher than in 1987 (table 7). Rockfish (a multispecies group) maintained its first-rank position, with 1.9 million fish caught; this is about a 12% increase over the previous year.

The kelp/sand bass complex (730,000 fish) remained at about the 1987 level. Within this group, sand bass (*Paralabrax nebulifer*) landings again increased and exceeded the kelp bass (*Paralabrax clathratus*) catch, which showed a slight decline. Pacific mackerel (*Scomber japonicus*) and bonito (*Sarda chiliensis*) exchanged rankings in 1988, with 406,000 and 245,000 fish taken, respectively. The bonito catch decreased more than 50% from last year.

The barracuda catch, 140,000 fish, was fair and ranked fifth. This is still well above the landings of 50,000–90,000 fish during the 15 years preceding 1987. Sculpin (*Scorpaena guttata*) landings were exceptional, with 128,000 fish logged; this is more than double the 1987 catch, and this species ranked sixth in 1988. White croaker showed a dramatic increase of over 3000% in 1988, with 121,000 fish landed. The highly prized salmon group provided another good season, with landings of 113,000 fish. This is slightly less than in 1987, but still relatively high. The catch of halfmoon, a nearshore resident species, more than doubled in 1987; it ranked ninth, with 80,000 fish. The popular yellowtail ranked tenth, with 66,000 fish recorded; this is a 15% increase over 1987. The highly desirable California halibut ranked nineteenth, experiencing a 52% increase for 1988 (11,501 fish). This is the highest catch since 1982 (11,804 fish), and the second highest since 1970.

Probably the highlight of 1988, albeit a negative one, was the virtual failure of the albacore fishery, with only 559 fish logged. This is the lowest catch since 1959, when the CPFVs caught only 39 albacore.

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