

**REVIEW OF SOME CALIFORNIA FISHERIES FOR 1999:  
MARKET SQUID, DUNGENESS CRAB, SEA URCHIN, PRAWN, ABALONE,  
GROUNDFISH, SWORDFISH AND SHARK, OCEAN SALMON, NEARSHORE FINFISH,  
PACIFIC SARDINE, PACIFIC HERRING, PACIFIC MACKEREL, REDUCTION,  
WHITE SEABASS, AND RECREATIONAL**

CALIFORNIA DEPARTMENT OF FISH AND GAME

Marine Region  
Bodega Marine Laboratory  
2099 Bay Flat Road  
Bodega Bay, California 94923-0247  
rogersbennett@ucdavis.edu

In 1999 commercial fisheries landed an estimated 214,229 metric tons (t) of fishes and invertebrates from California ocean waters (fig. 1), an increase of 66% from the 128,885 t (updated estimate) landed in 1998. The preliminary ex-vessel economic value of California commercial landings in 1999 was \$145 million, an increase of 36% from the \$107 million of 1998.

The commercial invertebrate fisheries in California had a greater combined ex-vessel value (\$79 million) than the combined finfish fisheries value (\$66 million) in 1999. The top three fisheries in millions of dollars ex-vessel value were market squid (\$35 million), groundfish (\$18 million), and Dungeness crab (\$17 million). Market squid increased dramatically to a new record high in 1999. Sea urchin landings increased slightly from their ten-year low in 1998, although landings in northern California continued to decline in 1999. Ridgeback prawn increased 320% in 1999, while spot prawn decreased 25%. In 1999 Dungeness crab landings were slightly above their ten-year average, and a high percentage (28%) of meat was recovered from the crabs. The commercial abalone fishery remained closed statewide, while 40,000 fishers participated in the recreational-only red abalone fishery in northern California.

Ocean conditions along the California coast were dominated by cold La Niña conditions following the dramatic El Niño of 1997–98. Pacific sardine landings were at their highest level in decades, while Pacific mackerel landings dropped to less than half of the 1998 levels. Other pelagic species such as Pacific herring recovered from El Niño with a 45% increase in landings during the 1998–99 sac roe season, although the San Francisco Bay herring eggs-on-kelp fishery landed the second lowest tonnage on record. Commercial chinook salmon landings in the ocean nearly doubled in 1999 compared with 1998. Swordfish landings increased more than 50% in 1999, while shark landings continued to decline. Commercial white seabass landings reached their highest level in 17 years.

In spite of the cold-water La Niña conditions, landings in several fisheries continued to decline in 1999,

most notably groundfish. Commercial groundfish landings decreased 37% from 1998 levels and 51% from 1997. Landings of rockfish such as bocaccio, widow rockfish, and chilipepper decreased from 1998 levels. The National Marine Fisheries Service listed lingcod, bocaccio, and Pacific ocean perch as overfished. As a result, more restrictive limitations have been put in place for these species. Landings for some flatfishes, such as sablefish, sanddabs, and petrale sole, increased in 1999. The drop in revenues from the groundfish fisheries was slightly moderated by increased landings of high-value sablefish and increased value of rockfish in the live-fish fishery. The live-fish fishery in California continued its exponential growth with a tenfold increase in the number of vessels from 1989 to 1999. Prices paid for live rockfish reached \$10 per pound.

Statewide landings by recreational fishers aboard commercial passenger fishing vessels (CPFVs) increased by 8%, to 3,395,471 individual fishes. Fishers in southern California brought in 75% of the statewide landings reported from CPFVs in 1999. Recreational landings of ocean salmon decreased to 87,600 chinook salmon; no coho salmon were permitted to be taken. Recreational landings of white seabass increased eightfold in 1999.

The Marine Life Management Act continues to direct California Department of Fish and Game (CDFG) efforts to sustainably manage marine resources. As part of this effort, the CDFG is moving toward an ecosystem-based management approach. The CDFG also continues to strengthen ties with other groups in an effort to co-manage marine resources within the state. Finally, many of the data presented in this report are generated from the CDFG's new, Oracle-based data system, called the Commercial Fisheries Information System.

## INVERTEBRATE FISHERIES

### Market Squid

Market squid (*Loligo opalescens*) landings reached a record high of 90,322 t during La Niña conditions in 1999, surpassing the previous high of 80,402 t in 1996

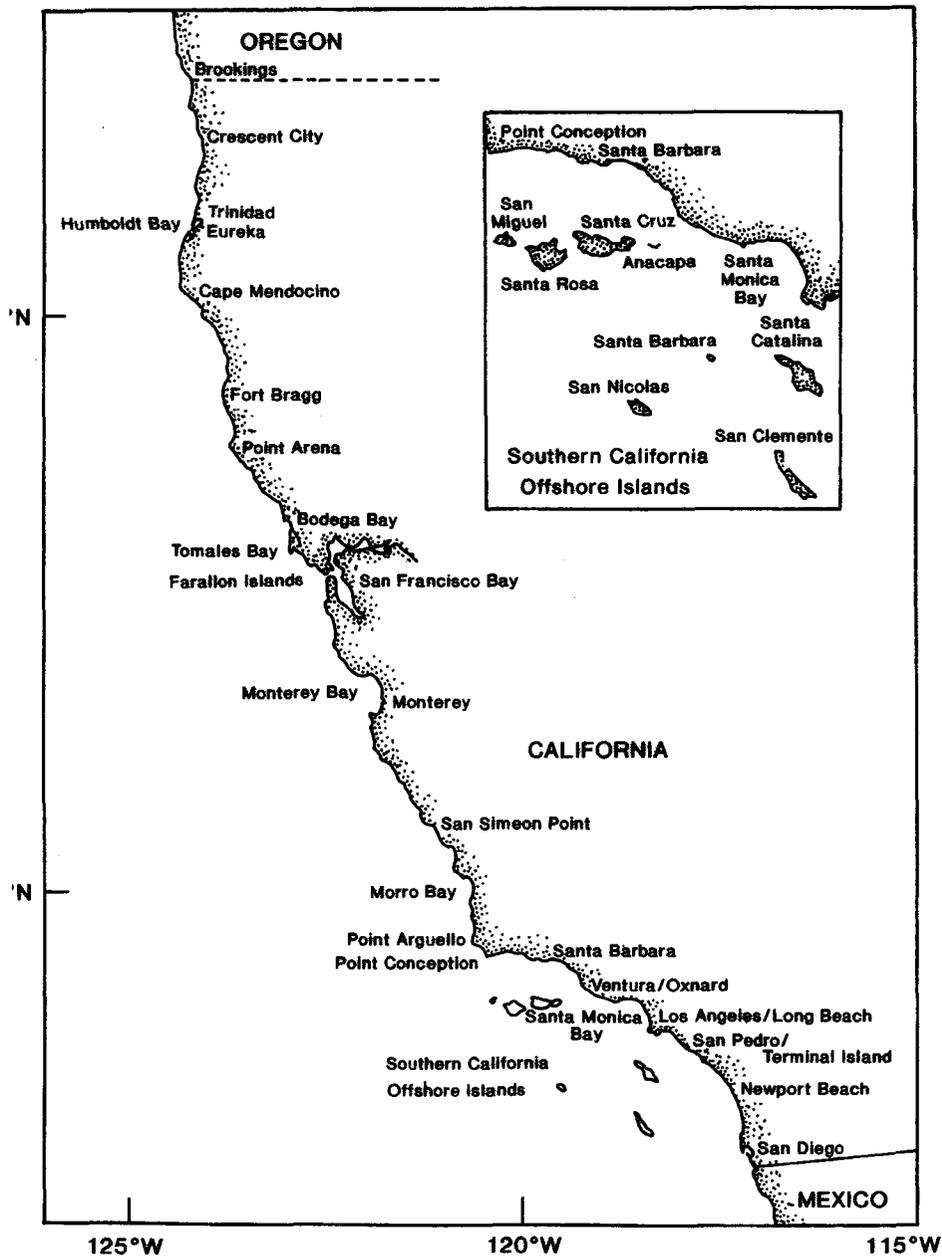


Figure 1. California ports and fishing areas.

(table 1, fig. 2). This was more than a 30-fold increase over the previous year (2,894 t), when the fishery was hampered by the 1997–98 El Niño. Landings reached new highs five times in the 1990s, reflecting the continued expansion of the southern California fishery and increased export demand.

Market squid is one of the most important fisheries in the state, in terms of both volume and revenue. In 1999, ex-vessel revenues generated from market squid were approximately \$35 million, ranking this fishery first among California commercial fisheries. Average ex-vessel price paid to fishers was \$388.32 per t. Nearly 38% of landings were exported; market squid ranked sixth by volume and sixteenth in value among U.S. exports of

edible fishery products. The primary country of export was China, which received 10,295 t, an increase over the 46 t exported to China in 1998, but less than the 26,000 t in 1997. More than 70% of squid exports went to China and five additional importers: Spain (5,470 t), Japan (3,626 t), the Philippines (2,995 t), Italy (2,230 t), and Hong Kong (1,920 t). Processors reported that the Patagonian squid fishery did not noticeably affect their 1999 exports. Domestically, market squid was sold throughout the country, primarily to restaurants, Asian fresh fish markets, and as frozen bait. Processors grossed approximately \$36 million from exports in 1999.

The California market squid fishery is separated at Point Conception into northern and southern fisheries.

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

Year	Pacific sardine	Northern anchovy	Pacific mackerel	Jack mackerel	Pacific herring	Market squid	Total
1979	16	48,094	27,198	16,335	4,189	19,690	115,542
1980	34	42,255	29,139	20,019	7,932	15,385	114,764
1981	28	51,466	38,304	13,990	5,865	23,510	133,163
1982	129	41,385	27,916	25,984	10,106	16,308	121,828
1983	346	4,231	32,028	18,095	7,881	1,824	64,405
1984	231	2,908	41,534	10,504	3,786	564	59,527
1985	583	1,600	34,053	9,210	7,856	10,275	63,577
1986	1,145	1,879	40,616	10,898	7,502	21,278	83,318
1987	2,061	1,424	40,961	11,653	8,264	19,984	84,347
1988	3,724	1,444	42,200	10,157	8,677	36,641	102,843
1989	3,845	2,410	35,548	19,477	9,046	40,893	111,219
1990	2,770	3,156	36,716	4,874	7,978	28,447	83,941
1991	7,625	4,184	30,459	1,667	7,345	37,388	88,668
1992	17,946	1,124	18,570	5,878	6,318	13,110	62,946
1993	13,843	1,954	12,391	1,614	3,882	42,708	76,392
1994	13,420	3,680	10,040	2,153	2,668	55,395	85,929
1995	43,450	1,881	8,667	2,640	4,475	70,278	131,391
1996	32,553	4,419	10,286	1,985	5,518	80,360	135,121
1997	46,196	5,718	20,615	1,161	11,541	70,257	155,488
1998	41,056	1,457	20,073	970	2,432	2,709	68,646
1999	56,747	5,179	9,527	963	2,207	90,322	164,945

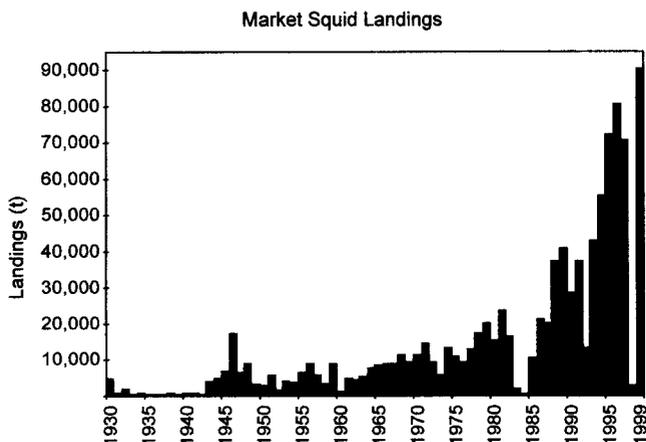


Figure 2. California market squid landings from 1930 to 1999.

Historically, the northern fishery accounted for the greater portion of the catch. Since the early 1980s, however, the southern fishery has repeatedly increased its landings and has dominated the fishery. Typically, the northern fishery is active during the summer months and the southern fishery in the winter. In 1999, the northern fishery was essentially inactive, accounting for less than 0.5% of statewide landings for the second year in a row. Landings in the north (348.2 t) were considerably below their annual average (1,750 t average for 1981–98).

In 1999 the southern fishery, near the Channel Islands, continued for nearly the entire year, with record-high monthly totals in April, May, and June. The southern fishery comprises 170 vessels that landed 89,973.9 t.

Although fishers and processors alike acknowledge that squid was readily available most of the year in southern California, catch levels were generally dictated by market conditions that expressed only moderate demand for the product. During most of the year, vessels fished on market-imposed limits of 30 short tons per trip.

The market squid fishery was an unregulated, open access fishery until 1 April 1998, when new legislation placed a three-year moratorium on the number of vessels in order to assure sustainability of the fishery. This legislation requires fishers to purchase a \$2,500 permit each year either to land more than 2 short tons per trip or to attract squid by light for purposes of commercial harvest, and participants must have purchased a permit the previous year. For the 1999–2000 squid fishing season (1 April to 31 March), 218 market squid vessel permits and 52 light-boat permits were sold, down from 248 vessel permits and 54 light-boat permits the previous season. The sale of permits provides funds for biological assessments of the resource and development of recommendations for a market squid conservation and management plan due 1 April 2001.

The same legislation provides for the Squid Fishery Advisory Committee and the Squid Research and Scientific Committee, established in 1998. Management measures recommended by the committees and approved by the Fish and Game Commission during 1999 include mandatory logbooks for squid vessels and light boats, and statewide weekend closures.

In 1999, the National Park Service reported to the CDFG and the two committees that there was an appar-

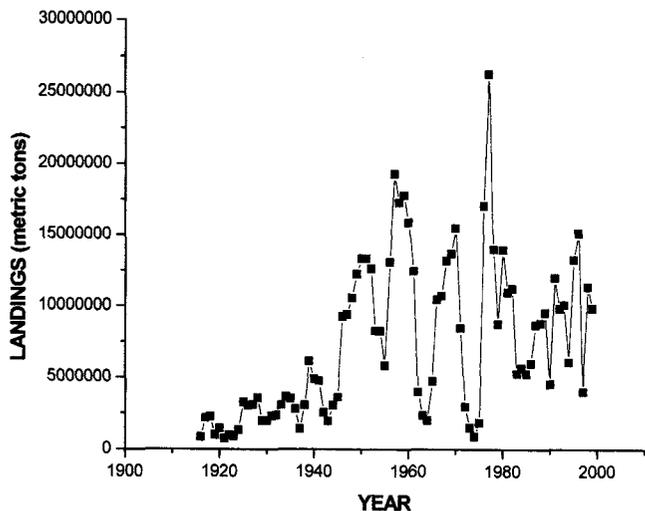


Figure 3. California landings of Dungeness crab, 1916–99.

ent increase in nest abandonment and chick predation among shorebirds at the Channel Islands. The Park Service questioned whether the abundance of vessels lighting for squid near these islands during the nesting season could have been responsible. In answer to the concerns, the Squid Fishery Advisory Committee recommended reduced lighting (maximum 30 kilowatts per vessel) and shielding lights as interim management measures.

Market squid research objectives for the CDFG include (1) collecting fishery data by port sampling, (2) conducting fishery-independent squid surveys with a remotely operated vehicle to describe spawning habitats and measure egg density, as well as conducting midwater trawl surveys to estimate relative abundance, (3) culturing eggs and paralarvae to determine the lowest viable temperature, in order to resolve spawning range constraints, and (4) analyzing satellite data to track growth of the market squid fishery since 1992. Preliminary port sample data indicate that the average squid taken in the commercial fishery weighs 45 g, is 133 mm long, and is approximately 185 days old.

### Dungeness Crab

California Dungeness crab (*Cancer magister*) landings during the 1998–99 season totaled 4,458 t, a decrease of 678 t from the previous season, and only slightly higher than the ten-year average of 4,352 t (fig. 3). The Dungeness crab fishery had an ex-vessel value of \$16.9 million.

In northern California the season opened on 1 December after preseason testing showed that the crab were in exceptionally fine condition, allowing a 28% meat recovery. Price started at \$1.25 per pound but by 22 December rose to \$1.95 and peaked in February at \$3.50 per pound. The fleet landed approximately 3,876 t in northern California, including 2,193 t in Crescent City, 330 t at Trinidad, 1,119 t at Eureka, and 234 t at

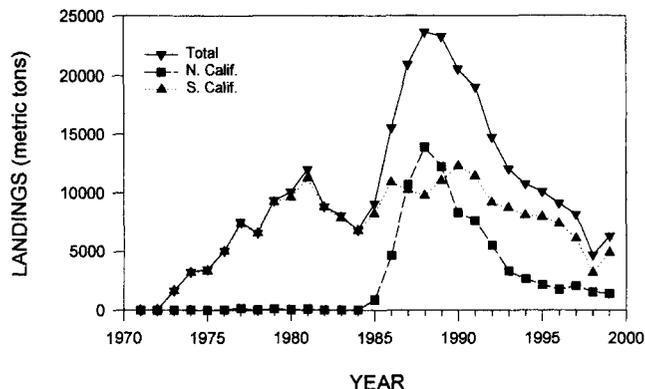


Figure 4. California landings of red sea urchin, 1971–99.

Fort Bragg (fig. 1).

The central California Dungeness crab season opened on 15 November. Total landings decreased by 1,036 t from the previous season, to 582 t. Crab fishers landed 247 t at Bodega Bay and Bolinas, and 318 t at ports in San Francisco and Half Moon Bay. Monterey and Morro Bay contributed only 17 t to the statewide totals.

### Sea Urchin

Red sea urchin (*Strongylocentrotus franciscanus*) fishery landings in 1999 increased from the record 20-year low in 1998. Statewide landings in 1999 totaled 6,283 t, up 25% from the 1998 total of 4,708 t. The rebound is attributed to the rise in southern California landings, which increased by 35% from 1998 (fig. 4). Northern California landings continued to decline, dropping 9% from 1998. The cooler seawater temperatures of La Niña provided good growth conditions for kelp and thus improved gonad quality in sea urchins, which was reflected in the increased landings.

Along with the increased landings, overall value of the fishery increased by 42%, from \$8 million in 1998 to \$13 million. The price per kg climbed from \$1.62 in 1998 to \$2.12. Southern California experienced a greater increase in price per kg (from \$1.82 to \$2.25) than northern California (from \$1.37 to \$1.65). The San Diego area experienced the largest increase in unit price (\$0.49) between 1998 and 1999. Fishery permits cost \$330, and sales dropped by 9% to 421 in 1999, still well above the permit target set at 300 in 1992.

Santa Barbara and the Oxnard/Ventura areas continued to be the most active ports for sea urchin landings, with a combined 55% of the statewide catch in 1999 (table 2). Los Angeles was the third most active port, with 18% of the total catch, while Fort Bragg in northern California was fourth. Landings in all other northern California ports either declined or remained the same.

The return of cooler sea temperatures helped boost the sea urchin fishery from its 20-year record low in

TABLE 2  
Preliminary California Commercial Red Sea Urchin Landings (Metric Tons) for 1999

Port	Landings	Percentage of statewide catch	Value	Price per kg
Fort Bragg	650.3	10.4	\$ 1,099,835	\$1.69
Albion	191.0	3.0	\$ 307,265	\$1.61
Point Arena	332.4	5.3	\$ 548,461	\$1.65
Bodega Bay	195.0	3.1	\$ 324,696	\$1.67
Half Moon Bay	6.5	0.1	\$ 9,222	\$1.41
Other N. Calif.	18.8	0.3	\$ 24,365	\$1.30
N. Calif. subtotal	1,394.1	22.2	\$ 2,302,976	\$1.65
Santa Barbara	2,063.3	32.8	\$ 4,708,447	\$2.28
Oxnard/Ventura	1,402.5	22.3	\$ 3,367,150	\$2.40
Los Angeles	1,150.4	18.3	\$ 2,353,948	\$2.05
Orange	7.3	0.1	\$ 12,572	\$1.73
San Diego	262.2	4.2	\$ 455,873	\$1.74
Other S. Calif.	3.0	0.0	\$ 8,920	\$2.98
S. Calif. subtotal	4,888.7	77.8	\$10,983,335	\$2.25
Grand total	6,282.7		\$13,286,311	

1998. The continued decline of the northern California fishery in the face of this recovery and the fact that 1999 statewide landings were 27% of the historical peak fishery levels raises questions about the sustainability of the fishery. To help address these concerns, a workshop was held in the summer of 1999 to discuss the status of the fishery and the future direction of management. The workshop was funded by the CDFG's Sea Urchin Advisory Committee and the California Sea Grant College System. Workshop participants included CDFG biologists and managers, academic researchers, fishery representatives, and invited guest speakers from other states and Canada. The information presented at this workshop will serve as a basis for formulating a sea urchin management plan with the goal of managing the fishery sustainably in the near future.

### Spot and Ridgeback Prawn

**Spot prawn.** Preliminary 1999 spot prawn (*Pandalus platyceros*) landings were 279 t, a 25% decrease from the

372 t landed in 1998. Approximately 187 t of spot prawn were harvested by trawl in 1999, while 92 t were taken with trap gear (table 3). This reversed a ten-year trend of increasing landings (fig. 5). The largest decline occurred in the Santa Barbara area trawl catch, where spot prawn landings dropped 62 t from the previous year's total.

Spot prawn are caught with both trap and trawl gear. A total of 95 vessels (46 trap and 49 trawl) made landings in 1999; table 3 shows types of gear and landings for spot prawn by port area. Some trap and trawl vessels fished in several different port areas during the year. Over half of the combined trap and trawl spot prawn landings in 1999 were made in the Santa Barbara port area. In the past, boats using trap gear were the major contributors to the fishery. However, since the mid-1970s boats using trawl gear have increased in number, and their landings now dominate the fishery. In the last ten years the number of spot prawn trawlers has increased even more rapidly, with an influx of vessels from other groundfish fisheries that have been subjected to increasingly restrictive quotas or seasons.

Spot prawns are large and command high prices. In 1999 the ex-vessel value of the spot prawn fishery was approximately \$4.3 million. The median ex-vessel price for all spot prawns was \$7.50 per pound. Live spot prawn had a median ex-vessel price of \$7.50 per pound, and prices for live prawn ranged from \$3.50 to \$10.60. Fresh dead spot prawn sold for a median ex-vessel price of \$3.50 per pound, with a range of \$1.50 to \$5.00. Approximately 80% of all spot prawn were sold live.

During 1999, the trap and trawl spot prawn permit fisheries in southern California (south of Point Arguello) were operating under concurrent closures running between 1 November and 31 January. Up to 50 pounds of incidentally trawled spot prawns could be retained during the closure. This southern California trap and trawl closure was enacted in 1997 to protect gravid female spot prawns. North of Point Arguello the spot prawn season was open all year.

In 1999 a CDFG ad hoc advisory committee was

TABLE 3  
1999 California Spot Prawn Landings (Metric Tons) by Port Area and Gear Types

Port areas	Number of fishing vessels by gear type		Spot prawn landings (metric tons)			Percentage of total
	Trap	Trawl	Trap	Trawl	Totals	
Eureka	0	4	0.0	3.4	3.4	1.2
San Francisco	7	21	2.9	40.4	43.3	15.5
Monterey	10	14	9.7	14.3	24.0	8.6
Santa Barbara	16	41	28.1	121.8	149.9	53.8
Los Angeles	18	6	34.5	7.7	42.2	15.1
San Diego	16	0	16.0	0.0	16.0	5.8
Totals	67	86	91.2	187.6	278.8	100.0

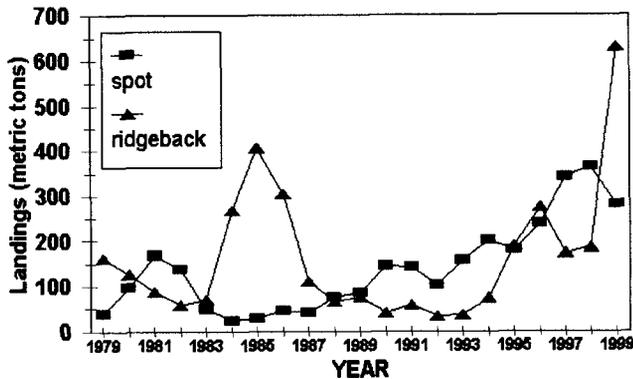


Figure 5. California landings of spot and ridgeback prawn, 1979–99.

formed in response to concerns about the fishery expressed by some spot prawn harvesters. The advisory committee's mandates were to determine the sustainability of current spot prawn harvest levels, and to document the magnitude and composition of the fishery's bycatch of finfish and invertebrate species. The advisory committee's findings will be used to develop new regulatory strategies, including possible additional trawl gear restrictions or modifications, requirements for excluder devices, seasonal harvest restrictions, or area closures.

**Ridgeback prawn.** Preliminary 1999 ridgeback prawn (*Sicyonia ingentis*) landings totaled 631 t, a 320% increase from the 197 t landed in 1998 (fig. 5) and the highest total since 1985. The availability of ridgeback prawn on the trawl grounds, coupled with a growing market demand for both dead and live ridgeback prawns, accounted for the large increase in landings. In 1999 the ex-vessel value of the ridgeback prawn fishery in California was approximately \$1.7 million. In 1999 five ridgeback prawn dealers purchased 100,000 or more pounds; only one dealer purchased that much in 1998.

Ridgeback prawn are smaller than spot prawn and are taken exclusively by trawl nets. From 31 May through 1 October the season is closed, although an incidental catch of 50 pounds is allowed. Thirty-five trawl vessels made ridgeback prawn landings in 1999, about the same number as in 1998. All of the landings were made at southern California ports, between Los Angeles and Santa Barbara, and almost all ridgeback prawn were caught within the Santa Barbara Channel.

Live ridgeback prawn composed 28% of total ridgeback prawn landings in 1999, a major decrease from 1998, when over 50% of the catch was landed live. The median ex-vessel price paid for all ridgeback prawn was \$1.30 per pound. Live ridgeback prawn sold for a median price of \$2.00 per pound, with a range from \$1.00 to \$4.00, while dead ridgeback prawn sold for a median ex-vessel price of \$1.00 per pound, with a range from \$0.20 to \$3.35.

## Abalone

The southern and central California commercial and recreational abalone fishery moratorium, established by the Fish and Game Commission and the legislature in 1997, continues. A state legislature-mandated Abalone Recovery and Management Plan is currently being prepared for all seven California species, and will focus primarily on the traditional commercial and recreational species: red, pink, green, black, and white abalone. The magnitude of the declines in these species in southern California offers little hope for recovery of the resource over the next decade.

In contrast, red abalone stocks north of San Francisco continue to provide recreational divers and shore pickers a vigorous fishery involving 32,000–40,000 fishers annually. This recreational-only fishery continues to be sustainable. Restrictions include size limits, daily limits, season closures, and participation by skin divers and shore pickers only. The prohibition of scuba creates a de facto refuge for abalone at depths greater than 9 m. New regulations placed on the fishery will include an annual limit of 100 red abalone per fisher, with the date, location, and number taken recorded on a punch card. Enforcement of abalone fishing regulations and closures in California remain a priority. Several poaching cases were made in 1999, involving large numbers of legally harvested recreational abalone from northern California being illegally sold to commercial markets.

While the abalone fisheries are closed throughout most of California, abalone remains one of the top species of concern, particularly—but not exclusively—in northern California. Fishery-independent measures of red abalone abundance were made in northern California at fished and reserve sites in 1999 and compared with similar studies in 1986. Preliminary data indicate that even at fished sites, adult abalone densities are comparable to 1986 levels. During timed swim surveys, 100 red abalone per hour were observed at some sites. Size-frequency data collected during these surveys indicate, however, that there are few juvenile and sublegal red abalone at the sites. Creel surveys of abalone taken by shorepickers and divers in northern California at ten major sportfishing areas were conducted in the spring of 1999 for the twenty-fifth consecutive year. These surveys reveal that the average size of abalone taken in 1999 has not declined. More studies are being conducted to examine recruitment and reproduction in red abalone in northern California. Evaluation of red, pink, green, black, and white abalone in southern California continues.

The discovery of withering syndrome (WS) in northern California red abalone stocks has caused serious concern. Although the abalone merely carried the WS bacteria and showed no symptoms, a north coast-wide evaluation was made to determine the extent of the

pathogen. The WS pathogen may have entered natural populations through the introduction of infected abalone into nearshore areas from aquaculture facilities or through out-planting infected animals. While the presence of the WS pathogen in north coast red abalone populations has not caused symptoms of the disease, its presence is significant. If environmental conditions (e.g., warm, ENSO-influenced sea temperatures) that stress abalone populations increase, the disease could become symptomatic, spread, and become lethal throughout the north coast.

Scientists in the CDFG shellfish laboratory have identified the pathogen responsible for WS as a rickettsia-like bacteria, and developed a prophylactic treatment for abalone held in culture, but this treatment is not practical for treating natural populations. Researchers in the laboratory are currently studying the red abalone WS problem in northern California and developing nonlethal methods to evaluate the presence of WS in seawater.

White abalone was designated a candidate species for listing under the Endangered Species Act by the National Marine Fisheries Service (NMFS). A consortium of public and private agencies, including the CDFG, the NMFS, the National Park Service, the University of California (Scripps Institution of Oceanography and Santa Barbara), the U.S. Geological Service, Proteus Sea Farms, and the Marine Conservation Biology Institute, are working on the recovery of this abalone. A cruise, supported by a Saltonstall-Kennedy grant and the NMFS Southwest Fishery Science Center, used the *Delta* research submersible to survey and evaluate white abalone populations at the southern Channel Islands and offshore banks. A total of 157 white abalone were located, and extensive data about the ecology of the species were collected. Unfortunately, only about 25% of the abalone were found in groups, which facilitate reproduction. White abalone will be collected for culture research and grow-out studies.

Black abalone population levels are very low throughout southern California. This abalone has also been designated a candidate species by the NMFS. Research centers on WS, and the development of resistant black abalone strains. Some recent recruitment has been observed in central California, and gametes from these individuals are being used for study. Little recovery has been observed in Channel Islands locations, where black abalone once dominated the intertidal community.

## FINFISH FISHERIES

### Groundfish

The California commercial groundfish harvest for 1999 was 14,206 t (table 4). Total 1999 landings decreased 37%, or 8,312 t, from 1998 and 51%, or 14,726 t, from 1997. The ex-vessel value for 1999 was approximately \$18.8

TABLE 4  
 California Groundfish Landings (Metric Tons) for 1999

	1998	1999	Percent change
<b>Flatfish</b>			
Dover sole	3,572	3,745	5
English sole	427	375	-12
Petrale sole	473	529	12
Rex sole	289	282	-2
Sanddabs	644	925	44
Other flatfish	173	141	-19
<b>Rockfish</b>			
Widow rockfish	906	574	-37
Chilipepper	1,417	885	-38
Bocaccio	148	70	-52
Splitnose rockfish	1,435	138	-90
Thornyheads	1,919	1,467	-24
Other rockfish	3,052	1,152	-62
<b>Roundfish</b>			
Lingcod	150	153	2
Sablefish	1,442	1,905	32
Pacific whiting	5,723	1,308	-77
Grenadier	503	312	-38
Cabezon	163	144	12
<b>Other</b>	82	101	23
<b>Total</b>	<b>22,518</b>	<b>14,206</b>	<b>-37</b>

million, a drop of 13% from 1998 revenues of \$21.7 million and of nearly 41% from 1997 values.

In 1999, 86% of the groundfish landed were taken by bottom and midwater trawl gear, a slight decrease from the 88% in 1998. Line gear accounted for the second largest amount at 12%, a slight increase from the 10% in 1998 and similar to that of 1997. The line gear contribution reached a recent high of 18% in 1992. Gill and trammel nets landed just under 1%, after a steady decline from 5% in 1993 to 1% in 1996. Traps accounted for approximately 1% of total 1999 groundfish landings.

Dover sole (*Microstomus pacificus*), thornyheads (*Sebastes* spp.), sablefish (*Anoplopoma fimbria*), Pacific whiting (*Merluccius productus*), and rockfish continue to dominate landings, although the 1999 harvest of Pacific whiting and rockfish was off sharply from the previous year. Landings of some flatfish species and sablefish were higher in 1999. The sharp decline in Pacific whiting landings reflects their reduced availability to the Eureka area shoreside fishery during the 1999 season and not a drop in overall coastwide abundance. The redistribution appears to be associated with the onset of La Niña conditions. Many of the rockfish declines reflect increasingly restrictive Pacific Fishery Management Council (PFMC) landing limitations, although the decline in splitnose rockfish (*Sebastes diploproa*) landings is also associated with the transition to La Niña conditions after the weakening of the strong 1997-98 El Niño. The drop, therefore, most likely reflects a return to their more normal distribution on the slope, where fishing is minimal.

The drop in overall ex-vessel revenues when compared to total landings was moderated by an increase in high-value sablefish landings and the increasing value of rockfish in the live-fish fishery. And even though Pacific whiting landings were down sharply, the effect on total groundfish revenues was relatively small because Pacific whiting is a high-volume, low-value fish.

For 1999 the PFMC maintained optimal yields (OYs) for Dover sole, shortspine thornyhead (*Sebastolobus alascanus*), longspine thornyhead (*Sebastolobus altivelis*), sablefish, Pacific whiting, lingcod (*Ophiodon elongatus*), widow rockfish (*Sebastes entomelas*), yellowtail rockfish (*Sebastes flavidus*), canary rockfish (*Sebastes pinniger*), bocaccio (*Sebastes paucispinis*), and Pacific ocean perch (*Sebastes alutus*). Also for the first time, OYs were set for both splitnose and chilipepper rockfish (*Sebastes goodei*) south of Cape Mendocino. The PFMC again used cumulative landing limits as well as trip limits to meet the objective of staying within the annual OYs while providing for a year-round fishery.

Stock assessment teams prepared assessments for Pacific whiting, southern lingcod (California), petrale sole (*Eopsetta jordani*), bocaccio, canary rockfish, and cowcod (*Sebastes levis*). These assessments were reviewed by stock assessment review (STAR) panels, whose recommendations were forwarded to the Groundfish Management Team (GMT). While developing management measures for the year 2000, the GMT addressed the STAR panel recommendations as well as the NMFS notice that lingcod, bocaccio, and Pacific ocean perch were overfished and that the PFMC needed to implement rebuilding plans. Incorporating the yields recommended in the draft rebuilding plans for overfished species necessitated management strategies that will greatly reduce landings of the overfished species as well as species normally associated with them.

In 2000, the PFMC will continue to investigate a capacity-reduction program for the groundfish industry, and the feasibility of a comprehensive groundfish observer program. Planned stock assessments include bank rockfish (*Sebastes rufus*), darkblotched rockfish (*Sebastes cramerii*), coastwide lingcod, widow rockfish, yellowtail rockfish, Pacific ocean perch, and Pacific whiting. Results from the 1999 cowcod and canary rockfish assessments indicate that these species are also overfished and will require the PFMC to develop rebuilding plans for implementation in 2001.

### Swordfish and Shark

Swordfish and shark fisheries in California are located primarily in the southern part of the state. Although swordfish (*Xiphias gladius*) and common thresher shark (*Alopias vulpinus*) are caught in directed fisheries, shortfin mako shark (*Isurus oxyrinchus*) is more often landed

TABLE 5  
 California Landings (Metric Tons) of Swordfish  
 and Selected Shark Species

	Swordfish	Common thresher shark	Shortfin mako shark
1990	851	210	262
1991	711	344	151
1992	1,068	179	97
1993	1,218	162	84
1994	1,165	194	88
1995	796	155	66
1996	803	181	64
1997	861	178	93
1998	859	175	64
1999*	1,356	148	42

\*Preliminary

incidentally in these and other fisheries. Fluctuations in landings for all three species are attributed partially to changes in marketability and demand, although oceanic conditions have also played a major role.

Preliminary swordfish landings totaled 1,356 t in 1999 (table 5), 58% more than 1998. Drift gill nets accounted for only 30% of the catch, down significantly from the 59% of 1998. High-seas longline landings showed a corresponding increase from 32% in 1998, to 64%. This pattern has not been seen since 1994, when the high-seas longline fleet was most active. Twenty-six vessels using longline gear outside the U.S. Exclusive Economic Zone (EEZ) landed swordfish in southern California ports. Though several of these vessels made only one landing in 1999, the average landing increased from around 4 t in 1997 and 1998 to nearly 8 t. The majority of vessels fishing outside the EEZ were Hawaii-based; only two California-based vessels made landings. Harpoon landings constituted 4% of the catch, the same as in 1998 but down from highs of around 8% in 1994–97. Eighty-three percent of the swordfish catch was landed in southern California ports.

As expected, gear type affected swordfish ex-vessel prices. Typically, fishers landing either drift gill net- or longline-caught swordfish received \$1.25 to \$4.50 per pound. The drift gill net catch, however, tended to claim a higher price (mode = \$3.00) than longline (mode = \$1.75). This is probably due to the fact that the longline fishery is conducted outside the EEZ, so fish are held onboard for longer periods. The swordfish fishery had an ex-vessel value of \$8.2 million in 1999. Fishers landing harpoon-caught swordfish received the highest ex-vessel prices, with a range of \$3.00 to \$7.50 per pound.

Preliminary landings of common thresher shark totaled 148 t in 1999 (table 5), decreasing 15% from 1998. Thresher shark were taken primarily with drift gill nets (60%), followed by set gill nets (34%), and assorted other gears (6%). Most (90%) landings continued to be made

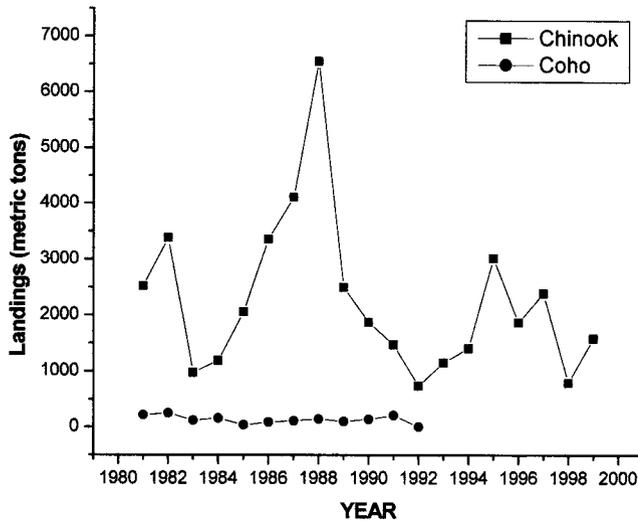


Figure 6. California commercial landings of ocean salmon, 1980–99.

in southern California. The thresher shark fishery had a \$462,000 ex-vessel value in 1999. Typically, ex-vessel price varied from \$0.50 to \$3.25 per pound.

Shortfin mako shark preliminary landings totaled 42 t in 1999 (table 5), a decrease of 34% from 1998 and the lowest total since 1980. The decreasing catch over the past two years could be indicative of the cold-water regime shift noted for California waters. The ex-vessel value of the mako shark fishery in 1999 was \$115,000. Most of the catch (84%) was landed in southern California ports, at ex-vessel prices typically ranging between \$0.50 and \$2.50 per pound. Like thresher sharks, mako sharks were caught primarily by the drift gill net fishery (72%). The remainder of the catch was landed by set gill nets (12%), longline vessels operating outside the EEZ (8%), hook-and-line gear (3%), and incidentally by other gears (5%).

### Ocean Salmon

In 1999, the PFMC again enacted restrictive commercial and recreational ocean salmon regulations in California to achieve (1) the escapement goal for Sacramento River fall chinook salmon (*Oncorhynchus tshawytscha*) of 122,000 to 180,000 hatchery and natural adults combined; (2) a 12.3% exploitation rate on age-4 Klamath River fall chinook salmon to accommodate inriver recreational and tribal subsistence and commercial fisheries, as well as a minimum adult natural spawning escapement of 35,000; (3) a 31% increase in the adult spawner replacement rate for endangered Sacramento River winter chinook salmon relative to the observed 1989–93 mean rate; and (4) a reduction in harvest impacts on depressed coho salmon (*Oncorhynchus kisutch*) stocks coastwide.

In 1999, commercial fishing for ocean salmon (all species except coho salmon) in California was allowed

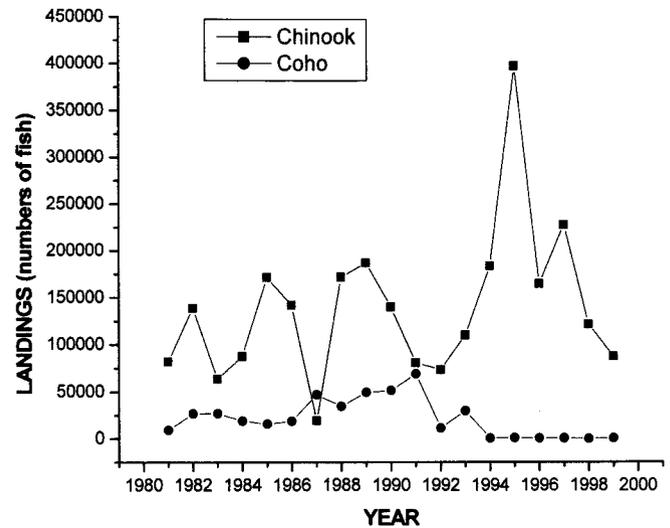


Figure 7. California recreational landings of ocean salmon, 1980–99.

coastwide from 14 April to 30 September, with various time and area closures. The minimum size limit was 26 inches total length (TL), 27 inches after June 30 to help reduce retention of the generally smaller Sacramento River winter chinook salmon; however, the 1998 Bodega Bay test fishery was conducted in July, and maintained a minimum size limit of 26 inches. Approximately 1,583 t (264,500 fish) of dressed chinook salmon were landed by commercial trollers, who fished approximately 14,000 days (fig. 6). Ex-vessel prices for dressed salmon averaged \$1.89 per pound, and the total ex-vessel value of the fishery exceeded \$6.6 million.

Recreational fishing regulations in California were less restrictive than in 1997, with various time and area closures (14 February–15 November). Statewide recreational landings decreased by almost 28% compared to the previous year (fig. 7), totaling 87,600 chinook salmon during 148,000 angler trips (catch per unit angler = 0.59). Anglers were limited to two salmon per day (all species except coho salmon) with a minimum size limit of 24 inches TL, except from 1 July to 7 September between Point Reyes and Pigeon Point, where anglers were required to keep the first two salmon regardless of size. Anglers fishing by any means other than trolling in the area between Point Conception and Horse Mountain were required to use only “circle” hooks.

In the Klamath Management Zone (KMZ: Horse Mountain, California, to Humbug Mountain, Oregon) season management, rather than quotas, continued, with more fishing days because of increased Klamath fall chinook salmon. In the KMZ, two separate seasons were enacted: 29 May–4 July, and 29 July–14 September, open all days a week. The bag limit was one salmon per day (all species except coho), with no more than 4 salmon in 7 consecutive days; there was a 20-inch TL size limit north of Horse Mountain. In the California portion of

TABLE 6  
 Top 20 Fish Species and Market Category Groups Landed (Metric Tons)  
 in California's Live/Premium Fish Fishery in 1999

Market category	1999			1998			Live rank
	Live	Dead	Value (\$1,000's)	Live	Dead	Value (\$1,000's)	
Cabezon	137.9	6.9	906	157.4	11.5	1,020	1
California sheephead	54.6	4.0	373	102.5	16.0	607	2
Gopher/group gopher rockfish	47.6	6.8	274	55.8	16.0	337	3
Group bolina/brown rockfish	39.0	20.4	264	36.5	26.1	179	5
Lingcod	36.7	114.4	91	31.7	118.4	79	6
California scorpionfish	29.6	8.3	146	29.9	21.1	100	7
Grass rockfish	26.0	0.4	190	39.2	2.5	319	4
Unspecified rockfish	19.4	270.3	123	21.0	1,348.0	114	8
Kelp greenling	13.2	1.4	77	5.8	0.9	38	11
Group red rockfish	12.5	95.7	60	4.9	316.4	20	14
Black and yellow rockfish	10.3	0.4	81	0.4	0.5	3	26
Blackgill rockfish	8.5	26.7	23	0.6	152.0	0.9	24
Copper rockfish	8.3	7.5	42	4.2	25.8	19	17
White croaker	6.5	85.6	19	1.3	63.3	2	21
Black rockfish	6.0	52.6	14	4.9	80.6	9	15
Quillback rockfish	5.4	2.6	53	5.0	6.9	22	13
China rockfish	5.2	1.1	33	5.7	4.2	42	12
Blue rockfish	4.7	8.7	8	3.8	38.0	8	18
Ocean whitefish	3.7	1.3	19	4.7	6.1	18	16
Vermilion rockfish	3.4	7.1	13	1.1	9.1	3	22
Subtotal	478.5	722.2	2,809	516.4	2,263.4	244	
Other fishes	25.5	2,202.8	114	17.3	4,524.9	57	
Grand total	504	2,925	2,923	533.7	6,788.3	301	

the KMZ, anglers landed 6,200 chinook salmon during 17,800 angler trips made primarily on private skiffs.

### Nearshore Finfish

Preliminary 1999 California commercial landings of nearshore finfishes totaled 504 t of live fish and 2,925 t of dead fish, for a combined total of 3,429 t, yielding an ex-vessel value of approximately \$5.9 million, of which \$2.9 million was paid for live fish. This compares to a total of 534 t of live fish and 6,788 t of dead fish landed in 1998 (table 6). Finfish landed dead in 1999 decreased by more than 50% from 1998, while landings of live fish dropped slightly. The top 20 species landed live in 1999 are compared to landings for 1998 in table 6. Fishers traveled farther from their home ports and explored more remote fishing grounds as the demand for live and premium-quality fish continued and the resources close to ports declined.

The principal goal of the fishery is to deliver the fish live to the ultimate consumer in as timely a manner as possible. The fishery ranges from the intertidal zone to about 30 m over rocky habitat. Fish are transported by trucks or vans equipped with aerated tanks, directly to fish markets, restaurants, or individuals. Many fishers deliver and sell their own catch. All of these elements have complicated the accuracy of reported landings, which may be substantially higher.

The commercial fishery for nearshore live and pre-

mium fish began in California in the mid-1980s; in the last decade the number of vessels in the fishery has increased tenfold. In 1989, 76 vessels made at least one landing of nearshore fishes; by 1999 the number of vessels had increased to 819. The most active vessels—those landing at least 500 pounds during the year—numbered only 304 in 1999 and brought in 94% of the total statewide landings. Vessels in the nearshore fishery ranged in size from 3 m (kayak) to 33 m, with an average size of 9 m. Larger vessels may serve as mother ships for several smaller skiffs. Some fishers fish from shore.

The Nearshore Fisheries Management Act of the Marine Life Management Act of 1998 defines nearshore finfishes as rockfish (genus *Sebastes*), California sheephead (*Semicossyphus pulcher*), greenlings (genus *Hexagrammos*), cabezon (*Scopaeenichthys marmoratus*), California scorpionfish (*Scorpaena guttata*), and other species found primarily in rocky reef or kelp habitat in nearshore waters. Historically, the commercial use of the nearshore resources was minimal, but with potentially high profits and low overhead costs. Before 1988, the price per pound for line-caught rockfish ranged from \$0.50 to \$1.50. In 1999, ex-vessel prices for live and premium fish ranged from \$0.20 to \$10.00 per pound, with an average price of \$2.82. Prices vary depending on species, physical condition, and size of the fish. Many fish do not survive the rigors of capture and transport and are sold dead, often at greatly reduced prices.

Nearshore fishes were caught with a variety of gear types, including lines, traps, nets, and diving. Line gear was the reported gear type used for 70% of the statewide landings. Hook and line gear included rod and reel; horizontal and vertical set lines; pipes (stick gear), which consist of short (4- to 8-foot) sections of PVC pipe (rebar or cable) with up to 15 (typically 5) hooked leaders attached; and groundfish troll lines. Net gear was used for 23% of the statewide landings; trap gear accounted for 7%. Diving gear was also used but accounted for less than 1% of the statewide landings.

Approximately 50 market categories of marine fishes were documented as landed live in 1999. Commercial landing weights are reported on landing receipts as market categories that include specific (e.g., "cabezon") and nonspecific (e.g., "small rockfish group") categories. Markets typically buy fish in groups based on value, not species. In 1998, CDFG sampling of market categories indicated that specific categories may contain from one to seven species, while nonspecific categories may contain from three to twelve species. Market sampling in Morro Bay found the species composition of market category cabezon to comprise cabezon, grass rockfish (*S. rastrelliger*), kelp greenling (*Hexagrammos decagrammus*), and copper rockfish (*S. caurinus*).

Sablefish, thornyheads, and California halibut have also been landed live in recent years. Preliminary landings from 1999 totaled 136 t for live fish and 3,642 t for dead. These landings are projected to increase as new regulations with low quotas are enacted to protect species targeted in the fishery for nearshore premium and live fish.

Northern California (port complexes of Eureka and Fort Bragg) landings totaled 1,430 t dead and 105 t live fish. Together, these landings (1,535 t) make up 45% of the statewide landings for live and premium fish, with a total ex-vessel value of \$1.8 million, of which \$0.5 million was paid for live fish. In 1999, live landings were dominated (over 10,000 pounds landed) by cabezon, lingcod, kelp greenling, and copper and china rockfish categories, which accounted for 74% of the area's landings of live fish. Line gear was used to catch 99% of the live fish.

Central California (port complexes of Bodega Bay, San Francisco, Monterey Bay, and Morro Bay) landings of finfish totaled 1,352 t of dead and 238 t live fish. Together these landings (1,590 t) make up 46% of statewide landings for live and premium fish, with a total ex-vessel value of \$2.8 million, of which \$1.3 million was paid for live fish. Central California landings were dominated by cabezon, bolina, and gopher rockfish groups, grass rockfish, lingcod, and black and yellow rockfish categories, accounting for 85% of the area's landings of live fish. Line gear caught 88% of the land-

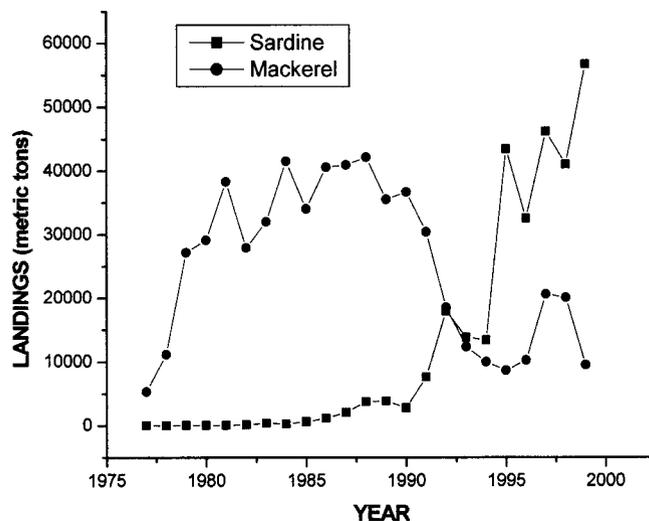


Figure 8. California commercial landings of Pacific sardine and Pacific mackerel, 1977-99.

ings of live fish, followed by trap gear (11%) and net gear (1%).

Southern California (port complexes of Santa Barbara, Los Angeles, and San Diego) landings of live fish totaled 143 t of dead and 161 t of live fish. Together these landings make up 9% of statewide landings for live and premium fish, with an ex-vessel value of \$1.3 million, of which \$1.1 million was paid for live fish. Live landings were dominated by California sheephead, California scorpionfish, cabezon, and unspecified rockfish categories, which accounted for 82% of the area's landings of live fish. Line gear caught 51% of the live fish, followed by trap gear (28%), net gear (20%), and diving (<1%).

### Pacific Sardine

Rebuilding of the Pacific sardine (*Sardinops sagax*) fishery continued in 1999, with the year's total landings of 56,747 t being the highest since the reopening of the directed fishery in 1986 (table 1, fig. 8). The 1999 fishery had an approximate ex-vessel value of \$5.0 million, up from \$3.6 million in 1998. Approximately 47% of the 1999 CDFG quota was landed, and the directed fishery remained open until year's end.

Fish and Game Code (§8150.8) stated that annual sardine quotas were to be allocated two-thirds to southern California (south of San Simeon Point, San Luis Obispo County) and one-third to northern California (fig. 1). Based on a 1 July 1998 biomass estimate of 1,073,091 t, the harvest formula generated an initial 1999 southern fishery quota of 80,286 t, and a northern quota of 40,188 t (table 7). In October, the CDFG reallocated uncaught quota portions equally between north and south. The revised quotas were 72,183 t for the southern fishery, and 48,291 t for the northern fishery. Neither of these allocations were approached during the 1999 season.

TABLE 7  
 Pacific Sardine Quota Allocations (Metric Tons)  
 in California for 1999

	Initial quota	Reallocated quota	Landings
North	40,188	48,291	13,884
South	80,286	72,183	42,449
Total	120,474	120,474	56,333

The most recent stock assessment, conducted jointly by the CDFG and the NMFS, estimated 1.07 million t in the area of California's coast (Ensenada, Mexico, to San Francisco) and up to 1.6 million t coastwide (Ensenada to British Columbia).

Management authority for all coastal pelagic species was transferred to NMFS through the PFMC on 1 January 2000. Regulations prior to 2000 gave the CDFG considerable latitude in setting annual sardine quotas. When biomass was estimated to be more than 18,144 t, Fish and Game code required that allowable catch be consistent with resource rehabilitation. To calculate the 2000 harvest guideline, a harvest formula selected by the PFMC as the preferred option in the draft Coastal Pelagic Species Fishery Management Plan (Amendment 8) was used. Based on the 1999 estimate of total biomass (age 1+), the 2000 sardine fishery opened on 1 January with a harvest guideline of 186,791 t for the California fishery, 65% higher than the 1999 CDFG quota.

Ex-vessel prices paid to fishers for sardines remained relatively low in 1999, and were similar to those in 1998, ranging from \$66 to \$110 per t, and averaging \$89 per t. Other important target species for the southern California wetfish fleet include Pacific mackerel (*Scomber japonicus*) and market squid (*Loligo opalescens*) in winter, and tunas in summer. In northern California, Pacific herring (*Clupea pallasii*) is also an important target species from January to March. Squid and tuna command significantly higher ex-vessel prices than sardines: \$388 per t for market squid and \$600–\$1,400 per t for tuna. During 1999, sardine landings varied by month because of availability, demand, and fleet participation in other fisheries.

In 1999, most Pacific sardine landings in southern California were sold to market processors (78%) or to canneries (22%). Currently, fish are processed for human consumption (fresh or canned), pet food, or export. Of the exported sardines, most are either sold for human consumption or used as feed in aquaculture facilities. About 15% of all sardines landed in California were canned domestically for human consumption. The only southern California cannery that packs fish for human consumption continued intermittent canning of sardines. In northern California, one cannery packed fish for human consumption.

Aside from the wetfish fishery for sardine, there is a small bait fishery that is not subject to a quota, and usually takes less than 5,000 t annually. Live bait ex-vessel prices, more than \$600 per t in 1996, were approximately seven times greater than prices for the directed fishery. In 1999, the ex-vessel value of the sardine live bait fishery was about equal in value to the directed fishery.

Approximately 61% of California's sardine landings were exported in 1999, primarily (85%) as frozen blocks. For the year, 36,089 t of sardines were exported, up from the 1998 total of 22,397 t. Export revenues totaled \$17.13 million at approximately \$475 per t. Australia is the major importer of sardines for fish food in aquaculture facilities, while Japan supplements its catch to meet consumer demand following the recent decline of its own sardine resource.

### Pacific Herring

Pacific herring (*Clupea pallasii*) fisheries for 1999 recovered from the devastating effects of the 1997–98 El Niño. Statewide landings for the 1998–99 sac roe season (December–March) totaled 2,637 t, a 45% increase from the previous season. Annual sac roe landings declined from 2,432 t to 2,207 t, down 9.2% from the previous year (table 1). Success of the sac roe fisheries was mixed. The San Francisco gill net fleet, composed of three platoons (434 permits) landed 2,571 t, 2.7% over the 2,501 t quota. The Tomales Bay fishery landed a total of 49 t, well below the 390 t quota following the 1997–98 season, when no landings were made. A total of 53 pounds were landed in Crescent City from the 27 t quota, and Humboldt Bay landings totaled 19 t, 39% of the 49 t quota.

Herring collected from CDFG research nets and the gill net fishery appeared to have physically recovered from the weakened state attributed to El Niño conditions during the 1997–98 season. Mean weights per given lengths were within normal ranges; female herring did not display evidence of abnormal gonadal development (as seen during El Niño); and eggs were the typical golden roe that technicians are accustomed to seeing. Higher ratios of female to male herring in samples were reflected in higher than average roe counts for all three gill net platoons, and a higher frequency of unripe male and ripe female herring was noted throughout the season.

Ex-vessel prices for herring with 10% roe recovery averaged about \$600 per short ton for gill net landings, with an additional 10% of the base price per ton paid for each percentage point above 10%. The ex-vessel price per ton was approximately 50% more than in the previous season, reflecting improvement in the Japanese economy. Total ex-vessel value of the sac roe fishery was an estimated \$2.3 million, nearly a fourfold increase from

the previous season, partly because of higher roe recoveries and improved fish condition. This increased value, however, was well below the average for the previous twelve seasons (approximately \$11 million).

The San Francisco Bay herring eggs-on-kelp fishery landings totaled 28.8 t, 42% less than the 49.5 t quota, and the second lowest total on record. Total estimated value of the 1998–99 eggs-on-kelp harvest was \$317,000, based on an average ex-vessel price of \$5.00 per pound. Product quality varied considerably during the 1998–99 season. Lower-quality product was discarded because of the low price and because the higher processing costs made it economically infeasible to land marginal product. During the 1998–99 season, permittees reported that giant kelp (*Macrocystis pyrifera*) lasted longer while suspended due to higher salinities in the bay. These higher salinities probably resulted from the lack of early winter storms.

The CDFG conducted hydroacoustic and spawn deposition surveys to estimate herring spawning biomass in San Francisco Bay. Spawn deposition estimates were used exclusively to assess the Tomales Bay population. No surveys were conducted for Humboldt Bay or Crescent City Harbor. The 1998–99 herring spawning biomass estimate for the San Francisco Bay population was 35,909 t, nearly double that of the previous season. The stock's recuperation is associated with the abatement of El Niño and the return of favorable ocean conditions, resulting in improved recruitment of 2- and 3-year-old fish.

The Tomales Bay herring spawning biomass continued to fluctuate widely. The 1998–99 spawning biomass estimate was 3,699 t, almost a sevenfold increase from the previous season's estimate of 533 t. This was the highest annual increase since the fishery reopened after the 1992–93 season, and was close to the 25-year average of 4,123 t. This increased biomass followed three consecutive seasons of decline. Age-structure analysis showed that younger and smaller fish, unavailable to commercial gear, made up the bulk of the spawning biomass during the 1998–99 season, but fish age five and older were poorly represented.

Northwesterly winds cooled the ocean waters off central California considerably beginning in spring 1998. Favorable ocean conditions have continued with the prevailing La Niña, and herring fisheries were expected to improve in the 1999–2000 season. The December fishery in San Francisco Bay, however, opened with limited success. High salinities in the bay may have precluded mass spawning, although sampled herring were in good physical condition with normal gonadal development.

Kazunoko remains an integral part of traditional Japanese New Year's festivities. However, changes in the

Japanese culture and economy have also resulted in changes in the sac roe market. Industry observers predict that demand for kazunoko will wane as younger Japanese become more Westernized. Ex-vessel prices are expected to improve somewhat with the stabilization of the Japanese economy, but herring buyers were proceeding cautiously and offering only slightly higher prices than in the 1997–98 season.

### **Pacific Mackerel**

The 1999 annual landings of Pacific mackerel (*Scomber japonicus*) in California totaled 9,527 t, a 53% decrease from the 1998 total of 20,073 t (table 1, fig. 8). Effort was focused on traditional fishing grounds from Monterey south to the U.S./Mexican border. Ninety-nine percent of the landings were made in southern California, primarily at San Pedro and Terminal Island. Monterey landings typically range from 1,000 to 3,000 t per year, but were negligible in 1999. Cold oceanic conditions decreased mackerel availability to the northern California fishery in 1999, although Pacific mackerel were caught incidentally in the Canadian whiting fishery.

Management authority for Pacific mackerel was transferred from the CDFG to the NMFS through the PFMC as of 1 January 2000. Under the management of the CDFG, the Pacific mackerel fishing season was specified in the Fish and Game Code (§8410) as a 12-month period from 1 July through 30 June of the following calendar year. The 1999–2000 fishing season harvest guideline was based on a biomass projection derived from a tuned virtual population analysis (VPA) model called ADEPT. When the total biomass was estimated by CDFG to be greater than 18,144 t but less than 136,078 t, the allowable harvest was defined as 30% of the total biomass in excess of 18,144 t. On the basis of an estimated biomass of 230,446 t on 1 July 1999, the CDFG did not establish a quota for the first half of the 1999–2000 season. After the transfer of authority, the PFMC used the CDFG biomass estimate to set a harvest guideline of 46,428 t for the second half of the 1999–2000 fishing season. Landings made between 1 July 1999 and 31 December 1999 will be subtracted from the harvest guideline.

Unlike the 1997–98 season, when the quota was exceeded by 931 t (4%), the 1998–99 season closed with 7,155 t (23%) of the quota remaining. Availability of Pacific mackerel to the wetfish fleet remained low throughout the season, and processors had standing orders that were not filled. Monthly landings varied, from a high of 6,157 t in September 1998, to a low of 2.3 t landed in June 1999. This pattern was driven not only by availability, but also by fishers' participation in other fisheries (sardine, market squid, and tuna), weather conditions, and market demands.

The ex-vessel price paid for Pacific mackerel (landings over one t) ranged from \$40 to \$160 per t. The sale of the catch generated approximately \$1.09 million for fishers.

### Reduction

The reduction fishery targets species with the intent of landing whole fish for processing into protein products. Reduction products such as fish meal, oil, flour, or fertilizer are sold as supplements for animal feeds. (Fish scraps are also reduced, but they are not part of the reduction fishery.)

During the last several decades California's reduction fishery has targeted northern anchovy (*Engraulis mordax*). Northern anchovy landings for reduction peaked in 1975, when 141,586 t were processed. In 1976, landings in the reduction fishery began a general decline, reaching a low of 63 t in 1990. In 1991, a small fishery landed an annual total of 1,037 t. From 1992 to 1995 no northern anchovy landings were reduced. From 1996 to 1998 the fishery was limited to a few landings totaling approximately 3,900 t for the three years.

In 1999, the California anchovy domestic reduction harvest was low, less than 50% of the 16,000 t domestic allowable harvest quota set by the NMFS in its Northern Anchovy Fishery Management Plan. The NMFS used the 1995 spawning biomass estimate for the central sub-population of northern anchovy to set interim harvest limits (which ultimately became the final limits) for the 1999–2000 fishing year because no new assessment of the northern anchovy resource had been made. The NMFS had also used the 1995 spawning biomass estimate to establish harvest limits for the 1995–96 through 1998–99 fishing years. Also in 1999, the PFMC recommended that 3,000 t be set as a harvest limit for two vessels participating in an experimental fishery in the Farallon Islands Closed Area off San Francisco. Nearly all northern anchovy landed for reduction in California were taken in Subarea A, the northern portion of the Pacific anchovy fishing area (between Point Reyes in the north and Point Buchon in the south), and were processed by one company.

Poor market conditions influenced the 1999 anchovy reduction fishery, with ex-vessel prices averaging about \$40 per short ton, continuing a trend that has dominated the market since the early 1980s. Industry representatives have commented that because of the low price structure, reducing anchovy is, at best, a break-even exercise. As a result, only a few orders were placed, with very few boats participating in the northern anchovy reduction fishery in 1999.

In recent years, many in the industry have expressed an interest in the possibility of a reduction fishery for Pacific sardine (*Sardinops sagax*). Prior to 1999 no permits were issued allowing processors to engage in a re-

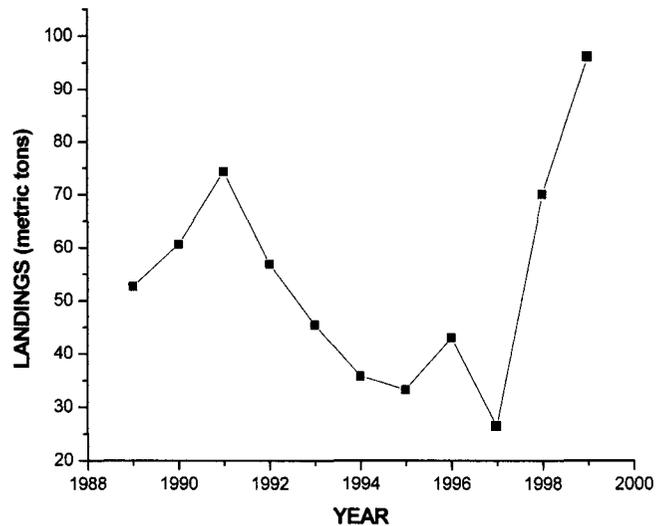


Figure 9. California commercial landings of white seabass, 1989–99.

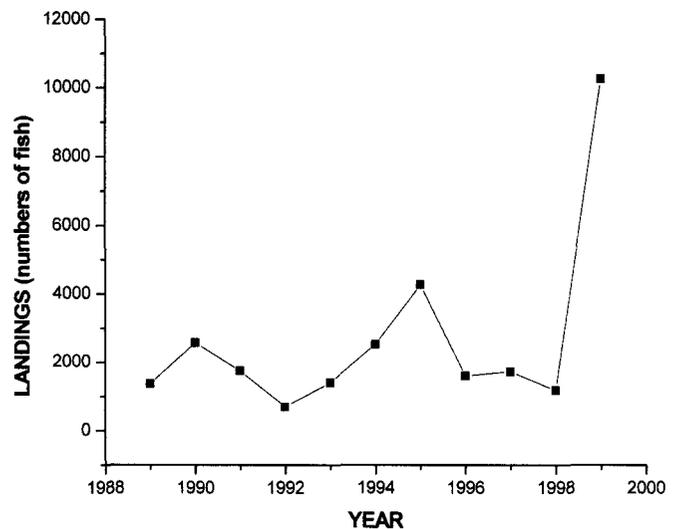


Figure 10. California CPFV landings of white seabass, 1989–99.

duction fishery for Pacific sardine. In 1999 one central California processor applied for, and received, a permit to reduce Pacific sardine. This occurred several months after the CDFG declared that the Pacific sardine resource was officially recovered. Even though this processor obtained a permit to reduce Pacific sardine, no landings of whole sardine were actually reduced. Instead, Pacific sardine reduction was limited to the processing of scraps left over from canning.

### White Seabass

White seabass (*Atractoscion nobilis*) is the largest member of the Sciaenid family harvested from California's nearshore waters and islands. Both the commercial and recreational components of this fishery reported relatively high yields in 1999 (figs. 9 and 10). In 1999, commercial white seabass landings rose to 96 t, the largest value

TABLE 8  
 Recovery of Coded-Wire Tagged OREHP-Produced White Seabass in 1999

Release	Location		Size (mm)		Days at liberty	Distance traveled (nmi)
	Capture	Release	Capture			
Channel Is. Harbor	Malibu Point	216	724	1,679	25	
Mission Bay	Long Beach Harbor	203	762	1,752	85	
Mission Bay	Mission Bay	279	737	730	n/a	
Newport Harbor	Platform Gina	221	770	1,789	77	

Data provided by Hubbs-Sea World Research Institute

in 17 years (fig. 9). This value represents a 27% increase from 1998, and a 73% increase from the historical low of 26 t reported in 1997. Commercial market data for 1999 indicated that most landings by weight (65%) were made at fish markets in Los Angeles Harbor. Other landings were made in Santa Barbara and Channel Islands Harbors (24%), Port San Luis and Morro Bay (6%), San Diego County (3%), and Monterey County (2%).

The ex-vessel price paid to the fishers by markets ranged from \$0.50 to \$6.00 per pound. The average price per pound was \$1.91, down \$0.36 from 1997, when commercial white seabass landings were at a historic low. The relatively low average price in 1999 is likely a function of supply and demand.

White seabass were harvested primarily by gill net gear: 55% by set gill net and 35% by drift gill net. Additional gears used to harvest white seabass included hook and line (5%), miscellaneous (4%), and trawl (1%). Catch data indicate that most of these fish were taken between Orange and Los Angeles Counties, while a small number of fish were taken from Ventura County, and north of Point Conception.

Two regulatory events over the past 20 years have negatively affected the number of commercial white seabass reported landed in California. Before 1982, most of the white seabass landed in California were harvested in Mexican waters. In 1982, the Mexican government prohibited U.S. commercial fishing vessels from exploiting its sovereign waters, and landings of white seabass in California plummeted. In 1990, California voters approved Proposition 132, which prohibited the use of gill and trammel nets in southern California's newly created Marine Resources Protection Zone (MRPZ). The MRPZ extends three nautical miles offshore of the mainland coast, between Point Arguello and the Mexican border. The MRPZ was completely closed to gill netting on 1 January 1994, and annual reported landings of white seabass dropped once again.

Recreational anglers landed 10,260 white seabass while fishing aboard commercial passenger fishing vessels (CPFVs) in 1999, a more than eightfold increase from 1998 (fig. 10). The CPFV industry has not made landings of this magnitude since the mid-1960s. Before 1999, annual reported landings from 1980 through 1998 os-

cillated between 600 and 5,000 fish, averaging 1,640 fish over a 19-year period.

In the early 1980s, the white seabass population in California appeared to be in decline. In 1983, the California legislature created the Ocean Resources Enhancement and Hatchery Program (OREHP) to perform basic and applied research on the artificial propagation, rearing, stocking, and distribution of adversely affected marine fish species that are important to sport or commercial fishing in California waters south of Point Arguello. Since 1989, white seabass has been OREHP's primary focus of research. Approximately 306,073 OREHP-produced juvenile white seabass were released into the ocean from 1990 through 1999; 25,115 fish were released in 1999. Each OREHP-produced fish was coded-wire tagged (CWT) at the hatchery before being transported to a predetermined grow-out site. There are twelve grow-out sites in bays and marinas from San Diego to Santa Barbara, including Catalina Island. The fish are raised by volunteers until they reach 200 mm, and then released at the grow-out site or nearby.

In 1999, four CWT white seabass that had recruited into the recreational fishery were the first to be recovered by either the recreational or commercial fishery (table 8). The recaptured fish had been at liberty between two and five years, and had traveled up to 85 nautical miles from their release site. The minimum size at release was 203 mm, and the maximum size at recapture was 770 mm. One of the recaptured fish had grown 458 mm in two years. This fish was released and recaptured in Mission Bay.

## RECREATIONAL FISHERY

### Southern California

Hook and line saltwater recreational fishing is conducted from private vessels, piers, shorelines, and CPFVs in southern California. Specific information about these recreational fisheries is collected through phone surveys and samplers (Marine Recreational Fisheries Statistics Survey, NMFS). In addition, the CDFG collects and maintains a large database derived from mandatory logbook information supplied by CPFVs. Much of our knowledge of CPFV recreational fishing in southern

TABLE 9  
 Southern California CPFV Landings (Number of Fishes) in 1999 and 1998

Species/species group	1999 landings		1998 landings*		Percent change
	Number	Rank	Number	Rank	
Rockfishes, unspecified	495,873	1	358,722	3	+38
Barred sand bass	435,777	2	377,853	2	+15
California barracuda	386,315	3	455,776	1	-15
Albacore	239,554	4	147,436	6	+62
California scorpionfish	225,726	5	119,620	8	+89
Ocean whitefish	139,281	6	69,222	10	+101
Kelp bass	129,475	7	233,591	5	-45
Pacific mackerel	82,802	8	127,596	7	-35
Yellowtail	78,466	9	250,587	4	-69
Bluefin tuna	36,362	10	18,891	12	+92
Flatfishes, unspecified	35,301	11	3,318	22	+964
Halfmoon	25,500	12	7,951	15	+221
California sheephead	23,084	13	18,354	13	+26
Yellowfin tuna	21,215	14	75,367	9	-72
White seabass	11,512	15	1,344	23	+755
White croaker	10,039	16	6,449	17	+56
California halibut	9,285	17	4,834	18	+92
Wahoo	5,151	18	4,348	19	+18
Jack mackerel	4,690	19	3,544	20	+32
Dolphinfish (dolphin)	3,633	20	6,470	16	-44
Lingcod	3,579	21	3,539	21	+1
Pacific bonito	2,810	22	57,630	11	-95
Skipjack tuna	2,707	23	13,734	14	-80
Blacksmith	1,253	24	888	24	+41
Queenfish	1,100	25	88	27	+1,150
Cabezon	687	26	745	25	-8
Shark, unspecified	532	27	283	26	+88
Jumbo squid	104,549	—	1,590	—	+6,475
Total number kept	2,538,251		2,376,944		+7
Number of anglers	543,626		580,730		-6
Reporting CPFVs	254		198		+22

\*These 1998 landings have been revised. The numbers presented here are the final 1998 commercial passenger fishing vessel landings.

California is based on these logbook data. Landings by CPFVs represent approximately 40% of the total landings by recreational fishers.

Traditionally, the taxa targeted by CPFVs in southern California and Baja California waters include California barracuda (*Sphyræna argentea*); serranids, or sea basses (*Paralabrax clathratus*, *P. nebulifer*); scorpaenids, or scorpionfishes (*Scorpaena guttata*, *Sebastes* spp.); scombrids, or mackerels, tunas, and wahoo (*Acanthocybium solandri*, *Katsuwonus pelamis*, *Sarda chiliensis*, *Scomber japonicus*, *Thunnus alalunga*, *T. albacares*); California halibut (*Paralichthys californicus*); ocean whitefish (*Caulolatilus princeps*); white seabass (*Atractoscion nobilis*); yellowtail (*Seriola lalandi*); halfmoon (*Medialuna californiensis*); and California sheephead (*Semicossyphus pulcher*). The taxa being targeted can vary with season, and also by year. Occasionally, El Niño conditions greatly increase the availability in southern California waters of species normally found off Mexico. Conversely, La Niña conditions increase the numbers of colder-water species. CPFVs are typically quick to exploit the fishing opportunities provided by these changing oceanographic conditions.

The top ten species or species groups in 1999 in southern California (by number of fishes in landings) were rock-

fishes, barred sand bass, California barracuda, albacore tuna, California scorpionfish, ocean whitefish, kelp bass, Pacific mackerel, yellowtail, and bluefin tuna (table 9). These top ten species or species groups include nine of the top ten groups from 1998. The exception, bluefin tuna, jumped in 1999 from the twelfth rank to the tenth, while yellowfin tuna dropped from ninth to fourteenth. The order of abundance also changed for nine of the top ten species or species groups, except for barred sand bass (second rank).

In 1999, 543,626 anglers aboard 254 reporting CPFVs landed 2,538,251 fishes south of Point Conception (table 9). These southern California landings represented 75% of the total landings by CPFVs statewide (3,395,471 fishes). The number of fishes landed statewide was 3% more than in 1998, with landings in southern California increasing by 7%. The number of anglers using southern California CPFVs dropped by 4% in 1999, and represented 80% of anglers using CPFVs statewide.

Decreased landings were reported in 1999 for Pacific bonito, skipjack tuna, yellowfin tuna, yellowtail, dolphinfish, kelp bass, Pacific mackerel, California barracuda, and cabezon (table 9). Decreases in some of the more southerly species or species groups (e.g., skipjack tuna,

TABLE 10  
Central and Northern California CPFV Landings (Number of Fishes) in 1999 and 1998

Species/species group	1999 landings		1998 landings*		Percent change
	Number	Rank	Number	Rank	
Rockfishes, unspecified	758,364	1	791,070	1	-4
Chinook (king) salmon	35,465	2	57,459	2	-38
Lingcod	23,268	3	16,847	4	+38
Albacore	15,429	4	8,549	6	+80
Striped bass	10,774	5	19,720	3	-45
California halibut	5,054	6	7,357	7	-31
Cabezon	2,218	7	1,834	9	+21
Flatfishes, unspecified	1,693	8	1,122	10	+51
Pacific mackerel	832	9	9,018	5	-91
White croaker	705	10	468	12	+51
Leopard shark	610	11	444	13	+37
Jack mackerel	475	12	2,060	8	-77
Sturgeon	354	13	686	11	-48
Shark, unspecified	117	14	241	14	-51
Bluefin tuna	28	15	94	15	-70
Dungeness crab	26,544		13,787		+93
Rock crab	1,914		3,321		-43
Jumbo squid	0		1,588		-100
Total number kept	857,220		919,059		-7
Number of anglers	131,791		137,506		-4
Reporting CPFVs	120		112		+7

\*These 1998 landings have been revised. The numbers presented in this table are the final 1998 commercial passenger fishing vessel landings.

yellowfin tuna, yellowtail, dolphinfish) can be primarily attributed to decreased availability. Cooler oceanic waters moved onshore along the California coast in 1999, causing some species to shift southward. Decreased landings of Pacific mackerel and Pacific bonito also may have been related to decreased availability, but reduced biomass may also have been a factor.

In response to the decreased availability of southerly species, the southern California CPFVs shifted their effort to other species or species groups, including albacore, bluefin tuna, and a number of nearshore species. Albacore landings increased 62% and bluefin landings 92%. The increase in albacore landings was due in part to increased effort. The number of trips that landed albacore in 1999 increased 29% over the previous year. Increased landings were also reported for a number of nearshore species including unspecified flatfishes, white seabass, halfmoon, ocean whitefish, California halibut, California scorpionfish, white croaker, rockfishes, California sheephead, and barred sand bass (table 9). White seabass landings increased from 1,344 fish in 1998 to 11,512 in 1999. The last year that white seabass landings exceeded 10,000 individuals was in 1964, when 14,901 fish were landed. The substantial increase in landings of unspecified flatfishes was partly due to an increase in CPFV trips out of the Seal Beach/Long Beach/San Pedro port group that targeted sanddabs.

Tremendous landings of jumbo squid were also recorded in 1999 by CPFVs operating in the Los Angeles area and south. The 1999 landings jumped 6,475%, from 1,590 squid in 1998 to 104,549 in 1999. This is

in contrast to the central and northern California area, where 1,588 squid were landed in 1998, compared to zero in 1999. The increase in jumbo squid landings in southern California is probably a result of both increased availability as squid shifted south in response to cooler nearshore waters, and more CPFV trips targeting this species.

### Central and Northern California

Along the California coast north of Point Conception, CPFV anglers traditionally target rockfishes (*Sebastes* spp.), salmon (*Oncorhynchus* spp.), lingcod (*Ophiodon elongatus*), and—opportunistically—albacore (*Thunnus alalunga*). Cabezon (*Scorpaenichthys marmoratus*) and other nearshore species are also taken. In addition, more southerly species such as bluefin tuna (*Thunnus thynnus*), white seabass (*Atractoscion nobilis*), skipjack tuna (*Katsuwonus pelamis*), and yellowtail (*Seriola lalandi*) may be targeted in warm-water years. Within San Francisco Bay, CPFV anglers target California halibut (*Paralichthys californicus*), striped bass (*Morone saxatilis*), sturgeon (*Acipenser* spp.), rockfishes, and leopard shark (*Triakis semifasciata*).

The top ten species or species groups taken in 1999 by northern and central California CPFVs (by number of fishes in landings) were rockfishes, chinook (king) salmon (*Oncorhynchus tshawytscha*), lingcod, albacore, striped bass, California halibut, cabezon, unspecified flatfishes, Pacific (chub) mackerel (*Scomber japonicus*), and white croaker (*Genyonemus lineatus*; table 10). These ten species or species groups included nine of the top ten from 1998. The exception, white croaker, rose in 1999

from the twelfth rank to the tenth, while jack mackerel dropped from eighth to twelfth. Also, the order of rank abundance changed for eight of the top ten species or species groups. Only rockfishes (first) and chinook salmon (second) ranked the same in 1998 and 1999.

In 1999, 131,791 anglers caught 857,220 fishes, a 7% decrease in landings from 1998. Decreases in chinook salmon, California halibut, striped bass, sturgeon, Pacific mackerel, jack mackerel, bluefin tuna, and unspecified sharks contributed to this overall decrease (table 10). In addition, fewer than ten individuals of California barracuda (*Sphyrna argentea*), white seabass, and ocean whitefish; and no yellowtail, Pacific bonito (*Sarda chilensis*), skipjack tuna, or dolphinfish (*Coryphaena hippurus*) were landed in central and northern California ports in 1999. Decreases in some of the more southerly species or species groups (e.g., California barracuda, white seabass, yellowtail, skipjack tuna, dolphinfish) can be attributed to a return to colder water conditions along the California coast in 1999. Lower landings of species such as Pacific mackerel, jack mackerel, and Pacific bonito may be due to a decrease in availability as well as a reduction in biomass. Decreased landings of striped bass may be due to several factors, including the presence of colder water outside San Francisco Bay, which reduced the availability of these fish to CPFVs in the area; increased bait availability and thus reduced catch rates; and a shift in effort to other species, such as albacore.

Albacore landings in 1999 increased to 15,429, slightly lower than the 16,567 albacore landed in 1997 but 80% higher than the 1998 landings. Increased landings also were reported for lingcod, cabezon, unspecified flatfishes, white croaker, and leopard shark (table 10). The increases in albacore landings can be attributed partly to

an increase in effort. Although the number of reporting vessels that landed albacore between 1998 and 1999 stayed the same (42), the number of trips that landed albacore increased by 11%. Lingcod landings increased from 16,847 fish in 1998 to 23,268 fish despite a change in bag limit from 3 to 2 fish starting on 1 January 1999.

Landings of crab and squid changed considerably between 1998 and 1999. Dungeness crabs increased by 93%, while rock crabs (*Cancer antennarius*) decreased by 43%. No jumbo squid were taken by CPFV anglers in this region in 1999, probably because the jumbo squid population shifted south as colder water returned to the area (see section describing the southern California CPFV landings).

**Editor:**

*L. Rogers-Bennett*

**Contributors:**

*D. Aseltine-Neilson, Calif. recreational*

*D. Bergen, Pacific mackerel, Pacific sardine*

*M. Erickson, ocean salmon*

*P. Haaker and K. Karpov, abalone*

*A. Henry, market squid*

*R. Leos, reduction fishery*

*K. Oda, Pacific herring*

*D. Ono, spot and ridgeback prawn*

*C. Pattison and A. Vejar, nearshore finfish*

*I. Taniguchi, sea urchin*

*D. Thomas, groundfish*

*J. Ugoretz, swordfish and shark*

*R. Warner, Dungeness crab*

*S. Wertz, white seabass*

*D. Wilson-Vandenberg, C. & N. Calif. recreational*