

REVIEW OF SOME CALIFORNIA FISHERIES FOR 1993

CALIFORNIA DEPARTMENT OF FISH AND GAME
 Marine Resources Division
 8604 La Jolla Shores Drive
 La Jolla, California 92038-1508

Total landings of fishes, crustaceans, echinoderms, and mollusks increased by 5% from 1992—not enough to reverse a ten-year declining trend in reported landings.

Pelagic wetfish landings increased 18% from 1992, but the increase was mostly attributable to a threefold increase in market squid landings; Pacific sardine, Pacific mackerel, jack mackerel, and Pacific herring declined substantially (table 1).

Groundfish landings continued a ten-year decline, with a 19% decrease from 1992, including significant decreases of Dover sole, sablefish, and whiting; only widow rockfish, rex sole, and lingcod landings increased. California halibut landings also reflected the trend, declining by 24%.

California Dungeness crab landings surpassed the ten-year average. Spiny lobster landings continued a three-year decline, but were above the 1974–92 average. Sea urchin landings were 18% less than in 1992, and declined 38% in northern California. Continuing a long-term decline, total abalone landings were only 8% of the 1957 historic high.

Swordfish landings increased by more than 13%, and approximately 82% of the catch was taken in the drift gill net fishery. Six vessels used longline gear to fish outside U.S. waters and land fish in southern California. A

significant portion (42%) of the swordfish catch was landed north of San Francisco because of persistent but weaker El Niño conditions. Statewide landings of live fish were estimated at 216 MT, a 17% increase over 1992. Catches were primarily with vertical longlines and troll longlines, although over 60% of live sheephead landings in southern California were made with trap gear.

Despite the lingering El Niño condition, 13% fewer anglers participated in the marine recreational fishery, and the total catch declined by 19%.

PACIFIC SARDINE

In 1986, spawning biomass estimates for the Pacific sardine (*Sardinops sagax*) exceeded the legally specified level for reestablishment of a commercial fishery in California. Each year since then, the California Department of Fish and Game (CDFG) has established a harvest quota based on an estimate of current spawning biomass. CDFG is required by law to include in the quota a directed fishery quota of at least 910 metric tons (MT) whenever the spawning biomass exceeds 18,200 MT.

At the fourth annual Pacific Sardine Resource Assessment and Management Workshop, the CANSAR (catch-at-age analysis of sardines) model estimated the 1992

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

Year	Pacific sardine	Northern anchovy	Pacific mackerel	Jack mackerel	Pacific herring	Market squid	Total
1973	68	118,391	25	9,201	1,259	5,383	134,326
1974	6	73,810	60	11,362	2,348	12,901	100,486
1975	3	141,486	129	16,415	1,086	10,542	169,661
1976	24	111,503	293	19,882	2,151	9,063	142,915
1977	5	99,504	5,333	44,775	5,200	12,605	167,424
1978	4	11,253	11,193	30,755	4,401	16,869	74,476
1979	16	48,094	27,198	16,335	4,189	19,660	115,493
1980	34	42,255	29,139	20,019	7,932	15,136	114,514
1981	28	51,466	38,304	13,990	5,865	23,132	132,785
1982	129	41,385	27,916	25,984	10,106	16,023	121,543
1983	346	4,231	32,028	18,095	7,881	1,786	64,367
1984	231	2,908	41,543	10,504	3,786	555	59,518
1985	583	1,600	34,053	9,210	7,856	10,110	63,410
1986	1,145	1,879	40,616	10,898	7,502	20,935	82,975
1987	2,061	1,424	40,961	11,653	8,264	19,662	84,025
1988	3,724	1,444	42,200	10,157	8,667	36,632	102,835
1989	3,845	2,410	35,548	19,477	9,046	40,235	110,560
1990	2,770	3,156	36,716	4,874	7,978	27,989	83,483
1991	7,625	4,184	30,459	1,667	7,345	37,388	87,203
1992	17,946	1,124	18,570	5,878	6,318	13,108	62,944
1993*	13,848	1,954	11,094	1,614	3,882	41,648	74,040

*Preliminary

TABLE 2
 Pacific Sardine Quota Allocations (Metric Tons) for California, 1993

	Original allocations*			Revised allocations		
	Quota	Landings	Remainder	Quota	Landings	Remainder
Fishery						
Directed	15,875	12,385	4,640	18,145	16,000	2,900
Northern	5,290	650	4,640	3,570	670	2,900
Southern	10,585	11,735	0	14,575	15,330	0
Dead bait	455	872	57	455	872	57
Northern	57	0	57	57	0	57
Central	57	57	0	57	57	0
Southern	340	815	0	340	815	0
Live bait	910	1,320	0	910	1,650	0
Incidental reserve	2,720	60	2,660	450	70	380
Total allowable harvest	19,960	14,637	7,357	19,960	18,592	3,337

*Original allocations were in effect from January 1 to October 6, 1993; revised allocations were in effect from October 7 to December 31, 1993.

sardine spawning at 99,800 MT. During July 1993, this estimate was revised to 116,200 MT after all 1992 data were included. This increased biomass estimate was not enough to raise the harvest quota established for 1993.

Estimates of the sardine spawning biomass declined from 374,200 MT in 1991 to 116,200 MT in 1992. This decrease may have been caused by the relatively high combined catch of sardines in the United States and Mexico during 1992 (approximately 52,000 MT) or by a combination of high catch and the continued warm-water event (El Niño). El Niño may have displaced sardines to the north of Point Conception (beyond the range of CDFG data collection and thus not included in the biomass estimate).

Fishing industry concern about the lack of data collected north of Point Conception caused CDFG to base the 1993 total allowable harvest on three factors: (1) the upper 95% confidence limit from the CANSAR biomass estimate, (2) the tonnage landed during 1992, and (3) a trend projection from general linear models of previous estimates. The total allowable harvest was set at 19,960 MT and allocated among four categories: directed fishery, dead bait fishery, live bait fishery, and incidental catch in the mackerel fishery.

The directed fishery quota was divided geographically and opened on January 1, 1993 (table 2). The southern directed fishery quickly surpassed its quota and closed on April 22. Demand for sardines was low in the northern directed fishery because fish available were small; consequently, less than 15% of the northern quota was landed, and a local cannery was unable to can sardines because large fish are needed for the canning process.

The central and southern dead bait fisheries quickly filled their quotas. Both were closed early in the year, and no landings were accumulated for the northern dead bait quota (table 2).

In September, the live bait fishery exceeded its allocation because many sportfishing vessels used small sardines while there was a shortage of anchovies. The fishery was allowed to continue landing live bait because historically its landings decreased at the end of the year and because it appeared that the northern directed fishery would not use all of its allocation. The incidental take of sardines (35% by weight) in the commercial mackerel fishery did not exceed its allocation in 1993.

Early closure of the southern directed fishery and low landings in northern California prompted the fishing industry to propose legislation (AB14, passed October 1, 1993) to reallocate the remaining northern directed fishery and the remaining mackerel incidental reserve quotas between the southern and northern directed fisheries. October landings for the reopened southern directed fishery were high, but fishing slowed in November and December. Northern directed fishery landings remained low, and that quota was not filled by year's end (table 2).

At the fifth annual Pacific Sardine Resource Assessment and Management Workshop, the CANSAR model estimated the 1993 spawning biomass to be 71,700 MT. Industry representatives were concerned with the low estimate because most data in the model still came from southern California. To correct this bias, CDFG conducted a cooperative Daily Egg Production Method cruise in April 1994 with the National Marine Fisheries Service (NMFS) and Mexico's Instituto Nacional de Pesca. The cruise ranged from San Francisco to Punta Abreojos, Baja California.

PACIFIC MACKEREL

By January 1 of the 1992-93 fishing season (July 1, 1992, through June 30, 1993) 10,671 MT of Pacific mackerel (*Scomber japonicus*) had already been landed.

Regulations authorize an open fishery when the Pacific mackerel biomass exceeds 136,080 MT, and require a quota fishery (equal to 30% of the biomass above 18,144 MT) when the biomass is below 136,000 MT. The 1992–93 fishing season started with no quota in effect, but because total biomass estimates at midseason were below 136,000 MT, a 34,020 MT quota (based on a biomass estimate of 126,100 MT) was established at that time.

Pacific mackerel landings were 5,803 MT during the first quarter of calendar year 1993, slightly less than in the first quarter of 1992. In January, Pacific mackerel availability increased for the first time in four months, as fishing effort was also directed toward Pacific sardines (*Sardinops sagax*) and market squid (*Loligo opalescens*). Mackerel landings increased throughout February and March, even though fishing effort was diverted to Pacific sardines and market squid.

Second-quarter landings totaled 1,652 MT—half of the 1992 second-quarter landings. Consistent with seasonal patterns of the previous five years, landings were low during April and May. Landings began to increase in June, but continued El Niño conditions kept the catch at a low level. Fishing effort was concentrated on Pacific mackerel because the directed sardine quota fishery closed in April and the sardine dead bait fishery closed in May.

The 1992–93 fishing season ended on June 30, 1993, with a total catch of 18,312 MT, well below the 34,020 MT quota established at midseason, and 30% less than the previous season. The 1992–93 landings continue a downward trend that started with the 1989–90 season, and were the lowest seasonal catch of Pacific mackerel since 1978–79.

Although the Pacific sardine fishery was open and fish were available during most of the season, mackerel were preferred over sardines because mackerel brought a higher ex-vessel price (\$100 to \$120 per short ton compared with \$80 to \$100 per short ton for sardines). El Niño conditions displaced mackerel to the north, making them less available to southern California fishers. Evidence of displacement began in early May, when Pacific mackerel were sighted off Tofino, British Columbia; by late May the fish were sighted in the Barkley Sound, and by late June, along the west coast of the Queen Charlotte Islands.

The 1993–94 fishing season opened July 1, 1993 (third quarter of the calendar year) with a quota of 29,665 MT based on a biomass estimate of 117,029 MT. Third-quarter landings totaled 2,403 MT, representing only 27% of the previous year's third-quarter landings. During July and August, most large seiners fished tuna because the availability of Pacific mackerel was low; it remained low through September. Sightings of Pacific mackerel continued in British Columbia during July and August and spread from the southern Canadian border (48° N) to Yakutat, Alaska (59° N).

During October, Pacific mackerel landings increased, only to decline in November despite ex-vessel prices of \$140–\$150 per short ton. Some fishing effort was diverted to Pacific sardines when the directed sardine fishery opened in mid-October. Pacific mackerel landings increased in December as water temperatures cooled and El Niño conditions deteriorated. Landings totaled 2,268 MT in the fourth quarter of 1993, higher than fourth-quarter landings of 1992, but only 41% of the average fourth-quarter landings from the previous five years.

By fishing year's end, 4,833 MT of Pacific mackerel were landed, bringing landings for the 1993 calendar year to 12,391 MT, the lowest annual catch since 1978. Most of the Pacific mackerel were landed in southern California; 7% were landed in the Monterey Bay area. The declining trend may be attributed to a combination of a declining biomass since 1988, fish displacement to the north by El Niño, and a decreased market following the 1992 closure of a major cannery on Terminal Island. The cannery closure shifted a five-year wetfish landings pattern from 75% landed at Terminal Island canneries and 25% at San Pedro fish markets to 40% landed at Terminal Island canneries and 60% at the San Pedro markets during 1993.

PACIFIC HERRING

Annual statewide landings for Pacific herring (*Clupea pallasii*) roe were 4,350 MT in 1993, a decrease of 29% from the previous year. Statewide landings for the 1992–93 season (November to March) totaled 4,946 MT. The three gill net platoons (374 permittees) in the San Francisco Bay fishery landed 3,493 MT, which was 4% over their quota of 3,348 MT. Thirty-three round haul (purse seine and lampara) permittees fishing in San Francisco Bay landed 1,181 MT, 12% less than their 1,347 MT quota (figure 1). Tomales Bay was opened to commercial herring fishing for the first time since the 1988–89 season, and outer Bodega Bay was closed to commercial fishing. Tomales Bay permittees landed 201 MT, exceeding the 181 MT quota by 11%. Humboldt Bay permittees waited until mid-January to begin fishing. As a result, they missed several early spawning episodes and landed only 26 MT of the 54 MT quota. Crescent City permittees landed 28 MT of the 30 MT quota.

A prediction that record amounts of roe herring would be harvested in Alaska drove down the price of roe herring in California. Ex-vessel prices for gill net-caught herring with 10% roe recovery ranged from \$500 to \$600 per short ton during the 1992–93 season. The base ex-vessel price for round haul herring was \$400 per short ton. As a result, the total ex-vessel value of California's roe fisheries was approximately \$3.3 million—well below the ten-year average of nearly \$10 million.

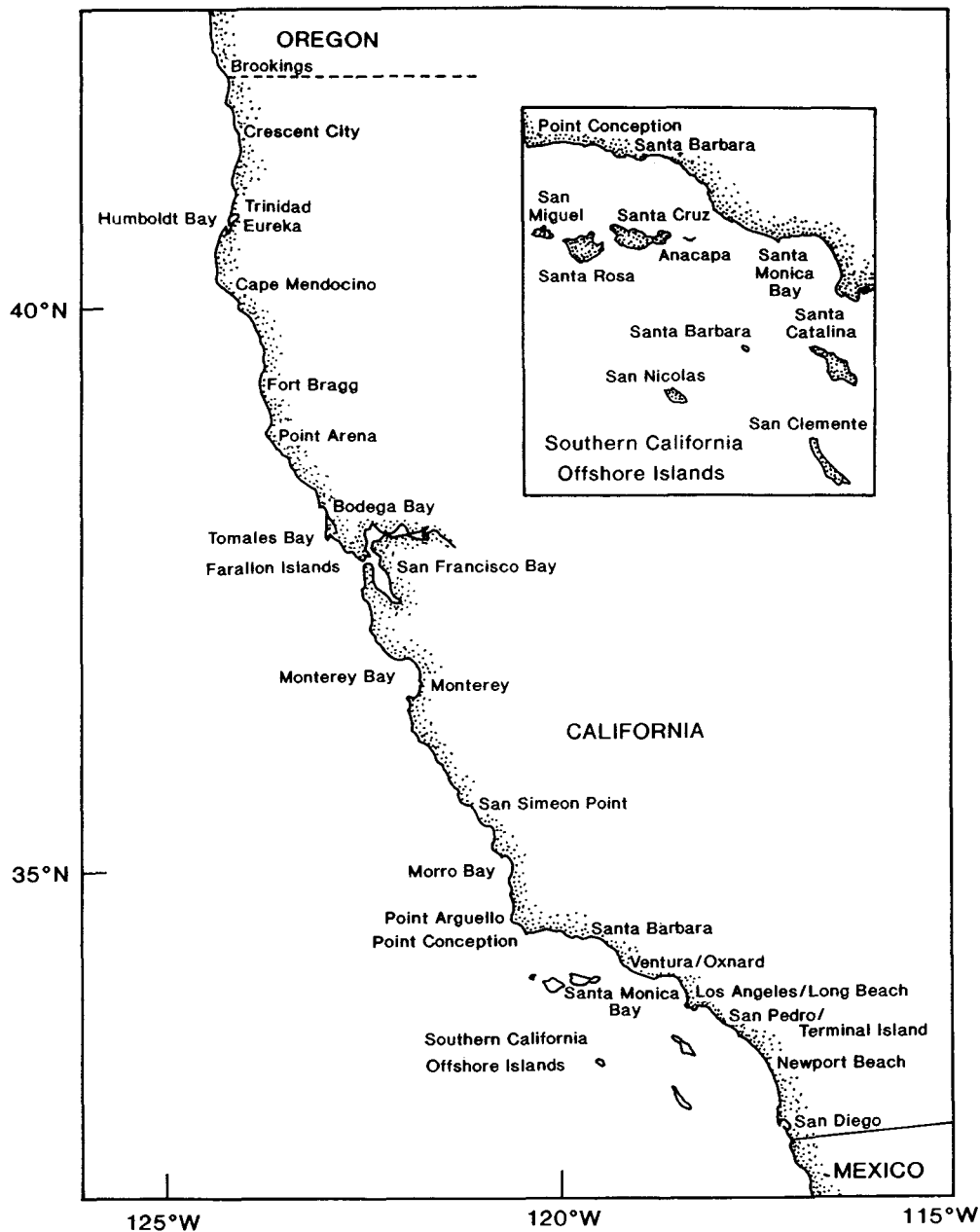


Figure 1. California ports and fishing areas.

Ten permittees in the San Francisco Bay herring roe-on-kelp fishery harvested 43 MT of roe-on-kelp, for 56% of the 77 MT quota. The estimated ex-vessel value of the roe-on-kelp fishery was \$950,000, at prices ranging from \$8 to \$12 per pound.

CDFG biologists estimated spawning biomass for San Francisco Bay and Tomales Bay populations. No estimates were made for Bodega Bay, Humboldt Bay, or Crescent City Harbor. Hydroacoustic and spawn-deposition surveys were used to estimate spawning biomass in San Francisco Bay, and spawn-deposition surveys were used in Tomales Bay.

Estimated spawning biomass of San Francisco Bay herring declined significantly for the third consecutive season, to 19,500 MT for 1992-93, less than half of the previous season's estimate of 42,300 MT. This was the lowest biomass estimate in fifteen years and far below the long-term average of 49,900 MT. The decline could be partly attributed to the second consecutive season of poor recruitment of two-year-old herring. The San Francisco Bay young-of-the-year abundance indices for 1991, 1992, and 1993 were higher than the index for 1990, but still below the thirteen-year average for the index. This suggests that the 1991, 1992, and 1993

year classes will be stronger than the 1990 year class and that the biomass may increase.

The total spawning biomass estimate for Tomales Bay was 3,700 MT, more than a threefold increase from the 1991–92 season's estimate of 1,124 MT. This was the fourth consecutive season that the biomass has increased. After six years of drought, rainfall amounts were above normal during the 1992–93 spawning season. Spawning biomass levels in Tomales Bay may drop next season; historical data indicate that biomass usually declines in years following strong El Niño conditions.

GROUND FISH

California's 1993 commercial groundfish harvest of 27,913 MT, with an ex-vessel value of approximately \$23.5 million, represented approximately a 19% decrease (6,565 MT) from the 1992 landings. Dover sole (*Microstomus pacificus*), thornyhead (*Sebastolobus* spp.), sablefish (*Anoplopoma fimbria*), rockfish (*Sebastes* spp.), and Pacific whiting (*Merluccius productus*) were principal species harvested. Significant decreases were noted for Dover sole, sablefish, and whiting. Thornyhead and most other categories also declined but to a lesser degree (table 3). Widow rockfish (*Sebastes entomelas*), rex sole (*Glyptocephalus zachirus*), and lingcod (*Ophiodon elongatus*) landings increased moderately.

Distribution of 1993 landings by gear type did not differ significantly from recent years, although the bottom and midwater trawl component rose from 75.2% in 1992 to 77.9%, and the line portion of the catch dropped from 17.7% to 15.8%. Trap and setnet components were similar to 1992, at 1.0% and 5.3%, respectively.

For 1993, the Pacific Fishery Management Council (PFMC) set harvest guidelines off California for Dover sole, thornyhead, sablefish, widow rockfish, bocaccio rockfish (*Sebastes paucispinis*), and Pacific whiting. The PFMC instituted cumulative landing limits as well as trip limits during 1993, to meet annual harvest guidelines while providing a year-round groundfish fishery. Cumulative two-week limits were established for the *Sebastes* complex (including bocaccio rockfish) and DTS complex (Dover sole, thornyhead, and sablefish); a cumulative four-week limit was set for widow rockfish.

In 1993, within the Washington-Oregon-California (WOC) area, a harvest guideline of 140,000 MT for Pacific whiting was fully met (140,962 MT) by domestic catcher vessels and processors. A 10,000-pound trip limit was imposed before the unrestricted season opened on April 15 and was reimposed on September 4 after the unrestricted season was closed. All at-sea processing of whiting was restricted to waters north of California. California's shoreside whiting fishery landed and processed 3,144 MT, a 36% decline from 1992 landings (table 3).

TABLE 3
 California 1993 Groundfish Landings (Metric Tons)

Species	1992	1993	Percent change
Dover sole	8,619	6,540	-24
English sole	564	470	-17
Petrale sole	528	457	-13
Rex sole	439	456	4
Other flatfish	520	479	-8
Widow rockfish	1,102	1,181	7
Bocaccio	1,467	1,254	-15
Other rockfish	7,396	6,061	-18
Thornyhead	4,328	4,101	-5
Lingcod	604	686	14
Sablefish	3,653	2,570	-30
Pacific whiting	4,930	3,144	-36
Other groundfish	328	514	57
Total	34,478	27,913	-19

Five midwater trawl vessels, fishing off Eureka and Crescent City, landed 98% of California's catch (at \$0.05 per pound).

A whiting observation program was established in 1993 to monitor bycatch of salmon and other species in shoreside landings. To facilitate monitoring the entire landed bycatch, experimental fishing permits (EFPs) were issued to three Crescent City-based trawl vessels. The permits required delivery of unsorted whiting catches to selected shoreside plants. Rapid chilling at sea of unsorted whiting purportedly improved the quality of the product. Of the 76 EFP trips, 28 were observed. Salmon bycatch was 0.018 salmon per MT of Pacific whiting. All salmon observed were chinook (*Oncorhynchus tshawytscha*). The five most abundant species in the bycatch were jack mackerel (*Trachurus symmetricus*), Pacific mackerel (*Scomber japonicus*), widow rockfish, splitnose rockfish (*Sebastes diploproa*), and spiny dogfish (*Squalus acanthias*).

Sablefish management in the WOC area resembled that of 1992, with a trawl allocation of 58% and a non-trawl allocation of 42%. The 7,000 MT harvest guideline (including a tribal allotment of 300 MT) was, however, a sharp reduction from the 8,900 MT available in 1992. Total WOC sablefish landings in 1993 were 7,400 MT, and California accounted for 2,570 MT, or 35% of the total WOC catch.

The PFMC allowed unrestricted nontrawl sablefish fishing in the WOC area to begin on May 12, 1993, three days before the Alaska sablefish fishery. In contrast to 1992, the PFMC set a single nontrawl trip limit of 250 pounds before and after the unrestricted season. Landings under the 250-pound trip limit totaled 74 MT. In the WOC area, nontrawl landings of 2,792 MT were 1% less than the nontrawl allocation. California non-trawl gear caught 711 MT, about 25%, of the WOC nontrawl landings.

For the DTS complex, the two-week cumulative limit

was initially set at 45,000 pounds, of which no more than 20,000 pounds could be thornyhead and no more than 25% (or 1,000 pounds) per trip could be sablefish. On April 21, the DTS-complex cumulative limit was changed to 60,000 pounds per specified four-week interval to further reduce the catch of sablefish without increasing the potential for discard. In the WOC area, trawl sablefish landings were 4,608 MT, about 16% greater than the trawl allocation despite increasingly restrictive catch regulations, which were changed several times during the season. California trawl vessels landed 1,818 MT, or 39%, of this coastwide total.

The coastwide harvest rate of thornyhead in 1993 was lower than in 1992 because of a reduced thornyhead cumulative limit of 35,000 pounds per four-week period. Coastwide landings of 7,636 MT declined from 1992 landings but still exceeded the 7,000 MT harvest guideline by 636 MT. California landed 4,101 MT, or 54%, of the coastwide thornyhead catch.

The coastwide catch of Dover sole was 14,320 MT, a decrease of 1,689 MT from 1992. The continuing decline in production was the result of reduced market demand and increasingly restrictive landing limits. California landings of 6,540 MT were 46% of total coastwide landings, compared with a 54% share for 1992.

California's *Sebastes* complex landings declined from 8,863 MT in 1992 to 7,315 MT in 1993, and included nearly 1,254 MT of commercial bocaccio harvest and an estimated 200 MT from the recreational fishery. The California *Sebastes* fishery began with a 50,000-pound two-week cumulative limit including a 10,000-pound bocaccio limit. Midyear projections that 1993 bocaccio landings would be below the harvest guideline of 1,540 MT, and reports that bocaccio were discarded at the 10,000-pound limit caused the PFMC to increase the cumulative bocaccio limit within the *Sebastes* limit to 15,000 pounds.

The 1993 coastwide widow rockfish harvest guideline (HG) of 7,000 MT was unchanged from 1992. Widow rockfish harvest was projected to exceed the HG by early November, but the PFMC chose not to modify the cumulative limit of 30,000 pounds per four-week period and waited until December 1 to impose a 3,000-pound-per-trip limit. The total 1993 landed catch of 7,905 MT was 113% of the HG, of which California contributed 1,181 MT, or 15%.

The groundfish limited-entry plan, adopted by PFMC in 1991, was approved by NMFS in late 1992 for implementation on January 1, 1994. The plan requires permits for any trawl, longline, or pot vessel fishing in the limited-entry fishery. Non-permitted vessels will be allowed to fish in the "open-access" fishery. The limited-entry and open-access fisheries will be subject to separate quotas and trip limits.

In 1992, PFMC examined the feasibility of individual transferable quotas (ITQs) and chose to develop an ITQ program for nontrawl sablefish. In 1993, the PFMC continued to narrow the program options with the goal of adopting a plan in spring 1994.

DUNGENESS CRAB

California Dungeness crab (*Cancer magister*) landings during the 1992–93 season were 4,567 MT, an increase of only 119 MT from the previous season, but well above the ten-year average of 3,643 MT.

The northern California season opened on December 1, 1992, with only a few fishers setting gear because of a price-related strike and poor (soft shell), postmolt crab condition. Fishers in Oregon and Washington agreed to an ex-vessel price of \$1.00 per pound on December 1, and fishers from the border port of Brookings, Oregon, immediately set gear in California waters southward to Point Saint George. During the strike period, Oregon fishers harvested intensively from that area, arousing considerable hostility in California fishers and finally leading to altercations and vessel ramings. Crab condition improved by January 1, 1993, but the price dispute continued despite a drop in the fishers' demand from \$1.25 to \$1.10 per pound. Fishing began in earnest on February 8 at \$1.05 per pound, \$0.30 per pound lower than the 1991–92 season price.

A fleet of 454 vessels landed approximately 4,357 MT at the northern California ports of Crescent City, Trinidad, Eureka, and Fort Bragg during the 1992–93 season. The port of Crescent City accounted for 2,500 MT of the total, followed by Eureka (1,436 MT), Trinidad (346 MT), and Fort Bragg (75 MT).

The San Francisco-area Dungeness crab season opened on November 10, 1992, with an ex-vessel price of \$1.83 per pound. Total crab landings decreased by 326 MT from the previous season, to a 1992–93 total of 121 MT. Crab fishers landed 37 MT at Bodega Bay, and 84 MT at ports in the San Francisco area. Monterey and Morro Bay contributed 89 MT to the season total.

The 1992–93 season marked the first time that fishers were required to obtain a permit to participate in the California Dungeness crab fishery. Assembly Bill 3189 enacted a three-year moratorium on new entrants to the fishery, pending a study of the need to limit participation.

In September 1993, resource agency directors from California, Oregon, and Washington signed a memorandum of understanding recognizing the need for interstate cooperation in managing the Pacific Coast Dungeness crab fishery in general, as well as adjusting the fishing season if soft-shelled crabs were commonplace at the beginning of the winter season.

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

	Swordfish	Thresher shark	Shortfin mako shark
1983	1,183	783	147
1984	2,013	756	150
1985	2,362	700	103
1986	1,749	276	215
1987	1,246	239	274
1988	1,129	250	222
1989	1,296	295	177
1990	851	210	262
1991	711	344	151
1992	1,068	179	97
1993*	1,206	155	84

*Preliminary

SWORDFISH AND SHARKS

Swordfish (*Xiphias gladius*) landings increased to 1,206 MT in 1993, 13% more than in 1992 (table 4). About 82% of the catch was taken by the drift gill net fishery. Harpoon landings increased to 8%, and longline landings doubled to 10% of the catch. Six vessels (there were three in 1992) used longline gear outside of the U.S. Exclusive Economic Zone (EEZ) and landed fish in southern California. As in 1992, a significant portion (42%) of the swordfish catch was landed north of San Francisco because of persistent (but weaker) El Niño conditions. Typically, swordfish caught in drift gill nets or by longline sold for \$2.25 to \$4.35 per pound, whereas harpooned fish sold for \$3.50 to \$6.50 per pound.

Common thresher shark (*Alopias vulpinus*) landings declined to 155 MT in 1993, the lowest level in thirteen years. Landings at southern California ports sold predominantly at ex-vessel prices between \$1.00 and \$2.00 per pound. Nearly all of the thresher sharks were caught by the drift gill net fishery.

Shortfin mako shark (*Isurus oxyrinchus*) landings decreased by 13% to 84 MT (table 4). Most (70%) of the catch was landed in southern California ports, at ex-vessel prices between \$0.75 and \$1.50 per pound.

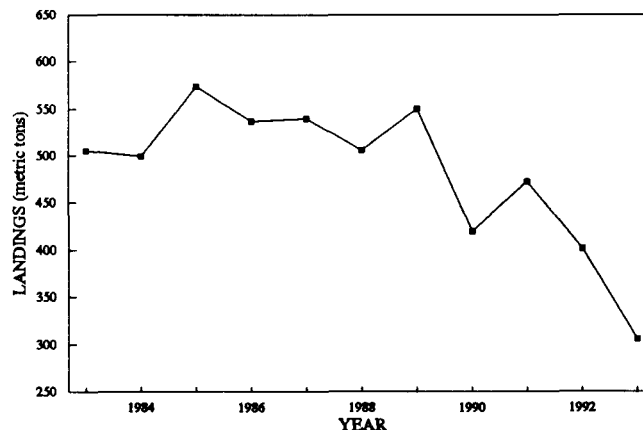


Figure 2. California landings of halibut, 1983-93.

Mako sharks are caught primarily by the drift gill net fishery, although hook and line gear accounted for approximately 14% of the mako catch, and almost 7% of the catch was landed by longline vessels operating outside the EEZ.

CALIFORNIA HALIBUT

California halibut (*Paralichthys californicus*) landings in 1993 were approximately 306 MT (table 5), a decline of 24% from the 401 MT landed in 1992 (figure 2). San Francisco accounted for 43% of total halibut landings; Santa Barbara accounted for 23%. Three factors may have contributed to low landings in Santa Barbara and other southern California ports. (1) The Marine Resource Protection Act of 1990 (Proposition 132) prohibited the use of gill and trammel nets in state waters south of Point Arguello after January 1, 1994, and entangling net fishers may have left the fishery to avoid increased permit fees (\$1,000). (2) Warmer-than-normal sea temperatures from the El Niño event may have shifted the halibut, and the fishery, northward. (3) Opportunistic feeding of harbor seal (*Phoca vitulina*) and California sea lion (*Zalophus californianus*) on southern California set and trammel nets reduced the catch.

TABLE 5
California Commercial Halibut Landings, 1993

Port	Pounds	Metric tons	Value	Percentage of total pounds
Unknown	947	0.4	\$2,353	0.1
Eureka	732	0.3	\$1,656	0.1
San Francisco	289,685	131.5	\$676,601	42.9
Monterey	39,576	17.9	\$79,842	5.9
Morro Bay	59,842	27.2	\$150,443	8.9
Santa Barbara	152,162	69.1	\$355,128	22.5
Los Angeles	72,956	33.1	\$218,364	10.8
San Diego	58,898	26.7	\$140,622	8.7
Totals	674,798	306.2	\$1,625,009	99.9

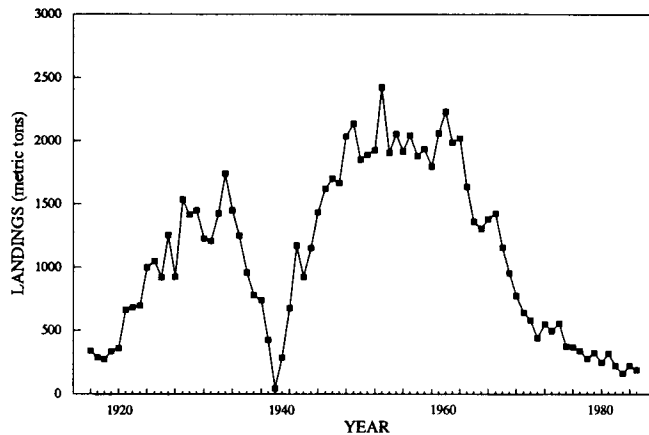


Figure 3. California abalone landings, 1916–93.

California halibut landings peaked in 1993 during March (51 MT) and July (50 MT). Landing-receipt data indicate that trawl nets accounted for 47% of the catch, followed by entangling nets (36%), hook and line (11%), and miscellaneous or unspecified gears (6%).

California halibut prices ranged from \$1.00 to \$6.75 per pound, averaged \$2.68 per pound, and totaled \$1.6 million for 1993.

ABALONE

Abalone (*Haliotis* spp.) historically have been harvested by both commercial and recreational fishers in California. Commercial landings were 200 MT in 1993, down from 235 MT in 1992 and third lowest since landing statistics began to be collected in 1916 (figure 3). The 1993 landings represented just 8% of the 1957 peak of 2,470 MT. Statewide recreational catch estimates were unavailable, but in 1989 the recreational catch of red abalone (*Haliotis rufescens*) in northern California was estimated to be 2.5 times larger than the statewide commercial abalone fishery.

Approximately 189 MT of red abalone, the principal species harvested, were landed by commercial fishers in 1993. These landings were 6% less than in 1992 and 80% less than the 1931–67 average of 953 MT. Red abalone was the only species taken commercially in northern California, off the San Mateo County coast and off the Farallon Islands.

Commercial catches of red abalone in southern California waters have declined over the past decade at all areas except San Miguel Island, where catches increased from 66 MT in 1982 to 133 MT in 1993, and constituted 71% of statewide abalone landings. During this same decade the statewide proportion of abalone landed in the Santa Barbara area declined from 20% to 3%; in the San Diego area, from 10% to 0.3%; at San Nicolas Island, from 10% to 0.2%; and at Santa Cruz Island, from 7% to 0.1%.

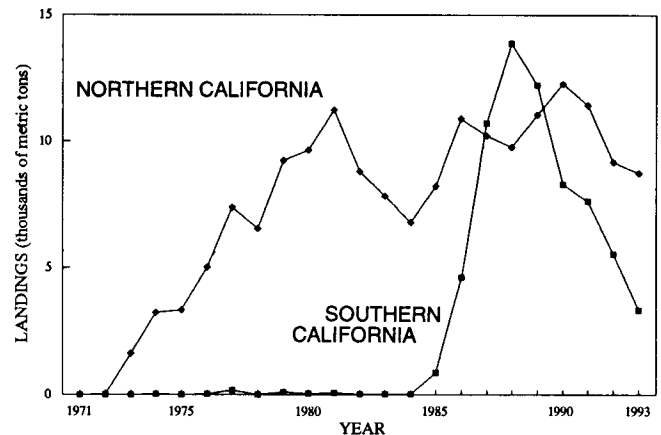


Figure 4. California sea urchin landings, 1971–93.

Pink, green, and black abalone were also landed commercially. All 1993 southern California landings reflect a continued decline from the previous year: pink abalone declined from 8 MT in 1992 to 7 MT; green abalone declined from 5 MT to 3 MT; and black abalone declined from 17 MT to 0.9 MT. Part of this decline was attributed to a statewide closure on sport and commercial take of black abalone. The closure was imposed in July 1993 to allow recovery for survivors of a disease known as withering syndrome, which continued to decimate black abalone populations at the Channel Islands and off the California mainland.

Average ex-vessel prices in 1993 increased by 29% from 1992 to \$6.98 per pound, reflecting increasing worldwide demand. Thus the ex-vessel value of abalone landings rose to \$3.1 million from \$2.8 million in 1992 despite declining landings. Since 1983, ex-vessel prices have risen by 239%, while inflation grew by only 52% as measured by the California Consumer Price Index.

SEA URCHIN

In 1993, California landings of red sea urchin (*Strongylocentrotus franciscanus*) totaled 12,046 MT, 18% less than the 1992 total of 14,655 MT. Southern California landings decreased by 6% from the previous year, while northern California landings decreased by 38% (figure 4).

Catch per unit of effort (CPUE), in kilograms per diving hour, decreased in northern California from 144 kg per hour in 1992 to 112 kg per hour in 1993, and was dramatically less than the high rate of 311 kg per hour in 1988 (figure 5). Southern California CPUE decreased from 106 kg/hr in 1992 to 93 kg/hr in 1993, continuing a slow decline from the high rate of 149 kg/hr in 1989 (figure 5).

The number of sea urchin permits declined from 548 permittees and 84 apprentices in the 1992–93 season to 520 permittees and 77 apprentices during the 1993–94

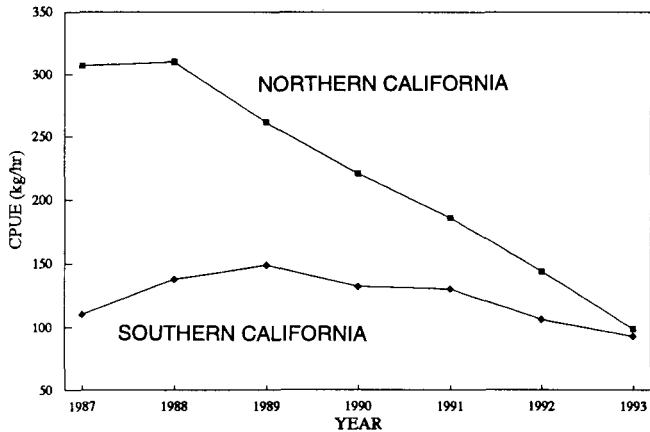


Figure 5. California sea urchin catch per unit of effort, 1987–93.

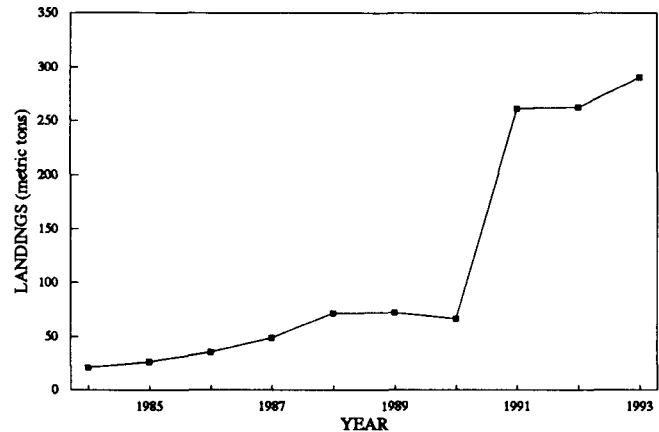


Figure 6. California sea cucumber landings, 1984–93.

season, a number considered too high, and well above the original target of 400 permits. The California Fish and Game Commission canceled the apprentice diver program in March 1994. Current apprentices will be granted full permit status, and no new permits will be issued until the number drops below the new target of 300.

The purple sea urchin (*Strongylocentrotus purpuratus*), a smaller species with less roe, is more difficult to process. Although interest in this species has increased in recent years, the market for purple urchins is still limited. Statewide, purple sea urchin landings decreased from 143 MT in 1992 to 49 MT in 1993. As the availability of red sea urchins continues to decline, harvest of purple sea urchins may increase, especially if harvesting and processing economics become favorable.

SEA CUCUMBER

Statewide, sea cucumber landings were 291 MT in 1993, an increase of 28 MT over 1992 landings. The catch comprised 12 MT of warty sea cucumber (*Parastichopus parvimensis*) and 279 MT of California, or giant red, sea cucumber (*P. californicus*). Commercial divers in southern California harvested the giant red sea cucumber by hand; trawlers harvested the warty cucumber. Most sea cucumbers were landed in the ports of San Pedro and Santa Barbara. The main fishing grounds for the giant red sea cucumber were the Santa Barbara Channel and the Santa Catalina Channel, at depths of 30 to 90 fathoms. Warty sea cucumbers were harvested as far south as San Diego, but most were taken from waters off the northern Channel Islands.

The average price for warty sea cucumbers was \$0.66/lb and ranged from \$0.30 to \$0.90/lb; the average price for California sea cucumbers was \$0.62/lb and ranged from \$0.20 to \$0.70/lb. The warty variety sold at a slightly higher average price because of a thicker, meatier body wall that yields a higher-quality food product. Most of the sea cucumbers were dried and exported to Hong

Kong and Taiwan. The end product, called trepang, sold for \$4.00 to \$13.00/lb. A small portion of the harvest was distributed and sold within the United States.

The sea cucumber fishery began in California near Los Angeles around 1978, and averaged under 45 MT annually until 1982, when a trawl fishery developed near Santa Barbara. During the next ten years, annual landings increased gradually (figure 6). In 1991, an influx of trawlers, predominately out of the Los Angeles port area, greatly expanded the fishing effort and catch. From 1991 through 1993, sea cucumber landings exceeded 260 MT (figure 6). Since the 1992–93 season, the fishery has been a limited entry fishery based on a previous minimum sea cucumber landing of 50 pounds. There were 86 permittees in 1993. Landing receipt data indicate that 27 trawlers and 20 dive boats actively participated in the fishery during 1993.

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

Sea cucumbers have a short life span, low age of maturity, sporadic recruitment, and high natural mortality. Species with these characteristics can be vulnerable to overfishing, but it is expected that the southern California populations of warty and giant red sea cucumber can sustain current harvest levels, because of permit restrictions placed upon the fishery. Northern California dive fishery landings have leveled off and appear to be sustainable unless harvest restrictions for the northern

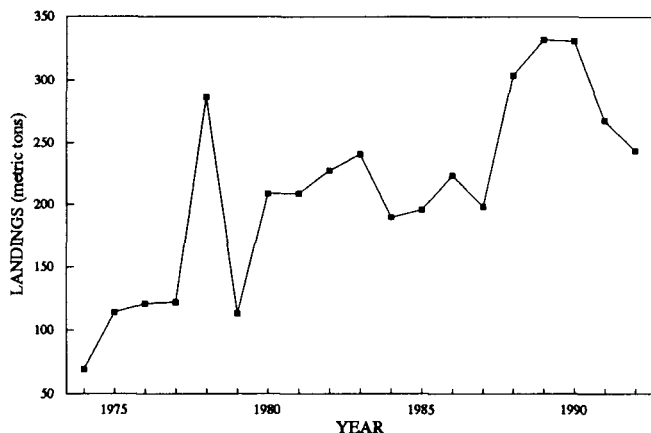


Figure 7. California spiny lobster landings, 1974–93.

California sea urchin fishery redirect that effort to the sea cucumber resource.

CALIFORNIA SPINY LOBSTER

During the 1992–93 commercial fishing season, spiny lobster (*Panulirus interruptus*) landings totaled 244 MT—24 MT (9%) less than the 268 MT landed in 1991–92 (figure 7). The 1992–93 landings were above the 1974–92 average of 209 MT. The historic high catch of 500 MT was recorded during the 1949–50 season.

Since 1974, landings during the first two months of the season have consistently made up over 50% of the season's total. During the 1992–93 season 62% of the total was landed in the first two months.

Starting in 1965, permits were required for commercial lobster trapping, and the number of permits ranged from a low of 180 in 1970–71 (when a \$100 fee was instituted) to 614 in 1968–69. For the 1992–93 season 329 permits were issued, representing a decrease of 8% from the previous season.

From 1952 to 1970, the total ex-vessel value of the fishery ranged between \$250,000 and \$500,000. Since then, total landings value increased to a high of \$4 million in 1990. Ex-vessel prices in the fishery were \$6.43 per pound for the 1992–93 season and totaled \$3.3 million, a decrease of 17% from the previous season.

Spiny lobsters were also taken by recreational fishers, mostly scuba divers, but hoop netting was popular in a few areas, especially San Diego Bay. During the 1992–93 spiny lobster season, CDFG conducted dockside interviews (intercept program) and mailed survey questionnaires to recreational lobster fishers. Analysis of data from the intercept program, mail surveys, and commercial passenger dive boat (CPDB) logbooks for the 1992–93 season revealed that most recreational lobster fishers caught one lobster per trip. Catch and effort analysis for the recreational fishers revealed patterns similar to those observed in the commercial fishery, with decreasing catch

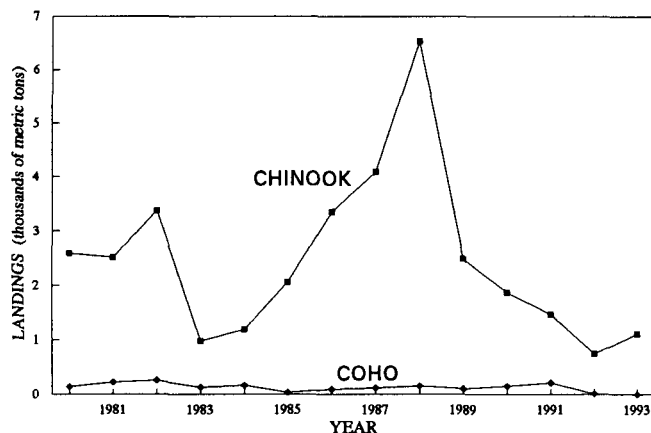


Figure 8. California commercial salmon landings, 1980–93.

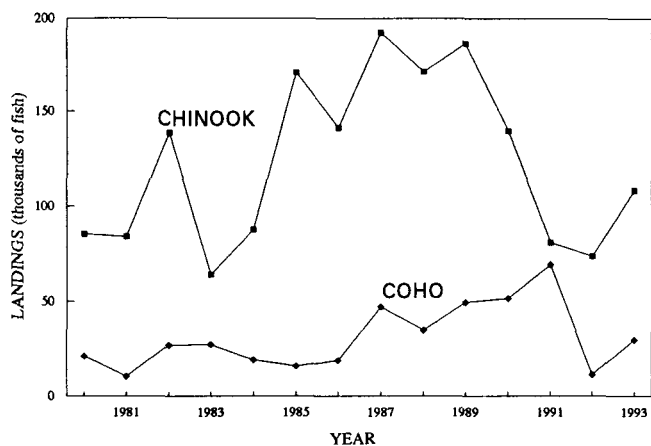


Figure 9. California recreational salmon landings, 1980–93.

and effort as the season progressed. Unlike the commercial fishery, however, the recreational fishing effort and subsequent catch increased during the final weeks of the season.

SALMON

During an estimated 24,800 days fished in 1993, the California commercial salmon fishery landed slightly over 2.4 million pounds of chinook salmon (*Oncorhynchus tshawytscha*; figure 8). No commercial landings of coho salmon (*Oncorhynchus ksutch*) were permitted. California recreational anglers caught 108,400 chinook and 29,700 coho salmon during 174,000 angler trips (figure 9).

Because six years of drought had reduced salmon availability, very restrictive commercial and recreational ocean salmon regulations were implemented to ensure annual escapement goals in the Klamath and Sacramento fall chinook stocks. These stocks represented most of California's ocean salmon landings. The Klamath fall chinook escapement goal was 35,000 natural spawners, and the Sacramento fall chinook goal was 122,00–180,000

spawners. The commercial fishery operated under various time and area closures between May 1 and September 30, 1993.

Ex-vessel prices for salmon, eviscerated and cleaned at sea, were \$2.25 per pound, and total ex-vessel value was \$5.4 million.

Recreational fishery regulations were less restrictive than in 1992, although a few restrictions north of Point Conception remained unchanged (barbless hooks, daily bag limit of two salmon, and a minimum size limit of 20 inches).

Recreational chinook landings at southern ports totaled 103,500 fish and were 46% higher than the 1992 landings of 71,000 fish. Recreational angler effort in the south totaled 140,300 angler trips, compared to 109,600 trips in 1992. The chinook catch per angler trip averaged 0.74 fish, compared to 0.65 fish in 1992. Recreational coho landings in the south totaled 15,400 fish, about three times more than the 1992 landings. The recreational chinook fishery opened with a catch quota of 12,000 fish, a daily bag limit of one salmon, and a closure of Sunday through Tuesday each week.

Northern recreational landings totaled 7,500 chinook and 19,000 coho, compared to 3,800 chinook and 8,200 coho in 1992. Angler effort was 51,300 trips in 1993, about 2.3 times greater than the 1992 effort of 21,900 trips. In September, 1,100 chinook and 1,400 coho were caught in the general area fishery, during 6,100 angler days.

LIVE-FISH FISHERY

The commercial fishery to catch and sell live fish continued to expand in California. In 1993, statewide landings for live fish were estimated at 216 MT, 17% more than in 1992 (table 6). The live-fish fishery began in 1988, mainly for the California Asian community. For this market, popular fishes are those that look attractive and can withstand the rigors of capture and transportation. Optimum weight ranges between 1 and 3 pounds, a suitable single entrée size at Asian restaurants. Ex-vessel prices ranged from \$2.00 to \$7.00 per pound. Larger fish were also sold live, but at a considerably reduced price. Prices fluctuated with market demand, fish size, fish condition, and weather conditions. Demand for live red rockfish increased toward the lunar New Year celebrations, and ex-vessel prices rose above \$6.00 per pound.

Live-fish landings in southern California (Morro Bay south) totaled 190 MT, 23% more than in 1992 (figure 10). Most landings were made with hook and line gear until 1989, when finfish traps were used to catch sheephead. Use of traps grew rapidly; by 1993 over 60% of live sheephead were caught with trap gear. Traps used for finfish are constructed like lobster traps, but variations abound as this fishery continues to develop. Target species for both gear types included California sheep-

TABLE 6
 Preliminary 1993 Landings of Live Fish (Metric Tons)

	Southern California	Northern California
California sheephead	97	0
Cabezon	15	0
Rockfishes	68	25
All others	10	1
Total	190	26

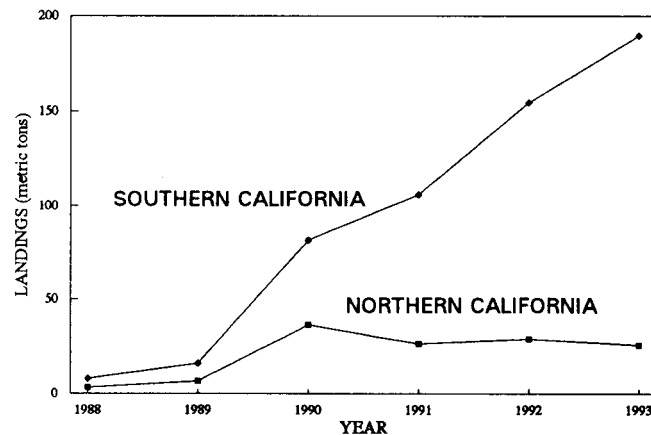


Figure 10. California live-fish landings, 1988-93.

head; cabezon; California scorpionfish; treefish (*Sebastes serriceps*); and kelp (*S. atrovirens*), brown, grass (*S. rastreliger*), and gopher rockfishes. Gill nets and trawls for live California halibut (*Paralichthys californicus*) were used near Ventura and Los Angeles, but total catch was not substantial.

Live-fish landings in northern California (north of Morro Bay) totaled 26 MT, 12% less than in 1992 (figure 10). Landings were made primarily by hook and line vessels using vertical longlines and troll longlines to harvest rockfish along nearshore rocky reefs and offshore banks. Principal rockfishes caught were canary (*Sebastes pinniger*), gopher (*S. carnatus*), brown (*S. auriculatus*), China (*S. nebulosus*), copper (*S. caurinus*), and quillback (*S. maliger*).

Monitoring and accurate data collection was difficult for this fishery because live-fish landings were not separated from dead-fish landings in the database. For this reason, CDFG developed and implemented new landing receipts that differentiate live fish from dead fish.

Management recommendations were drafted to regulate the live-fish trap fishery because of potential effects on sheephead populations. Proposed restrictions include a limited-entry program, limitations on number of traps, and construction requirements for traps.

RECREATIONAL FISHERY

California's large, diverse, marine recreational fishery includes skiff, beach-and-bank, pier, and commer-

TABLE 7
 Commercial Passenger Fishing Vessel Landings

Species/Species-group	1993 Provisional		Rank	1992 Final		Rank
	Number of fishes*			Number of fishes*		
Rockfishes (misc.)	1,535,229	(23,271)	1	2,051,576	(28,710)	1
Pacific mackerel	396,950	(8,387)	2	327,747	(242)	4
Kelp bass	333,313	(4,115)	3	463,673	(12,838)	2
Barred sand bass	306,363	(4,199)	4	363,304	(3,047)	3
California barracuda	198,943	(4,122)	5	248,055	(6,198)	5
Pacific bonito	119,201	(6,934)	6	115,866	(5,410)	6
Salmon (misc.)	69,376	(1)	7	43,384	(1)	10
Spotted scorpionfish	64,194	(12,031)	8	77,290	(12,128)	7
Halfmoon	54,622	(11)	9	42,372	(1)	12
Ocean whitefish	38,247	(959)	10	40,702	(707)	14
Lingcod	33,760	(230)	11	43,251	(264)	11
Yellowtail	32,020	(16,546)	12	40,834	(32,986)	13
Yellowfin tuna	26,065	(26,015)	13	73,739	(58,282)	8
California sheephead	23,964	(983)	14	25,778	(1,367)	15
Skipjack tuna	20,454	(15,811)	15	52,302	(25,976)	9
White croaker	11,274		16	4,824		21
Bluefin tuna	9,964	(9,716)	17	8,586	(5,261)	17
Dolphinfish	8,035	(7,353)	18	22,727	(20,815)	16
Jack mackerel	7,198	(20)	19	1,806		26
Flatfishes (misc.)	6,319	(7)	20	7,365		18
Blacksmith	5,689		21	6,369		19
California halibut	5,083	(40)	22	4,341	(30)	22
Sharks (misc.)	3,766	(10)	23	3,518	(9)	24
Croakers (misc.)	3,682	(298)	24	2,315	(96)	25
Wahoo	3,207	(2,638)	25	3,924	(3,736)	23
All others	13,923	(1,017)	—	15,121	(827)	—
Totals	3,330,841	(144,714)		4,090,769	(218,931)	

*Numbers in parentheses are fish caught in waters south of California (mainly off Mexico).

cial passenger fishing vessel (CPFV) modes. The CPFV fleet accounts for a substantial proportion of California's landings (table 7). In southern California, CPFVs fish for albacore (*Thunnus alalunga*), Pacific bonito (*Sarda chiliensis*), yellowtail (*Seriola lalandei*), California barracuda (*Sphyrnaea argentea*), yellowfin tuna (*T. albacares*), Pacific mackerel (*Scomber japonicus*), rockfishes (*Sebastes* spp.), barred sand bass (*Paralabrax nebulifer*), and kelp bass (*P. clathratus*). In central and northern California, CPFVs fish for salmon (*Oncorhynchus* spp.), striped bass (*Morone saxatilis*), rockfishes (*Sebastes* spp.), lingcod (*Ophiodon elongatus*), and white sturgeon (*Acipenser transmontanus*).

In 1992, above-normal sea-surface temperatures, caused by an El Niño event, and a six-year drought influenced fishing conditions by displacing some pelagic fish stocks northward. In 1993, fishing conditions were influenced by sea-surface temperatures that were returning toward normal and by a substantial rainy season. The more normal sea-surface temperatures had a negative effect on the CPFV industry, because some of the more desirable surface gamefish were less available, especially in southern California.

There were 13% fewer anglers (555,359) in 1993 than in 1992, and total catch declined by 19%, to 3,330,841 fish (table 7). Of the twenty-five most prominent fish species and species-groups ranked in the catch, fifteen

had lower catches than during 1992. Most notably, yellowfin tuna and dolphinfish (*Coryphaena hippurus*) both declined by 65%, and skipjack tuna (*Euthynnus pelamis*) declined by 61%. Others with moderately lower landings in 1993 were kelp bass (28% decline), rockfishes (25%), yellowtail and lingcod (both 22%), and California barracuda (20%). On a positive note, ten species and species-groups had higher landings in 1993 than in 1992: jack mackerel (*Trachurus symmetricus*) increased by 75%; white croaker (*Genyonemus lineatus*) by 57%; salmon by 38%; and croakers (*Sciaenidae*) by 37%. Others with moderately higher landings in 1993 were halfmoon (*Medialuna californiensis*), which increased by 22%, Pacific mackerel, by 17%; California halibut (*Paralichthys californicus*), by 15%; and bluefin tuna (*T. thynnus*), by 14%.

Contributors:

- | | |
|----------------------------------|------------------------------|
| R. Ally, CPFV | E. Konno, Pacific mackerel |
| K. Barsky, shark/swordfish | K. McKee, live fish |
| T. Bishop, Pacific sardine | D. Ono, sea cucumber |
| A. Grover, salmon | L. Quirollo, Pacific whiting |
| D. Hanan, editor | C. Ryan, Pacific herring |
| S. Harris, lobster | I. Taniguchi, sea urchin |
| J. Hernandez, California halibut | D. Thomas, groundfish |
| K. Karpov, abalone | R. Warner, Dungeness crab |