

## REVIEW OF SOME CALIFORNIA FISHERIES FOR 2001: MARKET SQUID, SEA URCHIN, DUNGENESS CRAB, LOBSTER, PRAWN, ABALONE, GROUND FISH, SWORDFISH AND SHARK, COASTAL PELAGIC FINFISH, OCEAN SALMON, NEARSHORE LIVE-FISH, PACIFIC HERRING, WHITE SEABASS, AND KELP

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### SUMMARY

In 2001, commercial fisheries landed an estimated 200,996 metric tons (t) of fishes and invertebrates from California ocean waters (fig. 1), a decrease of nearly 19% from the 247,122 t landed in 2000. The preliminary ex-vessel economic value of California commercial landings in 2001 was \$104 million, a decrease of 22% from \$133 million in 2000.

Two of the top three grossing fisheries in the state were invertebrate fisheries, as was the case in 2000. The top three fisheries for 2001 (excluding kelp) in ex-vessel value were market squid (\$17.5 million), groundfish (\$16 million), and red sea urchin (\$11.5 million). These fisheries all decreased in value in 2001 compared with 2000: squid declined 35%, groundfish declined 20%, and sea urchin declined 11.5%, continuing its downward trend since its historic high in 1988. The Dungeness crab fishery, with landings significantly lower than the ten-year mean, fell from the list of the top three fisheries and was valued at \$8.9 million in 2000. The swordfish fishery, worth \$8.6 million in 2001, was the fifth most valuable fishery in the state, recovering slightly from the low in 1998. Ridgeback prawn decreased 76% in 2001 from its 20-year high in 2000, and spot prawn continued its downward trend from the high set in 1998. White abalone was listed as endangered under the federal Endangered Species Act (ESA) in May 2001, making it the first marine invertebrate to be listed. A recovery plan is currently being drafted. Revenue generated from kelp harvesting in 2001 was worth an estimated \$19 million, after production, to the major harvester and producer of algin products, ISP Alginates; revenue was down from the \$40 million reported in 2000 due to the weakening in the U.S. economy in 2001, intense competition from foreign algin producers, and ISP's decision to shift production to its facility in Scotland.

Management authority over coastal pelagic species (Pacific sardine, Pacific mackerel, northern anchovy, and jack mackerel) was transferred from state agencies in California, Oregon, and Washington to the Pacific Fishery Management Council (PFMC) by the National Marine Fisheries Service (NMFS) in January 2000. Landings of Pacific sardine remained high in 2001, with

an increase in ex-vessel value per metric ton. Only 56% of the sardine harvest guideline was caught in 2001. Pacific mackerel landings fell to 7,000 t in 2001, as did landings in Baja California, Mexico. The fishery was closed in March when the harvest guideline was met. Anchovy landings increased substantially in 2001 to 19,000 t, up 37% from 2000.

Landings in the commercial groundfish fishery were less than 12,000 t in 2001, a 67% decrease compared with ten years ago and a 28% decrease compared with last year. The groundfish harvest was again dominated by the Dover sole, thornyhead, sablefish (DTS) complex, which declined substantially compared with 2000. Stock assessments prepared for the DTS complex show a lack of sablefish recruitment over the past decade. Rockfish landings were also down in 2001; 2,401 t were landed in 2001 compared with 3,238 t in 2000, a decline of 26%, and a decline of 83% compared with 1991. As a result of stock assessments in 2000, widow rockfish and darkblotched rockfish were added to the list of groundfishes declared "overfished"; already on the list are lingcod, bocaccio, Pacific ocean perch, and some rockfishes.

The nearshore finfish fishery landed 447 t statewide in 2001, well below the 1997 peak in the fishery of 947 t. The live-fish landings component was 307 t, 69% of the overall nearshore catch. In 2001, the ex-vessel value for live-fish landings was approximately \$2.8 million, about 17.5% of the value of the groundfish fishery (nearshore and offshore) and a greater proportion of the fishery's value than in the previous year. 2001 was the second consecutive year PFMC implemented two-month fishery closures for all nearshore rockfishes (winter closure south of Monterey and spring closure north of Monterey; no closure north of Cape Mendocino). During the rockfish closures, fishing effort for the live-fish market shifted to other species in some areas, such as surfperch in the San Francisco area.

Recreational finfish landings increased by 5%, to 3,073,793 individual fish caught by 682,019 anglers aboard commercial passenger fishing vessels (CPFVs) in 2001. Southern California CPFV landings comprised 83% of the statewide total, the same as in 2000. Commercial salmon fishers landed more than 1,012 t of

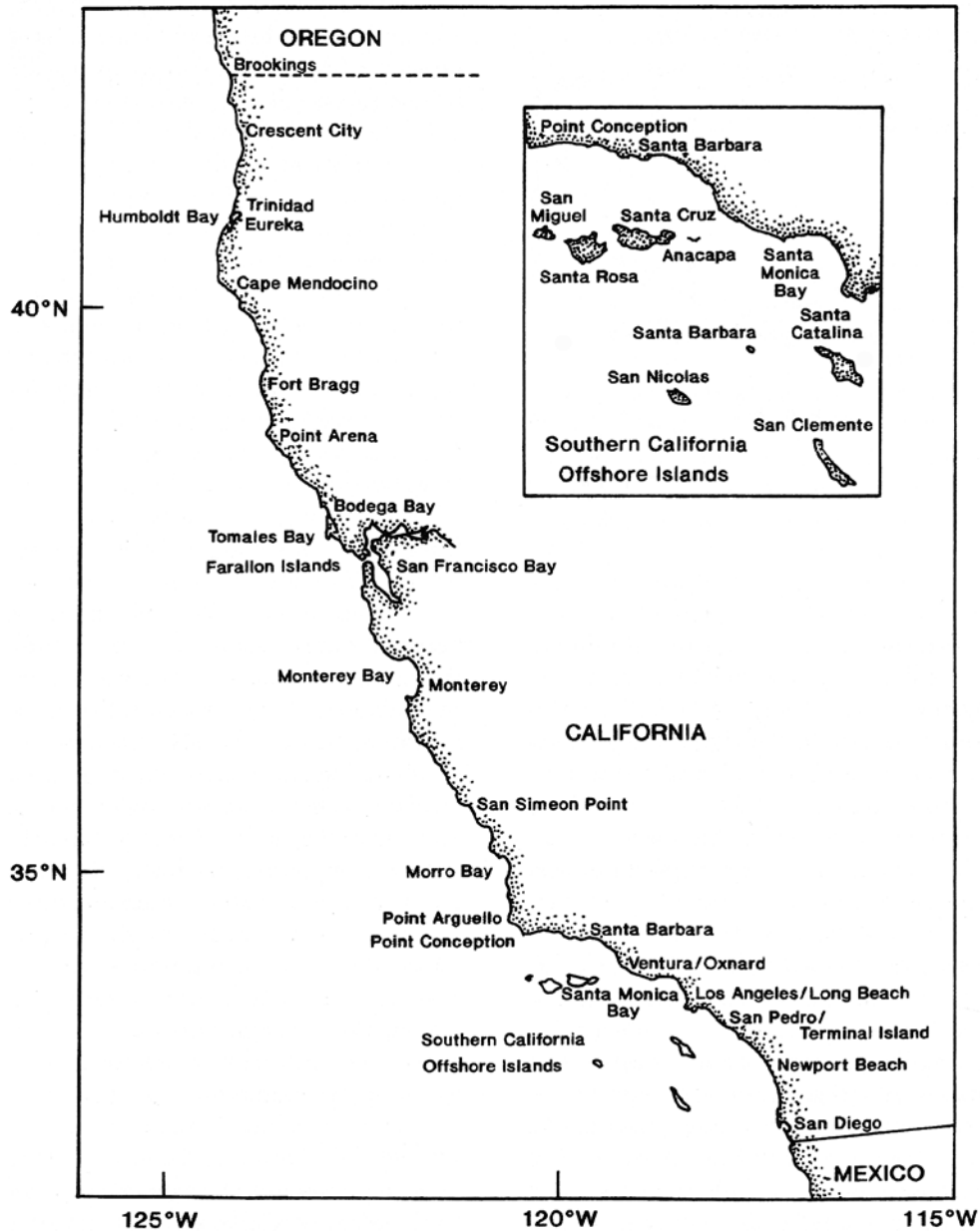


Figure 1. California ports and fishing areas.

chinook salmon, a six-fold decrease from the 20-year high set in 1988. Recreational anglers landed 97,000 chinook salmon from the ocean in 2001, a decline of 48% from the previous year. The coho salmon fishery remained closed. Commercial and recreational landings of white seabass reached an all-time high in 2001: commercial fishers landed more than 120 t, and recreational anglers landed more than 38,000 fish.

The Marine Life Management Act provides that fishery management plans (FMPs) shall form the basis for managing California's marine fisheries. A major component of the California Department of Fish and Game (CDFG) Marine Region's work in 2001 was to draft

these plans as well as to amend existing plans, such as the Coastal Pelagic Species FMP (finfishes only), which set a capacity goal for the limited-entry fleet. The California Fish and Game Commission is expected to adopt three more FMPs in 2002—for nearshore fishes, abalone, and squid. As part of the FMP drafting process, CDFG held numerous workshops to facilitate constituent input into the process. Furthermore, CDFG has partnered with PFMC and others to develop the preliminary FMP for West Coast highly migratory species.

In 2001 the California Fish and Game Commission undertook 25 rule-making actions that address marine and anadromous species. In May 2001 the emergency

closure of the gill-net fishery in shallow waters (<60 fathoms deep) off the central California coast was upheld, continuing the prohibition established in September 2000 to protect the common murre and the southern sea otter. In addition to the regulatory actions, the commission also received extensive oral and written testimony from the public. In response to comments received regarding Initial Draft Concepts for Marine Protected Areas within California state waters in July 2001, a new process was launched late in the year. This new process established Regional Working Groups composed of representatives from a broad range of constituencies to discuss issues related to the Marine Life Protection Act. In 2001 CDFG and the California Sea Grant Program published an update of "California's Living Marine Resources: A Status Report," which details the status of 150 marine species in the state. (To view this publication online, go to CDFG Marine Region's Web site, <[www.dfg.ca.gov/mrd/index.html](http://www.dfg.ca.gov/mrd/index.html)>).

**INVERTEBRATE FISHERIES**

**Market Squid**

Market squid (*Loligo opalescens*) is the largest fishery in the state by volume and ex-vessel value. In 2001, 85,828 t of market squid were landed, 27.2% less than the record high of 117,961 t set in 2000. The 2001 ex-vessel value was approximately \$16.9 million; the average ex-vessel price was \$197/t, a 10.5% decrease from 2000. The fishery remained strong, but landings were lower due to slumping market conditions.

Eighty-two percent of the market squid catch was sold internationally, with a total export value of \$49 million. China, the top export destination, bought 26,313 t of product, worth \$17.5 million. Domestically, the product was sold throughout the country to restaurants and Asian markets, was frozen for sale as bait, or was kept in cold storage for future sale.

The California market squid fishery targets large aggregations of spawning adults over a sandy substrate. Two vessels are used in the process: one, a vessel that uses intense lighting to attract the squid to the surface, and another, a seine vessel, that surrounds the aggregation with a seine net and captures the squid.

Most fishing takes place near the Channel Islands of southern California (the southern fishery) and in the Monterey Bay region of central California (the northern fishery). The southern fishery season occurs during the fall and winter. The northern fishery season typically runs from spring through fall. In the past 20 years landings have increased dramatically (fig. 2, tab. 1) in response to increased international demand for squid. In 2001 the southern fishery landed 78,059 t (90.9% of the catch) and the northern fishery landed 7,769 t (9.1% of

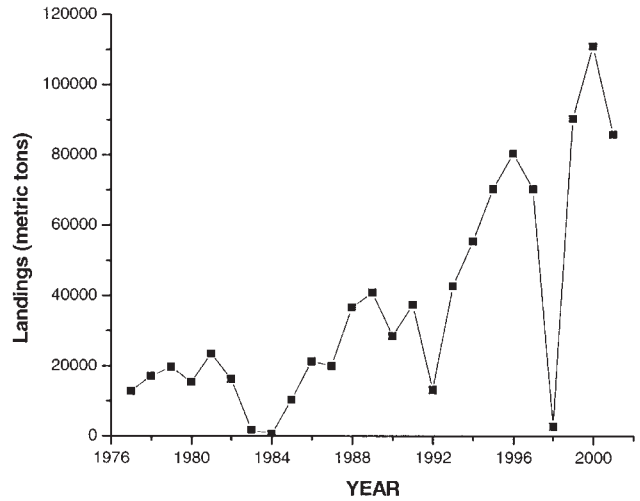


Figure 2. Northern and southern California landings of market squid, 1977-2001.

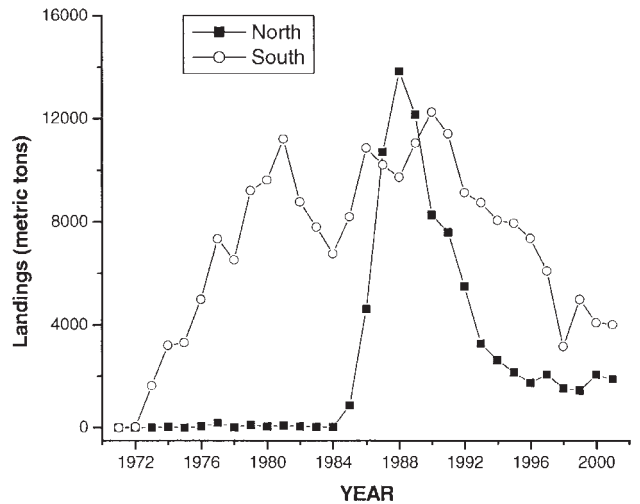


Figure 3. Northern and southern California landings of red sea urchin, 1971-2001.

the catch). As in the past, market demand regulated catch levels most of the year.

In 1997 the California legislature approved Senate Bill (SB) 364 to establish a moratorium on new permits and launch a 3-year study of the fishery, which began on 1 April 1998. The bill also gave interim management authority during the study period to the California Fish and Game Commission. The commission adopted several interim regulatory measures during this period, including a weekend closure, mandatory logbooks, lighting restrictions, and a seasonal harvest limit of 113,400 t.

A report on the history of the fishery and a summary of scientific research, titled "Status of the Market Squid Fishery with Recommendations for a Conservation and Management Plan," was completed and submitted to the California legislature in May 2001. The report also outlines information and recommendations on restricting

TABLE 1  
 Landings of Coastal Pelagic Species in California (metric tons)

Year	Pacific sardine	Northern anchovy	Pacific mackerel	Jack mackerel	Pacific herring	Market squid	Total
1977	5	99,504	5,333	44,775	5,200	12,811	167,628
1978	4	11,253	11,193	30,755	4,401	17,145	74,751
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
2000	53,586	11,504	21,222	1,135	3,736	117,961	209,144
2001	51,811	19,187	6,924	3,615	2,715	85,828	170,080

access to the fishery, number of days a week the fishery should be open, harvest replenishment areas (areas closed to fishing), a research and monitoring program, regulation of light vessels, catch limits, coordination with the federal Coastal Pelagic Species FMP, modifying fishing gear, advisory committee structure, and management authority.

In September 2001 the California legislature approved SB 209, which transferred management authority for the fishery from the legislature to the California Fish and Game Commission. CDFG must submit a Market Squid FMP to the commission on or before 31 December 2002; the FMP will describe alternatives to the recommendations presented in the report to the legislature, and the commission will select one of these alternatives for each management measure in the FMP.

### Sea Urchin

Red sea urchin (*Strongylocentrotus franciscanus*) landings statewide in 2001 were estimated to be 5,880 t, with an ex-vessel value of \$11.53 million, a 3% decrease compared with 2000, when 6,049 t, worth \$13.1 million, were landed (fig. 3).

In southern California, the red sea urchin fishery landed less than 4,536 t for two consecutive years, a level not seen since 1975, during the early days of the fishery. In the early 1990s annual landings averaged close to 9,000 t. The northern Channel Islands have supplied most of the catch over the years, but beginning in 1992

catches began to decline as effort and landings increased at San Nicolas and San Clemente Islands, signaling a shift away from the northern islands. This shift has been exacerbated by poor kelp production in the northern Channel Islands since the last El Niño event in the late 1990s. Though it appears that the kelp has made a comeback in these islands recently, sea urchin production remains depressed.

The northern California fishery has been characterized by rapid growth; landings peaked in 1988 at 13,600 t and then declined by the late 1990s, to about 1,350–1,800 t. The 2001 catch in the north is estimated at 1,874 t. The sea urchin resource is fully exploited in California, and evidence from a variety of sources points to an overfished condition in northern and portions of southern California. Additional management measures may be needed to address this condition. The number of sea urchin permits issued has slowly declined during the last decade, dropping to 385 in 2001. The target number of permits remains at 300 for this limited-entry fishery; however, no formal fleet capacity goals have been set.

Legislation reauthorizing the Director's Sea Urchin Advisory Committee (DSUAC) became effective in 2002; committee members have been incorporated into the restructured Sea Urchin Fishery Advisory Committee. CDFG and the California Wildlife Federation are drafting an agreement to allow the transfer of sea urchin enhancement funds, collected from an industry-imposed

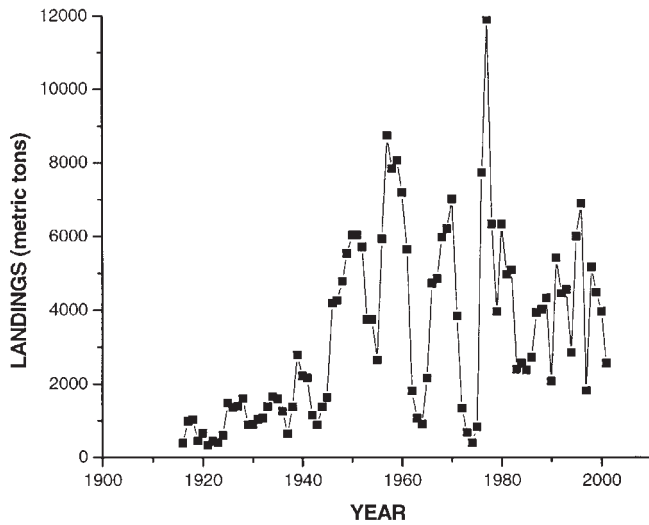


Figure 4. California landings of Dungeness crab, 1916–2001.

sea urchin landing fee, to the nonprofit California Wildlife Federation. Although the landing fee expired in 2001, the industry account has over \$300,000 remaining. Divers and processors are planning to spend the funds on data collection and other activities that will support and augment CDFG's efforts to enhance and manage the resource and associated fishery. CDFG Marine Region's invertebrate team, in conjunction with industry, will begin working on research goals and protocols for fishery-independent sea urchin data collection at the beginning of 2003. This will be done in conjunction with other preparatory actions in anticipation of the drafting of a sea urchin FMP. Sea urchins received a high ranking in CDFG's Master Plan, which the department will use to prioritize species for new FMPs. In the meantime, the industry and CDFG are working on interim regulatory changes that could be brought before the commission by the end of 2002.

### Dungeness Crab

Commercial Dungeness crab (*Cancer magister*) landings for the 2000–2001 season in California totaled 2,559 t, a 36% decrease from the previous season and a significant decline from the ten-year average of 4,279.5 t (fig. 4). These were the second lowest landings on record in 26 years. Statewide landings through January 2002 were 1,252 t, a 42% decrease from the very poor season of 2000–2001 and a 64% decrease from the 1999–2000 season. Southern Oregon has also reported low crab landings; this is in contrast to northern Oregon and Washington, which are reporting their best catches in years.

The crab fishery was worth \$12.6 million in 2000–2001, a decrease of 29% from the \$17.8 million pro-

duced in 1999–2000. The average price per pound for the season was \$2.23, the highest in ten years. The fleet was composed of 424 vessels, the fewest in ten years and a 45% decline from the 769 that fished in 1991–92. A restricted-access program has been in place since the 1995–96 season.

The Dungeness crab season south of Mendocino County opened on 15 November, with the industry agreeing on a price of \$2.50/lb. Fishers in the San Francisco Bay area landed a total of 735.1 t, an increase of 78% from the 1999–2000 season, when 412.9 t were landed. Crab fishers from the Monterey Bay area south landed 15.5 t, a 10% increase from the previous season.

The season in northern California from Fort Bragg to Crescent City opened on 1 December, but fishing did not start for another week because of price negotiations, which were finally settled at \$1.60/lb. The price reached a high of \$4.65/lb in May and fell to \$2.50/lb in July. This followed the general price trend, which is highest in the middle of the season on declining volume and falls toward the end of the season as crabs approach the molt and quality becomes more variable. The catch in northern California totaled 1,808.5 t, a 49% decrease from the previous season.

The crab fishery in California is managed using size, sex, and season limits. Only male crabs are fished commercially, and the minimum commercial legal size is 6.25 in., measured by the shortest distance across the carapace immediately in front of the posterior lateral spines. The minimum-size limit is designed to protect sexually mature crabs from being harvested for a season or two; season limits protect crabs when molting is most prevalent. The sale of female Dungeness crabs has been prohibited in California since 1897. Minimum-size regulations were first implemented in California in 1903 and have remained essentially unchanged since 1911. This management structure has been stable and very successful. Landings appear to cycle over time; a record high of 11,915 t were landed in the 1976–77 season.

Legislation authorizing a pre-season soft-shell crab testing program in California was introduced in 1994, and the industry-funded testing began prior to the 1995–96 season. The testing program, monitored by the Pacific States Marine Fishery Commission, is initiated each year around 1 November. A minimum meat recovery of 25% is required for the season to open. If meat recovery is less than 25%, the fishery remains closed until a second test is conducted two weeks later; if the pick-out is still below 25%, the season opening is delayed 15 days. This schedule may continue until 1 January, after which no more tests are conducted, and the season must be opened by 15 January. The first test of the 2000–2001 season produced a 25.2% pick-out.



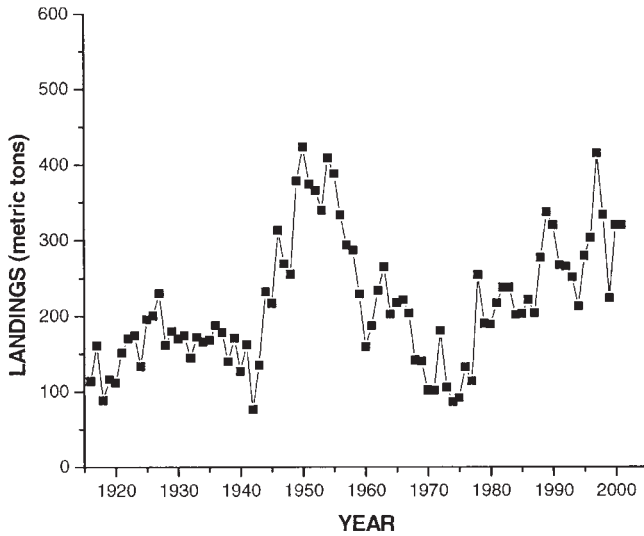


Figure 5. California landings of spiny lobster, 1916–2001.

### California Spiny Lobster

Landings in 2001 for California spiny lobster (*Panulirus interruptus*) totaled 320 t, the same as in 2000 (fig. 5). Landings were split equally among three ports: Santa Barbara (36%), San Diego (34%), and Los Angeles/Orange Counties (30%). Landings in previous seasons were centered in the San Diego area—in the 1995–96 season, 40% of the landings were in the San Diego area, suggesting a northern shift in landings.

The lobster fishery was valued at \$4.49 million in 2001, down from \$6.88 million in 1997. In southern California ex-vessel prices for spiny lobster rank among the highest compared with other fisheries, and prices ranged from \$6.00 to \$8.00/lb. Over the last three years, however, the average price per pound has fallen from \$7.30 in 1999, to \$6.90 in 2000, and down to \$6.65 in 2001.

In southern California, there has been a commercial fishery for California spiny lobster since the late 1800s, and commercial landings have been recorded since 1916 (fig. 5). The commercial fishery uses baited traps to capture live lobster for wholesalers and markets. There is also a recreational fishery, and both scuba and free diving are allowed, although only bare hands or hoop nets can be used to capture lobster. These fisheries operate in shallow coastal rocky areas from Point Conception south to the Mexican border and at offshore banks and islands. The season runs from early October through mid-March, and the majority of the landings occur in the first few months of the season.

Since the 1950s, there have been several major regulation changes to better manage the fishery. In 1955 a minimum-size limit of 3.25 in. carapace length was established. This regulation is still in effect today for both

recreational and commercial fishers. Since 1976, commercial fishers have been required to use rectangular escape ports (2.375 × 11.5 in.) on traps to decrease the retention of undersized lobster. This management tool, along with warming ocean conditions following the regime shift in 1977, may have helped reverse the long downward trend in landings from the 1950s to the 1970s (fig. 5). In 1997 access restrictions were placed on the commercial fishery to limit the number of participants. In 2001 CDFG issued 246 lobster operator permits, down from 298 in 1996.

A logbook for the commercial fishery has been required since 1973. The logbook contains catch and effort information, such as the number of legal-sized lobster taken, the number of small lobsters released, the number, depths, and locations of traps used, and the number of nights the traps were fished. During the 1999–2000 season, more than 800,000 traps were fished for over 41,000 nights; nearly 340,000 legal-sized lobsters were taken, and over 805,000 under-sized lobsters were caught and released. This is down from a peak in the 1997–98 season, when over 600,000 legal-sized lobsters were taken. However, the proportion of undersized lobster caught and released increased from 60% to 70% in the same time period, suggesting good recruitment to the fishery. Analysis of logbook compliance shows that prior to the 1995–96 season, reporting was nearly 50%, increased to 80% for the 1995–96 fishing season, and reached 95% for the 1999–2000 season.

Currently, there are no set quotas on the amount of lobster commercial fishers can land nor on the number of traps they can use. Some fishers have been reported to set 500 or more traps at the beginning of the season, though 100–300 traps is more typical. The bag limit for recreational fishers is seven lobsters a day, down from ten a day in 1971. There are no in-season limits or reporting requirements, such as punch cards, to track the recreational take of spiny lobster.

### Spot and Ridgeback Prawn

Preliminary 2001 spot prawn (*Pandalus platyceros*) landings were 188 t, a 6% decrease from the 199 t landed in 2000. This was the third consecutive year spot prawn landings decreased (fig. 6). The sharpest decline occurred in the Santa Barbara and Morro Bay port area trawl catches, where spot prawn landings dropped 31% from the previous year's total.

Spot prawn are caught with both trap and trawl gear. A total of 70 vessels (36 trap and 34 trawl) made landings in 2001. Over 40% of the combined trap and trawl spot prawn landings in 2001 were made in the Santa Barbara port area. Since the mid-1970s, the number of spot prawn trawlers has increased, particularly so in the last ten years because of an influx of vessels from other

TABLE 2  
 Landings of California Spot Prawn by Port Area and Gear Type, 2001

Port Area	No. of fishing vessels		Landings (metric tons)			
	Trap	Trawl	Trap	Trawl	Total	% of total
Eureka	1	4	1	5	6	3
San Francisco	0	9	0	28	28	15
Monterey	5	6	17	5	22	12
Morro Bay	1	14	2	33	35	19
Santa Barbara	7	20	28	20	48	25
Los Angeles	15	4	27	1	28	15
San Diego	10	0	21	0	21	11
Total			96	92	188	100

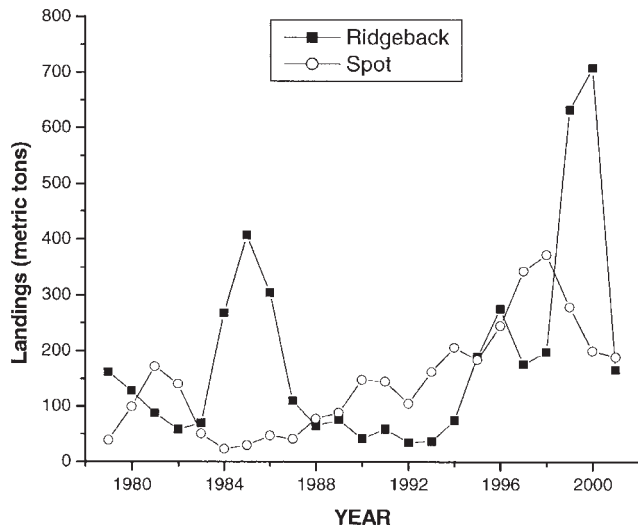


Figure 6. California landings of spot and ridgeback prawn, 1979–2001.

groundfish fisheries that have been subjected to restrictive quotas or seasonal closures.

Trawlers harvested approximately 92 t of spot prawn in 2001, and trappers took 96 t (tab. 2). The median ex-vessel price paid for all spot prawns was \$9.25/lb. Approximately 80% of all spot prawn were sold live. Ex-vessel prices for live spot prawn ranged from \$5.00 to \$13.00/lb, with a median ex-vessel price of \$9.25/lb. The ex-vessel price for fresh dead spot prawn ranged from \$1.50 to \$5.00/lb, with a median price of \$3.50/lb.

During 2001, the trap and trawl spot prawn permit fisheries in southern California (south of Point Arguello) and the trawl spot prawn fishery in northern California were closed from 1 November to 31 January. Up to 50 lb of incidentally trawled spot prawn could be retained during the closure. This southern California trap and trawl closure was instituted in 1997 to protect gravid females. North of Point Arguello, the spot prawn trap season was closed 1 May to 31 July.

In 1999 trap fishers and environmental representatives expressed concern at a California Fish and Game Commission meeting about the level of bycatch in the

spot prawn trawl fishery. The commission directed CDFG to study the type and relative magnitude of bycatch in the spot prawn trap and trawl fisheries. Beginning in the fall of 2000 and continuing for approximately one year, CDFG on-board observers were sent out on spot prawn trawl and trap vessels to monitor the bycatch. The samplers obtained passage on 9 trawl and 17 trap vessels and observed a total of 86 trawl tows and 262 trap strings.

Primary bycatch species of fishes by weight observed in trawl tows from vessels originating north of Point Conception were Pacific hake, Dover sole, sablefish, English sole, and splitnose rockfish. For trawl vessels fishing from ports south of Point Conception, the primary bycatch fish species were Pacific sanddab, Pacific hake, slender sole, shortbelly rockfish, and Dover sole. For northern and southern trawl vessels, rockfishes comprised 25% and 9%, respectively, by weight of the total fish bycatch. Primary bycatch fish species by weight observed in trap strings from vessels originating north of Point Conception were sablefish, rosethorn rockfish, greenblotched rockfish group, spotted cusk eel, and file-tail catshark. For trap vessels fishing from ports south of Point Conception, the primary bycatch fish species were lingcod, greenblotched rockfish group, threadfin sculpin, sablefish, and swell shark. Most sablefish, lingcod, and sharks, many sculpin, and some cusk eels taken by prawn trap were able to survive after being returned to the water. For northern and southern trap vessels, rockfishes comprised 25% and 32%, respectively, of the bycatch by weight. In general, the weight ratio of bycatch to spot prawns, particularly finfish bycatch, was substantially lower in the trap fishery than in the trawl fishery. A final report is being drafted for submission to the California Fish and Game Commission.

In 1999 a spot prawn ad hoc advisory committee, consisting of trap and trawl fishery representatives and a nonfishery representative from the Marine Science Institute in Santa Barbara, was formed to help CDFG develop new regulatory strategies, such as trawl gear restrictions or modifications, excluder device requirements, seasonal harvest limits, area closures, and restricted ac-

cess to harvest permits. In 2000 the California Fish and Game Commission adopted a package of regulatory changes that included establishing a control date to qualify for restricted-access spot prawn fisheries. In 2001 the commission adopted a two-tiered restricted-access program for the spot prawn trap fishery; the program was implemented in April 2002.

Preliminary 2001 ridgeback prawn (*Sicyonia ingentis*) landings totaled 165 t, a 77% decrease in landings from the 707 t landed in 2000 (fig. 6) and the lowest recorded in the fishery since 1994. Two major factors affected landings: the scarcity of ridgeback prawn on the trawl grounds and diminished market demand for ridgeback prawn.

Ridgeback prawn are taken exclusively by trawl nets. The season is closed from 31 May to 1 October, but an incidental catch of 50 lb is allowed. Thirty-one trawl vessels landed ridgeback prawn in 2001, 13 fewer vessels than in 2000. All landings were made at southern California ports from Santa Barbara to Los Angeles, and almost all ridgeback prawn were caught within the Santa Barbara Channel.

The median ex-vessel price paid for live ridgeback prawn was \$1.50/lb, and for dead ridgeback prawn, \$.93/lb. Approximately 67% of the landings were live ridgeback prawn, similar to the proportion landed live in 2000. Most of the dead ridgeback prawn were frozen whole and delivered to domestic and overseas markets.

Until 1998, ridgeback prawn landings were limited by market demand and the few dealers who could buy and process large quantities of prawn. By 1999, however, 45 dealers were purchasing ridgeback prawn. The fishery reached a peak in 2000, but in 2001 ridgeback prawn landings fell to pre-1998 levels as a consequence of both La Niña-driven oceanic cooling and economic market factors. These relatively rapid and substantial changes in the ridgeback prawn fishery warrant periodic monitoring surveys to assess whether the ridgeback prawn fishery is sustainable under existing harvest levels.

### Abalone

The recreational red abalone (*Haliotis rufescens*) fishery along the coast north of San Francisco is the only abalone fishery open in the state. The use of scuba or surface-supplied air is prohibited in this fishery. This regulation effectively restricts abalone fishers to intertidal and shallow depths. Abalone in deeper water are protected in "de facto" deepwater reserves along the coast. Also, a number of intertidal and shallow areas are protected because they are difficult for abalone divers to access. No abalone less than 178 mm (7 in.) may be taken, which prohibits the take of smaller pinto abalone (*H. kamtschatkana kamtschatkana*) and flat abalone (*H. walallensis*).

Landings in the recreational fishery have been estimated from measures of fishing pressure. Two methods are used for harvesting abalone: shore picking (wading) and free diving (breath-holding), and there is a continuum between the methods. In 1960 an estimated 11,000 diver-days were expended to take 53 t (118,000 lb) of red and black abalone; in 1972 29,000 diver-days were expended to take 87 t (192,000 lb). Since the 1960s the number of free divers fishing for abalone, including those using boats, has increased faster than the number of shore pickers. The estimated number of participants in the fishery in 1985–89 is 33,000. Estimated red abalone landings for the same period in northern and central California (divers and shore pickers combined) range from a high of 1,700 t (3.4 million lb) in 1986 to a low of 580 t (1.1 million lb) in 1989. In 1998 an abalone stamp was issued to generate revenues for fishery assessments and enforcement. In 2001, 40,790 abalone punchcards were sold, and in 2000, 39,297 were sold, showing that effort levels are slightly higher now than estimated for the 1985–89 period.

Many data sources, including fishery-dependent and -independent data, are used to assess the status of the recreational red abalone fishery on the northern California coast. Fishery-independent data suggest that red abalone populations at three heavily fished sites in northern California have higher densities of adults or not significantly different densities than observed in a survey conducted in 1986. Despite this finding, the population structure at five key sites suggests that no strong recruitment event has occurred in the past five years, as evidenced by the lack of red abalone with shell diameters smaller than 100 mm. Evidence also suggests that red abalone stocks are depressed north of the sea otter range in central California and at the Farallon Islands. Few abalone were found at the Farallon Islands during extensive CDFG remote-operated-vehicle surveys in 2000 or in the Half Moon Bay area during diver surveys in 1993. Other sources of information have raised concerns about the status of the red abalone fishery—for example, there has been a concentration of fishing effort in Sonoma and Mendocino Counties during the past decade, deepwater stocks at some sites have declined, the number of recreational abalone fishers has increased, and organized poaching has increased. To address these concerns, the California Fish and Game Commission implemented precautionary regulatory changes in 2001 reducing the daily limit from 4 to 3 abalone per fisher and the annual limit from 100 to 24 abalone per fisher.

In southern California, stocks on the northern Channel Islands show little evidence of recovery. In the most recent CDFG cruise (2001), red abalone abundance (measured as the number of abalone encountered by one diver in an hour) was very low. For example, at



TABLE 3  
 California Commercial Groundfish Landings (metric tons)

	2001	2002	% change since 2000	1991	% change since 1991
Flatfishes	4,559	5,259	-13	10,766	-58
Dover sole	2,399	3,267	-27	7,721	-69
English sole	419	299	40	812	-48
Petrale sole	555	628	-12	734	-24
Rex sole	235	223	5	621	-62
Sanddabs	788	727	8	559	41
Other flatfish	163	115	42	319	-49
Rockfishes	2,401	3,238	-26	13,830	-83
Thornyheads	847	1,240	-32	2,871	-71
Widow rockfish	332	705	-53	1,304	-75
Chillipepper	343	444	-23	3,116	-89
Bocaccio	23	27	-15	1,314	-98
Canary	9	13	-31	271	-97
Darkblotched	71	99	-28	341	-79
Splitnose rockfish	95	78	22	488	-80
Other rockfish	681	632	8	4,125	-84
Roundfishes	4,198	7,232	-42	11,111	-62
Lingcod	62	54	15	787	-92
Sablefish	1,547	1,859	-17	3,353	-54
Pacific whiting	2,306	4,986	-54	6,893	-67
Grenadier	211	221	-5	71	197
Cabezon	72	112	-36	7	929
Other groundfishes	704	633	11	128	450
Total	11,862	16,362	-28	35,835	-67

Santa Rosa and Santa Cruz Islands, abundance from timed swims ranged from approximately zero to eight abalone encountered in an hour at Santa Rosa Island and from zero to one abalone an hour at Santa Cruz Island; this is compared with 70 red abalone encountered in an hour at a site in northern California in 2000. San Miguel Island is the only location thought to have a minimum viable population size (of approximately 2,000 abalone per hectare) based on CDFG surveys in 1997.

Population levels of white, black, pink, and green abalone continue to be low, and there is concern about the continued viability of these species at such levels. White abalone was listed as endangered under the federal ESA in May 2001. A recovery team has been named by the National Marine Fisheries Service and this team will aid in the drafting of a recovery plan for the species. Several hundred thousand small white abalone are being raised at the Channel Islands Marine Research Institute for potential stocking to assist in population enhancement and recovery. Black abalone—virtually extirpated off the coast of southern California because of both withering syndrome and overfishing—is now a candidate species for listing under the federal ESA. CDFG surveys in 2001 found few pink or green abalones at the Channel Islands; average abundances from timed swims in March 2001 were 5.0 pink abalone an hour and 0.5 green abalone an hour.

CDFG is currently developing an Abalone Recovery and Management Plan (ARMP) mandated by Fish and

Game Code (FGC §5522). The plan will be submitted to the California Fish and Game Commission on or before 1 January 2003. This plan will outline the strategy for restoring depleted abalone stocks in central and southern California and describe the management approach for fishable abalone stocks in northern California. The plan will also describe a data-collection strategy to enable an adaptive management approach. A peer review committee was convened twice in 2001 to review and comment on elements of the plan. The committee is composed of representatives from the recreational and former commercial fisheries, nonprofit organizations, and scientists from major universities and the federal government. The timeline for the plan includes a period for public comment and formal peer review.

In 2001 the abalone aquaculture industry produced over 94 t (208,300 lb) of red abalone statewide, worth \$3 million. The causative agent of the disease withering syndrome has been identified in cultured animals, and this may impact production, particularly during warm water conditions.

## FINFISH FISHERIES

### Groundfish

The California commercial groundfish harvest for 2001 was 11,862 t (tab. 3). Total 2001 landings decreased 28%, or 4,500 t, from 2000; compared with 1991, landings decreased 67%, or 23,973 t. If Pacific whiting (*Merluccius productus*) landings are not included in the

1991, 2000, and 2001 total groundfish landings, then the total groundfish harvest shows a 16% decline from 2000 and a 59% decline from 1991. The ex-vessel value for all groundfishes in 2001, including Pacific whiting, was approximately \$16.2 million, a decrease of \$4.0 million, or 20%, from 2000 revenues.

In 2001, 86% of the groundfishes landed were taken by bottom and midwater trawl gear, a slight decrease from the 89% observed in 2000. Line gear accounted for the second largest amount at 11%, a slight increase from the 9% observed in 2000. The line gear contribution was at a recent high of 18% in 1992. The gill and trammel net component remained at just under 1% after a steady decline from 5% in 1993 to 1% in 1996. Trap gear rose to nearly 2% of total 2000 groundfish landings.

California's 2001 groundfish harvest was again dominated by Dover sole (*Microstomus pacificus*), thornyheads (*Sebastolobus* spp.), sablefish (*Anoplopoma fimbria*), rockfish (*Sebastes* spp.), and Pacific whiting. Landings of Dover sole, thornyheads, and sablefish (the DTS complex) and of most rockfishes were substantially lower in 2001 than in 2000; landings of lingcod and other flatfish were relatively stable. The declines reflect landing limits adopted by the PFMC in November 2000 that were designed to reduce the harvest of depleted rockfish stocks. Shoreside landings of Pacific whiting declined because of reduced availability in the Eureka–Crescent City area during spring and early summer, normally the period of peak availability.

For 2001, the PFMC continued to set optimal yields for a myriad of groundfish species and species groups. The allowable harvest was reduced for nearly all groups to protect those species in rebuilding status. Cumulative landing and trip limits were again used by PFMC to meet their optimal-yield objectives while continuing to provide for a year-round fishery.

Stock assessments prepared in 2000 by PFMC showed that widow rockfish (*Sebastes entomelas*) and darkblotched rockfish (*S. crameri*) are “overfished”; a rebuilding plan developed in 2001 will be adopted in 2002. The 2001 fishery for darkblotched rockfish was constrained by a separate optimal yield for the first time; because of the “overfished” status of darkblotched rockfish and widow rockfish, optimal yields for both were greatly reduced.

PFMC prepared stock assessments in 2001 for sablefish, Dover sole, and shortspine thornyhead. Stock Assessment Review Panels reviewed the assessments, and recommendations were forwarded to the Groundfish Management Team for development of 2002 management measures. The sablefish assessment indicated that a lack of recruitment in the last ten years has significantly decreased spawning biomass and that stocks are at risk for becoming “overfished.” The PFMC addressed these concerns by adopting a reduced optimal yield for

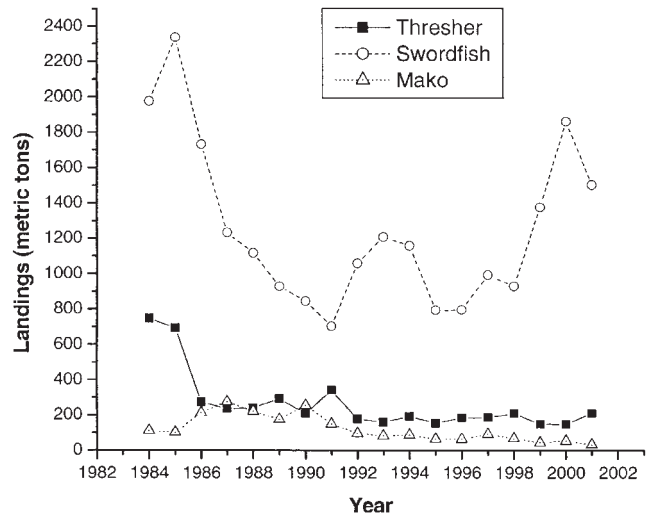


Figure 7. California commercial landings of swordfish, thresher, and mako sharks.

sablefish in its 2002 management measures. Dover sole appears to be undergoing a similar though less severe recruitment decline, and PFMC imposed a precautionary harvest reduction for 2002. The shortspine thornyhead assessment indicated that biomass is increasing, so the optimal yield was set slightly higher for 2002. Assessment plans for 2002 include assessing bocaccio (*S. paucispinis*) and canary rockfish (*S. pinniger*) and updating the sablefish assessment to incorporate new recruitment information.

### Swordfish and Shark

Commercial swordfish (*Xiphias gladius*) landings for 2001 totaled 1,502 t (fig. 7), a decrease of 19% from the 2000 total of 1,861 t. Swordfish are primarily targeted by the drift gill-net fishery, a small harpoon fishery operating within the Southern California Bight, and by a California-based longline fishery that fishes beyond the U.S. exclusive economic zone (EEZ). In 2001, 16% of the catch was taken with drift gill nets, down from 23% in 2000. Harpoon landings were also down, constituting only 2% of the catch. Longline landings, however, were up from 70% of the catch in 2000 to approximately 80% in 2001. Thirty-seven vessels used longline gear outside the U.S. EEZ and landed swordfish in southern California ports; only eight of these vessels were based in California. Approximately 98% of the swordfish catch was landed in southern California.

The total ex-vessel value for swordfish landings for 2001 was approximately \$8.7 million. As expected, gear type, size, and quality affected swordfish ex-vessel prices. Fishers landing swordfish caught in gill nets received \$.40–7.00/lb, or an average of \$3.25/lb. Longline fishers received \$.50–4.50/lb, or an average of \$2.18/lb; and

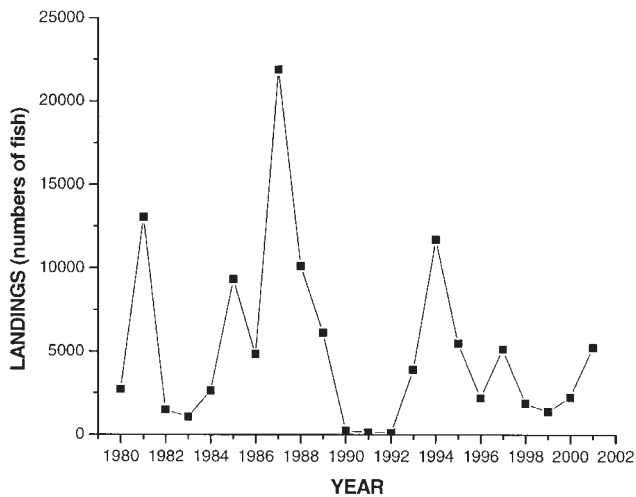


Figure 8. California recreational landings of shortfin mako shark, 1980–2001.  
 Note: Recreational landings for 1990–93 are CPFV logbook data only; all other years include CPFV data and MRFSS total landed estimates (catch type A + B1, private boats).

fishers landing harpoon-caught swordfish received the highest average price, \$6.39/lb; the range was \$1.00–8.25/lb.

The common thresher shark (*Alopias vulpinus*) was the leading commercial shark taken in California in 2001; preliminary landings totaled 210 t (fig. 7). This was the highest yearly landing since 1991 and an increase of 44% from 2000. Thresher sharks were taken primarily with drift gill nets (76%), followed by set gill nets (20%) and other types of gear (4%). Most (82%) of the thresher shark catch was landed in southern California. Ex-vessel prices varied from \$.25 to \$2.50/lb, with an average of \$1.38/lb. The total ex-vessel value was approximately \$600,000.

In 2001 the shortfin mako shark (*Isurus oxyrinchus*) was the second most important commercial shark in California. Shortfin mako landings totaled 32 t, a 41% decrease from the 2000 total of 54 t (fig. 7). The catch was primarily taken by drift gill nets (56%) targeting swordfish. The rest of the catch was landed by set gill net (15%), hook-and-line gear (11%), and longline vessels operating outside the U.S. EEZ (14%). Ninety-seven percent of the catch was landed in southern California ports. Ex-vessel prices varied from \$.50 to \$2.25/lb, with an average of \$1.11/lb. The total ex-vessel value was approximately \$76,000.

Shortfin mako shark was the primary shark target species for recreational anglers in 2001. Recreational anglers landed approximately 5,235 mako sharks, up 132% from 2000 (fig. 8). Ninety-nine percent of the catch were caught within the Southern California Bight, and the remaining 1% were caught in Mexican waters. The shortfin mako shark does not occur regularly in the recreational catch north of Point Conception.

PFMC is currently developing an FMP for West Coast highly migratory species fisheries; the plan will include swordfish, shortfin mako shark, and common thresher shark, among others. After receiving public comment and advice from the Highly Migratory Species Advisory Subpanel, the PFMC will consider final adoption of the FMP at its November 2002 meeting in San Mateo County, California. Once adopted, the plan will be submitted to NMFS for review and approval. Upon approval, NMFS will publish the proposed regulations, request public comment, and publish the final regulations.

### Coastal Pelagic Finfish

In January 2000, management authority over coastal pelagic finfishes—Pacific sardine, Pacific mackerel, northern anchovy, and jack mackerel—was transferred from state agencies in California, Oregon, and Washington to the PFMC by NMFS. These fishes have been among the traditional targets of California’s “wetfish” fleet and are frequently found nearshore in mixed schools. The sardine fishery extends from Baja California to British Columbia.

The federal Coastal Pelagic Species FMP has placed Pacific sardine and Pacific mackerel under an active management status that requires annual stock assessments, which are conducted jointly by CDFG and NMFS, and seasonal harvest guidelines. Northern anchovy and jack mackerel will continue to be monitored until landings increase to a threshold level of 25,000 t for anchovy and 31,000 t for jack mackerel for two consecutive years. Exploitation of northern anchovy is generally constrained by market forces, where availability is high but ex-vessel prices are low. Jack mackerel is desirable for human consumption, but because larger fish do not tend to school, the life history of the jack mackerel tends to prevent the fishery’s expansion.

Some limited amounts of these coastal pelagic finfishes are used domestically as dead bait, pet food, and products for human consumption. The primary use of Pacific sardine is for aquaculture feed in Australian tuna farms; in Japan large fish are sold in specialty markets both for human consumption and for long-line bait. Northern anchovy has been substituted in the Australian markets in the absence of sardine. Almost the entire Pacific mackerel catch in 2001 was exported frozen to South Korea, Australia, and the Philippines.

In addition to the directed fishery for sardine, the live-bait industry in California supplies sardine and anchovy to CPFVs, the albacore fleet, and recreational anglers. Live bait is a low-volume, high-value fishery not subject to quotas; it consists of fewer than two dozen vessels and has taken an annual reported average of 2,700 t of sardine and anchovy combined in the last decade. As with the directed fishery, live-bait vessels typically participate

in more than one fishery throughout the year, dependent on seasons and availability of target species.

In December, the Australian government began investigating reports of viral hemorrhagic septicemia (VHS) in Pacific sardine and Pacific mackerel from California waters. It is likely that import restrictions will severely affect the coastal pelagic species fisheries in California in the future.

**Pacific Sardine.** California landings of Pacific sardine (*Sardinops sagax*) in 2001 totaled 52,000 t, nearly matching the 2000 catch of 54,000 t (tab. 1, fig. 9). The approximate ex-vessel value was \$6.3 million, up from \$5.5 million in 2000. Combined landings from California, Oregon, and Washington totaled roughly 76,000 t (about 56% of the 2001 harvest guideline), and ex-vessel revenues totaled over \$9.1 million. The Ensenada fishery in Baja California, Mexico, landed 22,000 t in 2001, down from 51,000 t in 2000, and Canada had a small fishery, which landed about 1,600 t.

Pacific sardine biomass is estimated using a modified version of the integrated stock-assessment model Catch-at-Age Analysis for Sardine-Two Area Model (CANSAR-TAM). CANSAR-TAM is a forward-casting, age-structured analysis using fishery-dependent and fishery-independent data to estimate annual sardine abundance, year-class strength, and age-specific fishing mortality for 1983 through 2001. The modification of CANSAR was developed to account for the expansion of the Pacific sardine stock northward to include waters off the northwest Pacific coast. Based on a biomass estimate of nearly 1.2 million t, two-thirds of the coast-wide harvest guideline of 134,737 t for the 2001 season was allocated to southern California (south of San Simeon Point, San Luis Obispo County), and one-third was allocated to northern California, Oregon, and Washington. The initial allocation was 89,825 t to the southern fishery and 44,912 t to the northern fishery. In October 2001, NMFS reallocated the uncaught portions equally between the two fisheries at 36,153 t each. Although both fisheries remained open through the entire 2001 season, 44% of the harvest guideline remained unmet. Most of the sardine catch was from southern California ports, where summer fishing was affected by a bycatch limit on Pacific mackerel following a closure of that fishery. Landings in the Monterey fishery were low in the first semester of the season but increased in September as the availability of market squid declined. The 2002 season opened with a harvest guideline of 118,442 t, based on a biomass estimate of about 1.06 million t coastwide.

In October 2001, the California Department of Health Services issued a warning concerning elevated levels of domoic acid in the internal organs of sardines and anchovies along the Santa Barbara coast; this was in addition to an existing warning about sardines in Monterey.

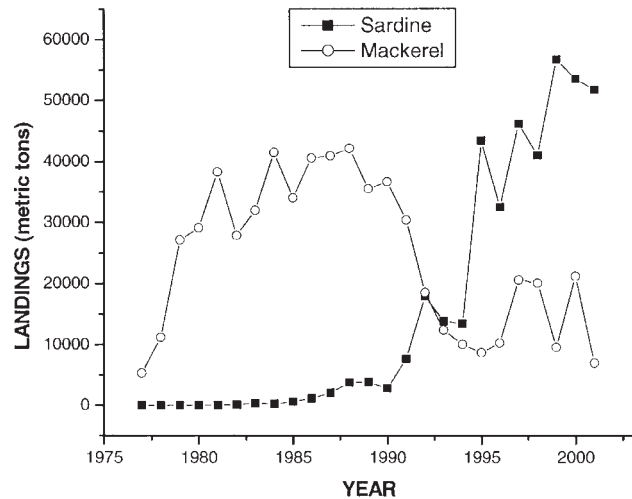


Figure 9. California commercial landings of Pacific sardine and Pacific mackerel, 1977–2001.

Monitoring of coastal pelagic species and shellfish continues in California because domoic acid has been found in other species in other areas.

**Pacific Mackerel.** Landings of Pacific mackerel (*Scomber japonicus*) in California totaled nearly 7,000 t in 2001, significantly down from the 21,000 t catch in 2000 (tab. 1, fig. 9). The ex-vessel price averaged \$154/t in 2001 and generated \$1.1 million in total revenues. The average price per metric ton in 2000 was \$132, for an annual total of \$2.9 million. No significant fisheries for Pacific mackerel exist in Oregon or Washington; landings at Ensenada, Baja California, Mexico, totaled 4,000 t in 2001, down from 7,000 t in 2000.

The fishing season for Pacific mackerel is July to June. In the 2000–2001 season, a harvest guideline of 20,740 t was met in March 2001 and the fishery was closed. The harvest guideline for the 2001–2002 season, based on a biomass projection derived from ADEPT, a tuned virtual population analysis model, was 13,837 t. This guideline was allocated to take advantage of high availability and demand in the first semester of the season, with a portion set aside to allow incidental catch in the sardine fishery without exceeding the seasonal guideline. The directed fishery was closed when the initial allocation of 6,000 t was met and was reopened on 1 April 2002 to fill the remainder of the guideline.

**Northern Anchovy.** California landings of northern anchovy (*Engraulis mordax*) increased substantially to 19,000 t in 2001, up from 12,000 t in 2000 (tab. 1) and the highest level since 1982. Ex-vessel revenues for each of these years generated about \$1.4 million, with an average price per metric ton of \$66 in 2001 and \$110 in 2000. Oregon and Washington had no reported landings of anchovy in 2001; landings at Ensenada, Baja California, Mexico, dropped to only 76 t, from 1,500 t in 2000.



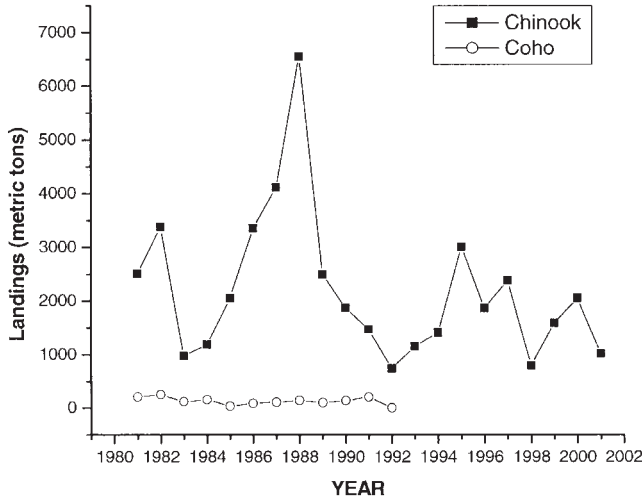


Figure 10. California commercial landings of ocean salmon, 1981–2001.

**Jack Mackerel.** Landings of jack mackerel (*Trachurus symmetricus*) in California totaled 3,600 t in 2001, up from 1,300 t in 2000 (tab. 1). Revenue totaled \$560,000 in 2001, an increase from \$260,000 in 2000. Oregon reported only 183 t in 2001 and 161 t in 2000, and no landings were reported by Washington or Ensenada for either year.

### Ocean Salmon

Commercial ocean salmon landings for chinook salmon (*Oncorhynchus tshawytscha*) were greatly reduced in California in 2001, reflecting a northern shift in populations that boosted landings 400% higher than average in Oregon. Approximately 1,012 t (179,600 fish) of dressed chinook salmon, less than half the landings made in 2000, were landed by commercial trollers. Commercial trollers fished approximately 12,600 days in 2001, down from 17,700 fishing days in 2000 (fig. 10). In 2001, commercial fishing for ocean salmon (all species except coho salmon) in California was allowed coastwide from 1 May to 12 October, with various time and area closures. The minimum size limit was 26 in. total length, 27 in. total length after 30 June to help reduce retention of the generally smaller Sacramento River winter chinook salmon. Ex-vessel prices for dressed salmon averaged \$1.95/lb; the total ex-vessel value of the fishery exceeded \$4.3 million.

Recreational fishing regulations in California were less restrictive than in 2000, with various time and area closures enacted (the fishery was open 17 Feb.–18 Nov.). Despite fewer fishing restrictions, recreational landings statewide decreased by almost 48% compared with 2000 (fig. 11), and a total of 97,200 chinook salmon were taken during 163,000 angler trips (catch per unit angler = 0.6). Landings were well below the ten-year mean of 164,000 chinook salmon. Anglers were limited to two salmon a day (all species except coho salmon) and a minimum size of 20 in. total length, except prior to June 1,

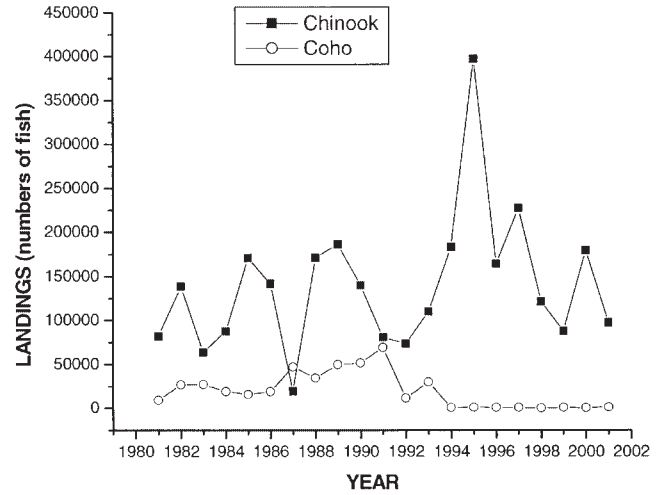


Figure 11. California recreational landings of ocean salmon, 1981–2000.

when the minimum size was 24 in. total length. 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 2001, the PFMC enacted commercial and recreational ocean salmon regulations in California to achieve (1) the escapement goal range for Sacramento River fall chinook salmon of 122,000–180,000 hatchery and natural adults combined; (2) a 17% exploitation rate on age-4 Klamath River fall chinook salmon to accommodate in-river 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 (*O. kisutch*) stocks coastwide.

The Klamath ocean harvest model was reworked to incorporate the fishing power of the fleet and more recent data to forecast future catches. In the Klamath Management Zone (Horse Mountain, California, to Humbug Mountain, Oregon) season management, rather than quotas, continued with more fishing days because of increased Klamath River fall chinook salmon. In the Klamath Management Zone, two separate seasons were enacted: (1) 17 May–8 July and 24 July–3 September, both open every day. The bag limit during the first season was two salmon a day and no more than four salmon in seven consecutive days (all species except coho salmon); during the second season, the limit was two salmon a day and no more than six salmon in seven consecutive days; north of Horse Mountain there was a minimum-size limit of 20 in. total length. In the California portion of the Klamath Management Zone, anglers landed 12,700 chinook salmon during 24,300 angler-trips made primarily on private skiffs.

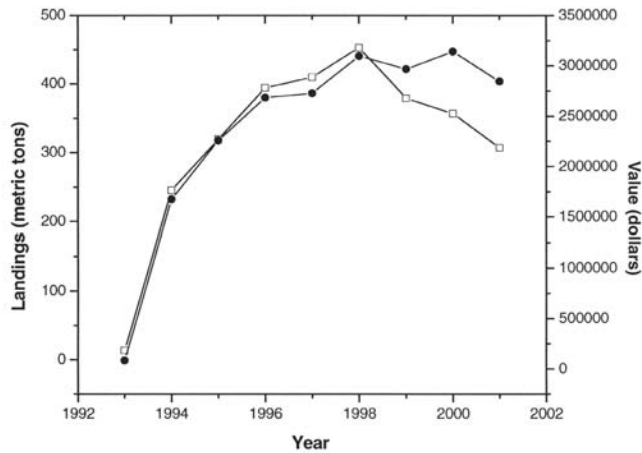


Figure 12. California landings of nearshore live-fish, 1993-2001.

### Nearshore Live-fish

**Current Fishery.** Preliminary landings summaries for the nearshore live-fish fishery in 2001 indicate that statewide landings of nearshore species totaled 447 t. These landings are less than half of the recent peak in 1997 (947 t). This decline may be partly attributed to the continued interim closures and two-month cumulative limits as well as the size restrictions and permit requirements for the fishery. The live component of the landings decreased to 307 t in 2001, down 32% from the peak of 452 t in 1998. Although live-fish landings accounted for 69% of the overall nearshore catch, this proportion represents the second time since 1993 that the amount of nearshore catch landed live has declined (fig. 12).

Although the landing weight of live nearshore finfishes declined slightly from the previous year, live landings in 2001 remained substantially higher than levels in the early 1990s when the fishery began. In 1999-2000, the total value of the nearshore live-fish fishery increased slightly despite a decrease in landings due to increases in the price per pound. In 2001, however, the total value of the nearshore live-fish fishery declined; this trend did not continue and value declined roughly in proportion to landings (fig. 12). Live-fish continued to command higher ex-vessel values than dead fish as overall landings decreased due to environmental factors, depleted stocks, and regulatory changes. Given this scenario, it is likely that a relatively high proportion of nearshore finfishes will be marketed live.

From 1990 through 2000, most nearshore vessels made fewer than 25 landings a year and landed less than 0.45 t (1,000 lb) of nearshore fish each. Presumably, the smaller landings were primarily live-fish. The overall number of hook-and-line vessels landing nearshore species peaked in the early 1990s (1,138 vessels in 1990) and has declined approximately 43% since. The number of permit holders has declined steadily since nearshore fishery per-

mits were instituted in 1999: 1,127 permits were issued for 1999, 1,007 for 2000, and 752 for 2001. In 2001, 439 permittees landed nearshore fish.

2001 was the second consecutive year PFMC authorized two-month closures in selected areas for nearshore rockfishes. The take of nearshore rockfishes was prohibited south of Lopez Point (Monterey County) during January and February and between Lopez Point and Cape Mendocino (Humboldt County) during March and April. There was no closed season north of Cape Mendocino. During months open to fishing, there were two-month cumulative landings limits applied to the fishery; these limits differed according to the type of permit held and the area fished.

CDFG observations have shown that during the rockfish fishery closures fishing effort in some areas shifted toward other species that can be marketed live. For example, in the San Francisco port area fishing effort shifted to surfperch (family Embiotocidae). Although commercial surfperch landings have been common in this area for the past several years, only recently have they been marketed live, coincident with the PFMC's two-month closures of the rockfish fishery. Presumably, fishers and dealers sold the surfperch live (at premium prices) to make up for revenue losses associated with the closures.

**History of the Fishery.** The nearshore fishery, as defined in the California Code of Regulations (Title 14) concerns a select group of finfish found within 3 mi of shore and in waters less than 20 fathoms deep. These nearshore species occur primarily in association with kelp beds or rocky reefs. This review focuses on the nearshore finfish species most commonly captured and sold live.

Many of the nearshore species targeted by the premium live-fish fishery are territorial, slow-growing, and long-lived, which makes them vulnerable to overfishing even at low exploitation rates. The Nearshore FMP, prepared in accordance with the Marine Life Management Act of 1998, will include 19 species of finfish that CDFG has identified as needing immediate management attention; these are cabezon, California scorpionfish, California sheephead, kelp and rock greenlings, monkeyface prickleback, and the following rockfishes: black, black-and-yellow, blue, brown, calico, China, copper, gopher, grass, kelp, olive, quillback, and treefish. These species represent the most common species captured in the nearshore live-fish fishery. All but three (California sheephead, monkeyface prickleback, and rock greenling) are designated as groundfish species under the PFMC's Pacific Coast Groundfish FMP.

Under the Nearshore Fishery Management Act (NFMA) size limits were implemented in 1999 for commercial fishers for the following nearshore species: black-and-yellow rockfish, cabezon, California sheephead,

China rockfish, gopher rockfish, grass rockfish, greenlings, kelp rockfish, and California scorpionfish. Also implemented under the NFMA was a permit requirement for the take, possession, or landing of any of the ten covered species. Comprehensive interim management regulations for the fishery began in 2001. The Nearshore FMP, adopted by the California Fish and Game Commission on 6 September 2002, will move the management of the fishery beyond interim status. The Nearshore FMP integrates five management measures (fishery control rule, regional management, resource allocation, marine protected areas, and restricted access) that together meet the goals and objectives of the Marine Life Management Act and provide for sustainable nearshore stocks and fisheries.

The nearshore live-fish fishery began in the mid-1980s in southern California. Starting in 1993, condition codes (live or dead) were required on market receipts. Prior to 1993 an estimated 0.024 t of nearshore live-fish, worth an estimated \$146,000, were landed in 1989. Initially, the fishery supplied live-fish for the Asian community in California; it now supplies markets in other states and other countries. The primary fishing gear is various hook-and-line methods and traps. Hook-and-line gear includes rod and reel, vertical longlines, horizontal longlines, and weighted "stick gear." Most of the hook-and-line and trap vessels are 20–39 ft in length.

Before market demand for live-fish increased, the price paid to fishers (ex-vessel value) for rockfishes, cabezon, California sheephead, and greenlings was low, especially when compared with prices paid for salmon and California halibut. Increasing consumer demand for premium, live-fish and its continued recognition as a specialty product have increased its value dramatically; for example, the average ex-vessel value of cabezon was less than \$.50/lb in 1989 but was \$4.25/lb in 2001. Target species, fishing methods, and locations fished are determined by the demand for high-quality, fresh live-fish. In 2001, the ex-vessel value for live-fish landings was approximately \$2.8 million (fig. 12).

Landing receipts, commonly called market receipts, are the primary data source for quantifying commercial fishing activity and characterizing the fishery. By law, a fish buyer must complete a landing receipt when fish are delivered. The buyer must provide the weight of the fish landed, price paid to the fishers, and the condition of the fish (live or dead). Most often, fish are separated into market categories and recorded by group rather than by species. This means that a particular market category (e.g., "group gopher") likely contains several different species. Also, in the nearshore fishery, fish that have been landed live are not always recorded as live on the landing receipt (this condition information can sometimes be inferred by examining the price paid per pound: a

higher price may indicate a live fish). Because of this incongruity, landing weights discussed here should be taken as conservative estimates of the actual live-fish landing weights. Also, the condition (live or dead) of fish being landed was not required on landing receipts prior to 1993; therefore, data used here refer to the period 1993–2001.

Regional differences exist in the nearshore live-fish landings. This is because several of the 19 nearshore species have different geographic ranges. South of Point Conception, California sheephead and California scorpionfish were the primary species landed live. In central California, from Point Conception to Cape Mendocino, the species composition of the live-fish landings was more diverse. Cabezon was by far the most common market category landed live in central California, and the more inclusive market categories "group gopher" and "group bolina" ranked second and third, respectively. These groups include gopher, brown, black-and-yellow, grass, kelp, copper, China, and quillback rockfishes.

**Future of the Fishery.** The implementation of the Nearshore FMP represents a plan to address the dynamics of this unique fishery. The plan's fishery control rule will establish the total allowable catch based on three sequential stages of fishery information, and limits will be imposed regionally to allow for localized fishery planning, policy, and management. Consequently, there is a clear need to accurately determine fishing patterns and indexes of abundance on both temporal and spatial scales. A fair and equitable distribution of allowable catch will be sought between recreational and commercial fishing sectors. To meet the goals and objectives of the Marine Life Management Act CDFG will seek to establish Marine Protected Areas in the nearshore ecosystem to help sustain marine resources during times of environmental fluctuations. Furthermore, fishing effort may need to be adjusted to match available resources in fished areas.

### **Pacific Herring**

California's Pacific herring (*Clupea pallasii*) fisheries for 2001, though improved since the 1997–98 El Niño, remain below average levels. Statewide landings for the 2000–2001 sac roe season (Dec.–Mar.) totaled 3,049 t, a 1.6% decline from last season's landings of 3,098 t. Annual (Jan.–Dec. 2001) sac roe landings declined from 3,736 t in 1999–2000 to 2,715 t in 2000–2001, a 27.3% decrease (tab. 1). Success of the sac roe fisheries continues to be mixed. The San Francisco gill-net fleet, composed of three platoons (428 permits), landed 2,713 t, 18.7% over the 2,285 t quota. The Tomales Bay fishery landed a total of 270 t of the 363 t quota, a record high for the area. A total of 9.5 t was landed in Crescent City from the 27 t quota, and Humboldt Bay landings totaled 55.5 t, 2% above the 54.4 t quota.

Ex-vessel prices for herring with 10% roe recovery averaged about \$700/short t for gill-net landings; an additional \$60 was paid for each percentage point above 10%. The ex-vessel price per ton was lower than the previous season, reflecting the continuing volatility of the Japanese economy. Statewide ex-vessel value of the sac roe fishery was an estimated \$3.0 million, a 21.1% decline from last season; however, this was well below the average for the previous 16 seasons (\$9.1 million).

For the fourth consecutive season, the San Francisco Bay herring eggs-on-kelp fishery landings were well below average. Landings totaled 24.7 t, 44.8% less than the 44.7 t quota, and the second lowest total in the past 16 seasons. Total estimated value of the 2000–2001 eggs-on-kelp harvest was \$380,000, based on an estimated average ex-vessel price of \$7.00/lb. Price paid varies with product grade; grade 1 received approximately \$10.00/lb, and grade 5 \$3.00–4.00/lb. Permittees reported that giant kelp (*Macrocystis pyrifera*) lasted longer while suspended because of higher salinities in the bay. Higher salinities were likely caused by the lack of early winter storms.

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 and Humboldt Bay populations. The 2000–2001 (Nov.–Mar.) herring spawning biomass estimate for the San Francisco Bay population was 33,838 t, an increase of 36.1% from the previous season. Although oceanic conditions were favorable, and returning herring were in good physical condition, an apparent displacement or loss of older-year-class fish, 5 year olds and older, continued this season. Younger herring, 1-, 2-, 3-, and 4-year-old fish comprised 97% of the spawning biomass for the 2000–2001 season. Of note, 1-year-old herring from the 2000 year class appeared in the spawning population in the highest numbers in 28 seasons.

The Tomales Bay herring spawning biomass continued to demonstrate a tendency to fluctuate widely. The 2000–2001 spawning biomass estimate was 3,807 t, which represents an increase of 98% from the previous season's estimate (1,786 t). This season's biomass is slightly below the 26-year long-term average of 4,653 t. For the first time since the 1991–92 season, CDFG conducted spawning ground surveys to monitor the herring gill-net fishery in Humboldt Bay. Because of the patchy distribution of eelgrass in northern Humboldt Bay, current data on vegetation density, essential to spawn escapement calculations, are not available. However, eelgrass density data were applied from a 1979 study in Humboldt Bay to spawning ground surveys conducted this season. An estimated 349 t of herring spawned in north Humboldt Bay. No surveys were conducted in Crescent City Harbor.

Favorable ocean conditions have continued with the

prevailing La Niña, and herring fisheries were expected to improve in the 2001–2002 season; however, the December fishery in San Francisco Bay opened with limited success. High salinities and cold water temperatures in the bay may have influenced spawning activity, although sampled herring were in good physical condition and exhibited normal gonadal development.

Kazunoko kumbo (herring roe on kelp) remains an integral part of traditional Japanese New Year's festivities; however, changes in Japanese culture and economy have affected the market. Industry observers expect demand for kazunoko sac roe to wane as younger Japanese become more Westernized. Ex-vessel prices are expected to decline as continued concern for the Japanese economy has herring buyers proceeding cautiously and offering lower prices than were offered in the 2000–2001 season.

### White Seabass

The white seabass (*Atractoscion nobilis*) is the largest member of the Sciaenid family in California waters. This species is targeted by commercial and recreational fisheries, which since 1997 have experienced increases in annual landings of up to 78% and 80%, respectively. The commercial white seabass fishery landed 121 t in 2001 (fig. 13), a 19% increase over the previous year. The recreational fishery landed 38,119 white seabass in 2001 (fig. 14), according to CPFV logbooks and Pacific States Marine Fishery Commission RecFIN data. Using RecFIN data for average weight estimates by fishing mode, recreational landings in 2001 were an estimated 307 t. The estimated combined commercial and recreational catch for 2001 was 428 t.

Although most (62%) of the commercial white seabass catch was landed in southern California ports in 2001, landings in northern California have increased since 1997. Over the past 20 years, the proportion of the com-

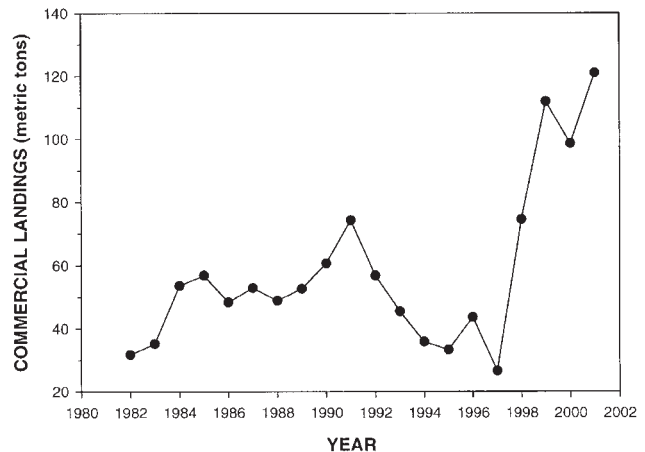


Figure 13. California commercial landings of white seabass, 1982–2001.



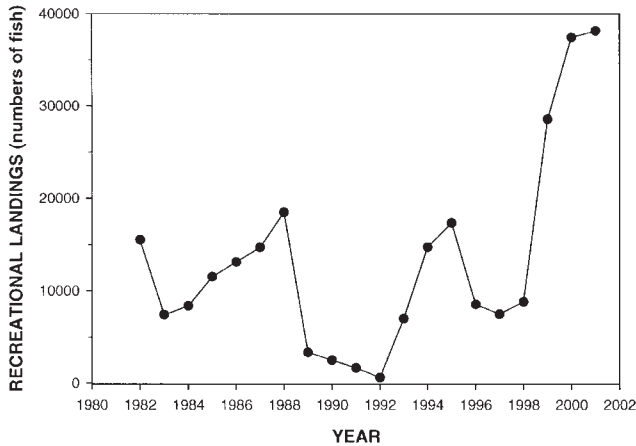


Figure 14. California recreational CPFV and RecFIN landings of white seabass, 1982–2001.

Note: RecFIN data were unavailable during 1990–92; data from those years do not include catch estimates from private/rental boats and shore-fishing modes.

**TABLE 4**  
**Commercial Landings of**  
**White Seabass by Port Area, 2001**

Port area	Landings (metric tons)	% of total
North of Point Conception		
Bodega Bay–San Francisco	2.5	2
Monterey	27.4	23
Morro Bay	15.7	13
Total	45.6	38
South of Point Conception		
Santa Barbara	32.7	27
Los Angeles	39.8	33
San Diego	2.9	2
Total	75.4	62

mercial white seabass catch landed in ports north of Point Conception has ranged from 2% to 19%. During 2001, however, the proportion was 38%, with most fish being landed in Monterey (tab. 4). In 2001, fish dealers paid from \$.25 to \$7.75/lb for white seabass. The average price per pound was \$2.28, for an estimated total ex-vessel price of \$607,935, approximately 30% higher than the previous year's total.

Historically, most of the commercial white seabass catch has been taken with set and drift gill nets. The proportion of drift gill nets used to catch white seabass increased until January 1994, when the use of gill and trammel nets within three nautical miles of the mainland from Point Arguello to the Mexican border was prohibited (FGC §8610.3). Probably in response to this regulation, the proportion of white seabass landed commercially with hook-and-line gear has increased since 1995. In 2001, 55.6% of the commercial catch was taken with set gill nets, and 24.5% was taken with hook-and-line gear.

The commercial fishery for white seabass is closed between Point Conception and the Mexican border from

15 March to 15 June (FGC §8383). Just over half (62%) of the total commercial catch in 2001 was landed during June and July, and 88% was landed from June through November.

A survey of 2001 CPFV logbooks and Pacific States Marine Fishery Commission RecFIN data indicated that an estimated 29,205 white seabass were taken on private or rental boats, 8,342 were taken on CPFVs, and 572 were taken from shore (e.g., from piers and jetties). Eighty percent of the white seabass taken by CPFV anglers came from waters around southern California's Channel Islands, and the remaining 20% were taken along the mainland from Trinidad, in northern California, to San Diego, or from offshore waters. Most (85%) white seabass caught on CPFVs were taken during May through September, with 60% taken during May and June.

In 1983, the California legislature authorized the creation of the Ocean Resources Enhancement and Hatchery Program (OREHP). Managed by CDFG, the program performs basic and applied research on the artificial propagation, rearing, stocking, and distribution of adversely affected marine fish species important to commercial or recreational fishing in California waters south of Point Arguello. Since 1989, white seabass has been OREHP's primary species for research. Juvenile white seabass are produced at the OREHP hatchery facility in Carlsbad, grown to 50–75 mm, and then placed in a grow-out facility. Currently there are 14 grow-out facilities located in bays and marinas from San Diego to Santa Barbara, including Santa Catalina Island. The fish are raised by volunteers until they reach 200 mm and then released at or near the grow-out site. This program had its best year of production in 2001, when approximately 131,000 hatchery-reared juvenile white seabass were placed in grow-out facilities and 100,318 were ultimately released into the open ocean. Since 1986, 503,000 white seabass, each marked with a coded wire tag, have been released from OREHP hatchery and grow-out facilities.

OREHP gill-net surveys are designed to capture 1- to 4-year-old juvenile white seabass at 19 sites from Santa Barbara to San Diego Bay, including six embayments and Santa Catalina Island, to help evaluate the success of releasing hatchery-raised white seabass. These surveys have been conducted since 1995 and have provided recruitment data on white seabass based on catch per unit effort (CPUE). The data show that the recruitment of white seabass in the areas sampled can be highly variable; however, the overall trend showed an increase in CPUE since 1995. In addition, 111 coded wire tagged white seabass released by OREHP were recovered during fiscal year 2000–2001, the most ever recovered.

In 1996, the California Fish and Game Commission adopted an initial FMP for the state's white seabass fishery. But legislation to fully implement the plan was never

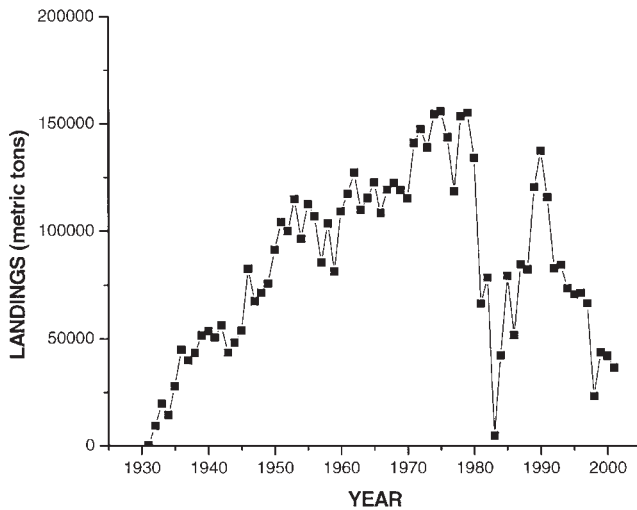


Figure 15. California harvest of giant kelp, 1931–2001.

introduced. In 1998, the legislature enacted the Marine Life Management Act, which granted broader authority to the Commission, and declared that the white seabass FMP would remain in effect until amended and brought into compliance with the Marine Life Management Act. CDFG revised the FMP in accordance with the Marine Life Management Act and submitted it to the commission, which adopted it unanimously on 4 April 2002.

### KELP

The commercial harvest of giant kelp (*Macrocystis pyrifera*) in 2001 totaled 36,390 t, a decline of approximately 5% from 2000 (fig. 15). Kelp harvesting for algin was worth an estimated \$40 million in products to the major harvester, ISP Alginates. The value of kelp landings was comparable to 2000. One firm, ISP Alginates, harvested 92% of the total for use in its production of alginates, though 16 firms/individuals purchased commercial licenses to harvest kelp in 2001. Favorable oceanographic conditions in 2001 supported high productivity from kelp beds, especially those in southern California; this allowed ISP Alginates to conduct most of its harvesting operations from beds it leases off San Diego County. The second largest use of kelp, after the production of alginates, is to feed cultured abalone. Six abalone aquaculturists actively harvested kelp in 2001, and their combined harvest accounted for approximately 7% of the total statewide landings; most of this kelp is harvested from leased beds in central California using small mechanized harvesters. One aquaculturist, based in northern California, uses a skiff to harvest bull kelp (*Nereocystis luetkeana*). The remaining 1% of kelp landings were harvested by the herring-roe-on-kelp fishery, Pacific Gas and Electric Co., edible seaweed distribu-

tors, basket makers, and various research organizations. Edible seaweed harvesting reported by two harvesters in northern California decreased in 2001 from 9.7 t in 2000 to 5.5 t in 2001. Kelp is also harvested for recreational use; however, with a current bag limit of 4.5 kg/day and a low amount of effort, the total amount taken by this group is probably negligible when compared with the commercial fishery. Recreational harvesters generally collect drift kelp that has been cast ashore.

Oceanographic conditions were favorable for kelp growth during 2000 and 2001; relatively cool summer sea surface temperatures were followed by mild, dry winters with relatively few large swell events. These conditions provided for strong recruitment and a general increase in canopy area for many beds, particularly those in southern California; however, the total amount of area occupied by kelp canopy is still far below levels documented in the early twentieth century. This long-term decline can be attributed both to natural disturbances, such as warm-water stress and intense storms associated with El Niño, and to human-induced disturbances, such as increased turbidity and siltation associated with coastal development, pollution, and commercial and recreational fishing activities. Fishing activities remove animals such as California sheephead and California spiny lobster, which help sustain kelp forests through trophic interactions.

In 2002 CDFG will conduct a statewide aerial survey using multispectral imagery to document the abundance and distribution of kelp during the late summer when most beds have reached their maximum canopy potential. Survey images will be entered into a GIS database, which will be used to map and monitor the health of this economically and ecologically important resource. CDFG intends to conduct at least one statewide kelp survey a year in the future.

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