REVIEW OF SOME CALIFORNIA FISHERIES FOR 2000: MARKET SQUID, SEA URCHIN, PRAWN, WHITE ABALONE, GROUNDFISH, OCEAN SALMON, PACIFIC SARDINE, PACIFIC HERRING, PACIFIC MACKEREL, NEARSHORE LIVE-FISH, HALIBUT, YELLOWFIN TUNA, WHITE SEABASS, AND KELP

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SUMMARY

In the year 2000, commercial fisheries landed an estimated 247,122 metric tons (t) of fishes and invertebrates from California ocean waters (fig. 1), an increase of 15% from the 214,229 t landed in 1999. The preliminary ex-vessel economic value of California commercial landings in 2000 was $133 million, a decrease of 8% from $145 million in 1999.

Kelp harvesting was worth an estimated $40 million in 2000 to the major harvester and producer of algin in California, ISP Alginates Inc. This exceeds ex-vessel values for market squid, the top-producing fishery in the state. As they did in 1999, in 2000 the commercial invertebrate fisheries in California had a greater combined ex-vessel value ($68 million) than the combined values for finfish fisheries ($65 million). The top three fisheries for 2000 (excluding kelp) in gross ex-vessel value were market squid ($27 million), groundfish ($20 million), and Dungeness crab ($14 million). Market squid landings increased again, with a new record high. Sea urchin landings, worth $13 million in 2000, continued their downward trend since the historic high in 1988. Ridgeback prawn increased 20%, while spot prawn decreased 28%. Dungeness crab landings decreased 35% compared with 1999, when landings were near the 10-year average. The recreational red abalone fishery in northern California landed an estimated 703,000 abalone, or 1,196 t, which was close to the 4-year average (1986–89).

Ocean conditions along the California coast recovered from the wild temperature fluctuations following the 1997–98 El Niño event and the 1999 La Niña. Pacific sardine landings remained high, while Pacific mackerel landings rebounded from their 1999 low to 1997–98 levels. Pacific herring continued to recover from the devastating effects of El Niño with a 16% increase in landings during the 1999–2000 sac roe season. Commercial chinook salmon landings in the ocean continued to increase, but remained at almost half of the 1988 high. Commercial white seabass landings declined slightly from their 18-year high in 1999.

Swordfish landings increased again, by more than 39%. Thresher shark landings continued to decline (by 2 t), although shortfin mako increased from 42 to 55 t (31%). In October 2000, the shark finning prohibition act (HR 5461) was passed; it bans shark finning inside the United States Exclusive Economic Zone.

Landings in the commercial groundfish fishery in 2000 remained at half of the 1990 value, but increased slightly compared with 1999. The groundfish harvest was again dominated by Dover sole, thornyheads, sablefish, rockfish, and Pacific whiting. As a result of new stock assessments, several groundfish species were declared overfished; they include lingcod, bocaccio, Pacific ocean perch, and some rockfish. The Pacific Fishery Management Council (PFMC) established a separate optimal yield for cowcod and drastically reduced both commercial and recreational levels of take; the council is also considering plans to establish a cowcod closure area. Rebuilding plans for cowcod and canary rockfish were developed in 2000 for implementation in 2001. Draft rebuilding plans have called for greatly reduced landings not only for the overfished species, but also for species associated with them.

The live-fish fishery in California continued its exponential growth. Although there was a slight decrease in landings, increased prices resulted in a higher ex-vessel value for the fishery than in 1999. The total ex-vessel value of the live-fish fishery was approximately 12% of the value of the groundfish fishery as a whole.

Statewide landings by recreational fishers aboard commercial passenger fishing vessels (CPFVs) decreased by 14%, to 2,923,535 individual fishes, despite an increase (3%) in the number of anglers. Southern California CPFV landings constituted 83% of the statewide total. Recreational landings of ocean salmon increased to 179,700 chinook salmon, more than double the landings in 1999, while the coho salmon fishery remained closed. Recreational landings of white seabass continued to increase in 2000, to 16,082 fish—nearly a 10-fold increase since 1982.

The Marine Life Management Act (MLMA) requirements for fishery management plans (FMPs) dominated much of the work in the California Department of Fish and Game (CDFG) as biologists worked to draft

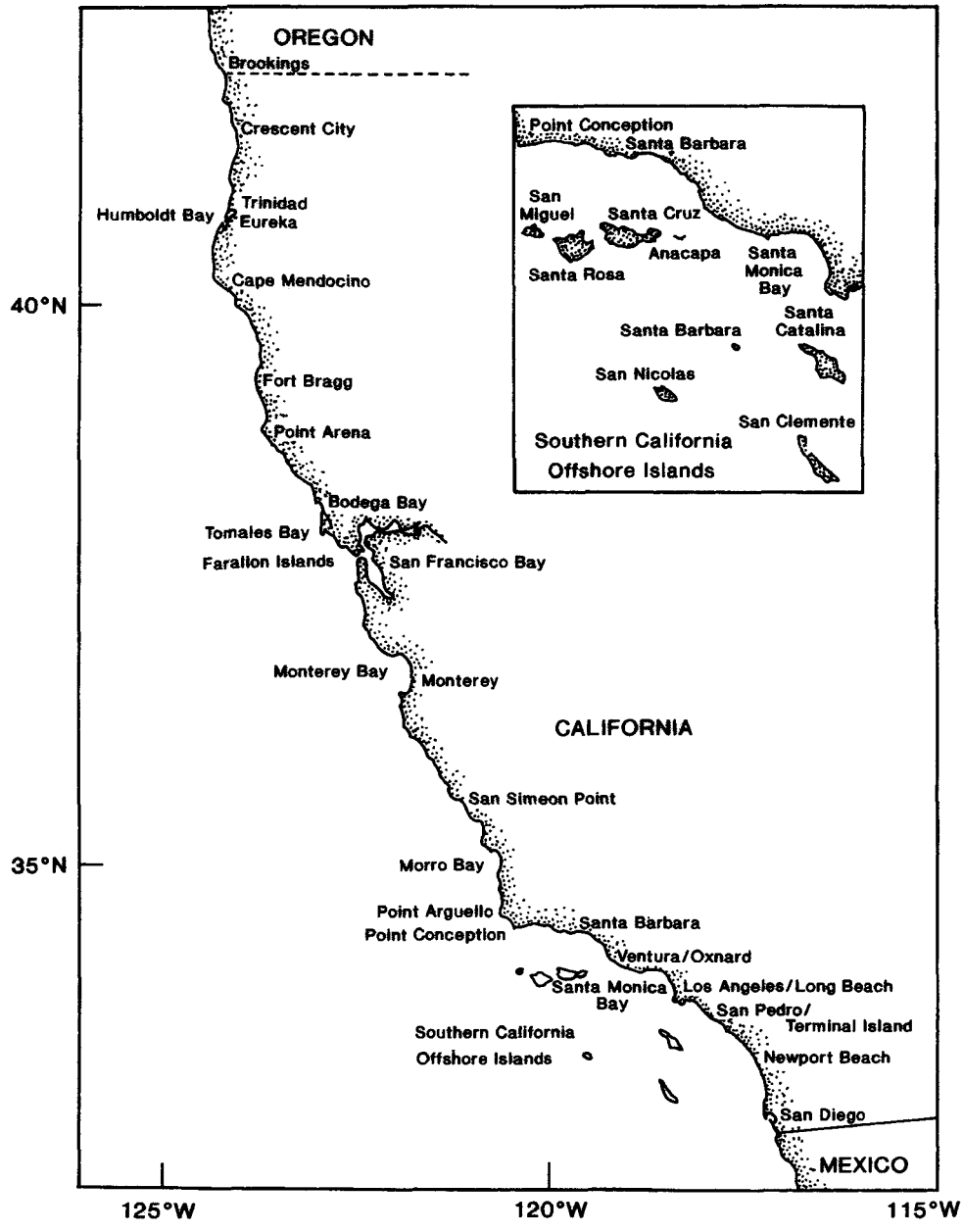

Figure 1. Map of California ports and fishing areas.

FMPs for nearshore fishes, white seabass, and abalone. As part of this effort, the CDFG addressed many of the plans' requirements for constituent involvement. The Marine Life Protection Act moved forward with the establishment of a scientific panel to select marine protected areas in California. As part of the nearshore fishery management plan, the CDFG is considering an ecosystem-based approach to implementing a network of sites to be monitored for nearshore rocky subtidal species such as rockfish, abalone, and red sea urchin. This network would encompass sites inside marine protected areas as well as fished sites both close to and far from ports. Subtidal work continued in 2000 to map areas for assessments and to help determine stock abundances. The Geographic Information Systems Laboratory constructed maps for the nearshore finfish species, showing spatial patterns in the distribution of landings. Biologists completed kelp bed assessments: fly-over data from 1999 (46 sq. kilometers) and 1989 (103 sq. kilometers) show a 56% decrease in kelp surface area in the state over the decade.

INVERTEBRATE FISHERIES

Market Squid

Market squid is one of the most important fisheries in the state, in terms of both volume and revenue. In

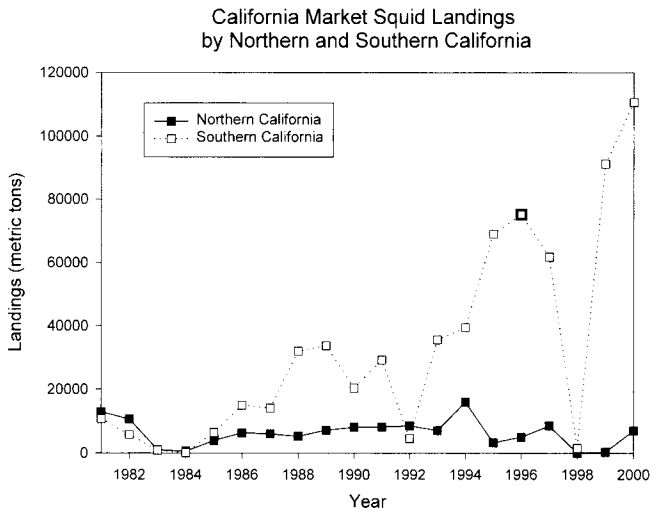

Figure 2. Northern and southern California market squid landings, 1981–2000.

2000, 117,890 t were landed, with an ex-vessel value of approximately $26 million. These landings set a new record, surpassing the previous high of 90,322 t set in 1999. While landings were high, the average price paid to fishers was $220 per t, a 43% drop from 1999. The fishery remained strong after the 1998 El Niño, which decreased landings to less than 2,000 t in 1998.

Market squid was a major fishery export product, with 51% of the catch sold to buyers outside the United States. The total export value was $48,196,174, with China the top export destination (22,940 t). Domestically, the product was sold throughout the United States to restaurants, Asian markets, and (frozen) as bait.

The California market squid fishery is unique in that two vessels are usually involved in fishing: a light vessel, which uses intense lighting to attract the squid to the surface, and a seine vessel, which surrounds the school with a net to capture the squid. The fishery targets large aggregations of spawning squid over a sandy substrate.

There are two centers for this fishery: the Monterey Bay region of central California and the Channel Islands in southern California. Prior to the early 1980s, the northern fishery contributed the larger portion of the statewide catch. The southern fishery grew as demand for the species increased, and it is now the dominant area of the fishery (fig. 2). The northern fishery season is typically spring through fall. The southern fishery season takes place during the fall and winter. In 2000, the Monterey fishery recovered from the effects of El Niño with 6,995 t (6% of catch) landed; only 297 t were landed in 1998 and 1999 combined. The southern fishery landed 110,894 t (94% of catch) in 2000. As in the past, catch levels were regulated by market demand for most of the year.

New regulations on squid-attracting lights were adopted by the Fish and Game Commission, and implemented by the CDFG in spring 2000. These regulations require all squid fishing vessels to limit their squid lights to 30,000 watts, shield the entire filament of each light, and orient the illumination downward or keep the lights underwater. These regulations were enacted to avoid interactions with nocturnal seabirds and to reduce light scatter in coastal communities.

In 1999, the Fish and Game Commission adopted two regulations based on recommendations from the Squid Fishery Advisory Committee and the CDFG, which implemented them in early 2000. One regulation involves closing the squid fishery from noon on Friday to noon on Sunday, statewide, to allow squid time to spawn uninterrupted. The other requires operators of vessels fishing for squid to complete a daily logbook. Information from logbooks will be used to determine fishing effort and location.

In recent years considerable information has been obtained about the status of market squid populations and the fishery. Department-funded research by biologists at the National Marine Fisheries Service has produced preliminary results on fecundity and spawning escapement that have management application. To determine fecundity, researchers used microscopic analysis of the ovary to estimate that each female lays approximately 4,600 eggs before completing her life cycle. A mantle-condition index was developed to measure tissue loss in relation to spawning activity. Research shows a relationship between the mantle-condition index and the number of eggs spawned. The mantle index was lower in squid that released more eggs. With this information, a mathematical model can be used to estimate the amount of spawning escapement.

Sea Urchin

Red sea urchin (*Strongylocentrotus franciscanus*) fishery landings statewide were off by 383 t, to 6,046 t (13.3 million pounds) in 2000 compared with 6,429 t in 1999. This continues the steep decline in landings since the record high in 1988, when landings were 23,981 t. Ex-vessel value held steady at about $13.1 million as prices improved and some dealers reported increasing the proportion of their product sold to U.S. markets.

The northern California catch has been under 2,269 t (5 million pounds) since 1995, after peaking at over 13,600 t (30 million pounds) in 1988 (fig. 3). Effort, as vessel trips, has ranged from 2,300 to 4,200 during this period. Commercial sea urchin divers can move freely from region to region, and in 1999, 18% of all divers (with >10 landings) fished exclusively in northern California. A total of 99 divers (24%) of the 421 permitted divers statewide in 1999 caught more than 50%

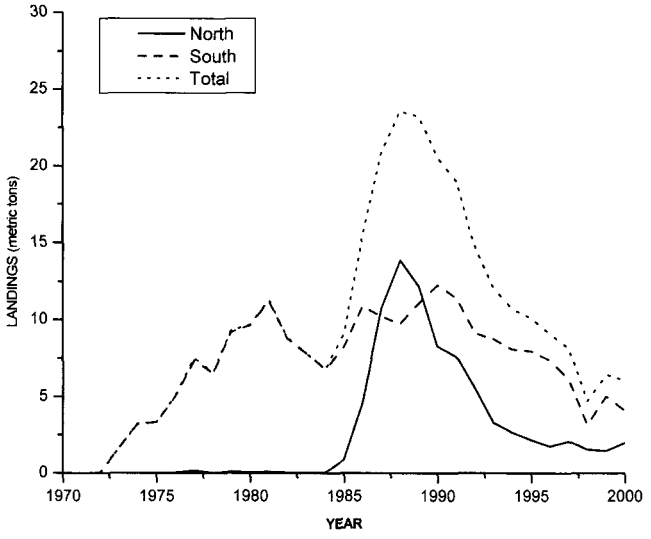

Figure 3. Northern and southern California landings of red sea urchin, 1971–2000.

of their catch in northern California, which produced 23% of the statewide catch. Latent effort is high in this fishery: 17% of the permittees took 50% of the statewide catch, and 90% of the catch was taken by 264 divers (63%). Overcapitalization in this industry may have been exacerbated by the closure of the commercial abalone fishery in 1997. Many of the participants, gear, and boat requirements are the same for both of these fisheries.

Subtidal surveys at northern California index sites in 1999 and 2000 indicate depressed abundances and recruitment levels for red sea urchin in fished sites compared with protected sites.

Southern California's red urchin catch fell below 4,535 t (10 million pounds) in 2000, for the second time in the last 25 years (fig. 3). Of the three regions comprising this area—the northern Channel Islands, the southern Channel Islands, and the mainland coast—the northern islands have contributed most of the catch over the years. But the catch from these islands has fallen from nearly 7,256 t (16 million pounds) in 1991 to just over 1,361 t (3 million pounds) of red urchins in 2000. The principal islands of the northern group are San Miguel, Santa Rosa, and Santa Cruz; the former two have provided most of the catch during the last decade. Availability estimates for kelp beds at these two islands (from ISP Alginates Inc.) are highly correlated with red urchin harvests during the period 1989–97.

No significant sea urchin management measures have been enacted since 1992, and the fishery has continued on a downward trend as industry and managers have been at an impasse over the best course of action. One important management measure recommended by the CDFG's Nearshore Invertebrate Team is the imposition of a maximum size limit in addition to the present minimum size limit. Extensive field work and modeling of sea urchin population dynamics indicate that such a limit would protect urchins with the greatest spawning potential and enhance the survival of juvenile urchins under the spine canopy of larger urchins. The team suggested a maximum size limit of 12.1 cm (4.75 inches) in the north and 11.4 cm (4.5 inches) in the south. In 2000, about 12% of the northern catch exceeded the proposed limit, while in the south less than 1% was larger than 11.4 cm. Although urchins exceeding the upper size limits have become scarcer, growth studies suggest that once red urchins escape the fishery they could live and reproduce for decades.

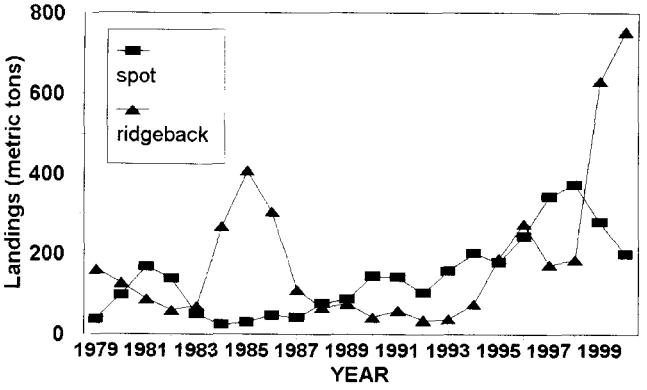

Figure 4. California ridgeback and spot prawn landings, 1979–2000.

Spot and Ridgeback Prawn

Spot prawn. Preliminary 2000 spot prawn (*Pandalus platyceros*) landings were 199 t, a 28% decrease from the 278 t landed in 1999. This was the second consecutive year of decreasing spot prawn landings (fig. 4). The largest decline occurred in the Santa Barbara area trawl catch, where spot prawn landings dropped 40 t from the previous year's total of 150 t.

Spot prawn are caught with both trap and trawl gear. A total of 75 vessels (39 trap and 36 trawl) made landings in 2000. Table 1 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 2000 were made in the Santa Barbara port area. In the past, boats using trap gear were the major contributors to the fishery. Since the mid-1970s, however, 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 season closures.

Trawlers harvested approximately 121 t of spot prawn in 2000, while trappers took 78 t (table 1). The median

TABLE 1
California 2000 Spot Prawn Landings by Port Area and Gear Type

Port areas	Number of fishing vessels by gear type		Spot prawn landings (metric tons)			
	Trap	Trawl	Trap	Trawl	Totals	Percentage of total
Eureka	0	2	0	9	9	5
San Francisco	1	4	<1	22	22	11
Monterey	11	6	13	5	18	9
Santa Barbara	12	27	30	80	110	55
Los Angeles	10	3	18	5	23	12
San Diego	10	0	17	0	17	8
Totals			78	121	199	100

ex-vessel price paid for all spot prawns was $9.00 per pound. Approximately 82% of all spot prawn were sold live. Live spot prawn had a median ex-vessel price of $9.00 per pound, with a range from $2.00 to $11.00 per pound. Fresh dead spot prawn sold for a median ex-vessel price of $3.50 per pound, with a range from $2.00 to $4.00 per pound.

During 2000, the trap and trawl spot prawn permit fisheries in southern California (south of Point Arguello) operated 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 provide more protection for gravid females. North of Point Arguello the spot prawn season was open all year.

Concern over bycatch in the fishery led the CDFG and the Fish and Game Commission to mandate an onboard spot prawn observer program in 2000. Trawl and trap fishermen landing spot prawns were required to purchase an observer stamp; the stamp funds were used to hire, train, and deploy observers on spot prawn vessels. Beginning in August 2000, CDFG onboard observers were sent out on spot prawn trawl and trap vessels to monitor bycatch. Observers completed 12 single-day trips on trap vessels and 13 days on trawl vessels, documenting the bycatch in 104 trap strings and 37 trawl tows. The collection and analysis of observer data is scheduled to continue through the 2000–2001 season.

Ridgeback prawn. Preliminary 2000 ridgeback prawn (*Sicyonia ingentis*) landings totaled 755 t. This represented a 20% increase in landings from the 632 t landed in 1999 (fig. 4) and was the highest total recorded since the fishery began in the late 1970s. Ridgeback prawn landings in both 1999 and 2000 were more than double the annual landings recorded in each of the previous four years. 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 greatly increased level of landings. Most of the ridgeback prawn were frozen whole and delivered to both domestic and overseas markets.

Ridgeback prawn are taken exclusively by trawl nets, and there is a closed season from 31 May through 1 October, when an incidental catch of 50 pounds is allowed. Forty-eight trawl vessels made ridgeback prawn landings in 2000, an increase of 13 from the number of vessels that fished in 1999. All of the landings were made at southern California ports, between Santa Barbara and Los Angeles, and almost all ridgeback prawn were caught within the Santa Barbara Channel.

The median ex-vessel price for ridgeback prawn was $1.25 per pound. Approximately 36% of the landings were live, an increase over the 28% live ridgeback prawn landed in 1999. Live ridgeback prawn sold for a median ex-vessel price of $1.40 per pound; the median ex-vessel price for dead ridgeback prawn was $1.00 per pound.

Until 1998 ridgeback prawn landings were limited by market demand and the number of dealers who could buy and process large quantities of prawns. In 1999 and 2000 market conditions changed, and there were at least five dealers who purchased 100,000 to 300,000 lbs. of ridgeback prawn annually. This was in addition to the more than 40 other dealers who purchased lesser quantities. Although there are currently no biomass estimates or maximum sustainable yield (MSY) calculations for ridgeback prawn, the recent substantial increases in landings warrant further monitoring and analysis of the fishery to determine if the current harvest levels are sustainable.

White Abalone

In 1997 the National Marine Fisheries Service (NMFS) designated white abalone (*Haliotis sorenseni*) as a candidate species for listing under the Endangered Species Act. The following year, NMFS contracted with Scripps Institution of Oceanography to review the biological status of white abalone. The comprehensive status review of the white abalone was completed in early 2000. The NMFS concluded that the white abalone was in danger of extinction throughout a large portion of its

range, and issued a proposed ruling to list white abalone as an endangered species. A consortium of public and private agencies, including the CDFG, NMFS, National Park Service, University of California (Scripps Institution of Oceanography and UC Santa Barbara), U.S. Geological Service, Channel Islands Marine Research Institute (CIMRI), and Marine Conservation Biology Institute are working on the recovery of white abalone.

Several cruises, supported by a Saltonstall-Kennedy grant and the NMFS Southwest Fisheries Science Center, were made in 2000 to begin collecting broodstock for culture, research, and species restoration. The collection cruises focused on historical white abalone habitat around Santa Catalina Island. One of the cruises used a remotely operated vehicle (ROV) owned and run by NMFS to search for white abalone habitat. The ROV proved effective for finding white abalone and thus helping to conserve scuba time for collecting animals at deep depths. Fourteen abalone were collected and are now in captivity in two culture facilities, UC Santa Barbara and CIMRI.

TABLE 2
California Commercial Groundfish Landings (Metric Tons)

	1999	2000	Percent change
Flatfish			
Dover sole	3,745	3,267	−13
English sole	375	299	−20
Petrale sole	529	628	19
Rex sole	282	223	−21
Sanddabs	925	727	−21
Other flatfish	141	115	−18
Rockfish			
Thornyheads	1,467	1,240	−16
Widow rockfish	574	705	23
Chilipepper	885	444	−50
Bocaccio	70	27	−61
Splitnose rockfish	138	78	−44
Other rockfish	1,152	744	−35
Roundfish			
Lingcod	153	54	−65
Sablefish	1,905	1,859	−2
Pacific whiting	1,308	4,986	281
Grenadier	312	221	−29
Cabezon	144	112	−22
Other groundfish	101	633	527
Total	14,206	16,386	15

FINFISH FISHERIES

Groundfish

The California commercial groundfish harvest for 2000 was 16,386 t (table 2). Total landings increased 15%, or 2,180 t, from 1999. Compared to 1990, however, landings have decreased 51%, or 14,726 t. The year 2000 increase in landings is due to increases in Pacific whiting (*Merluccius productus*): when Pacific whiting data are removed, both the 1999 and 2000 total harvests of remaining groundfish decrease, and the 2000 harvest is down 12% from 1999. The ex-vessel value for all groundfish in 2000 was approximately $20.2 million, an increase of $1.4 million, or 8%, from 1999 revenues.

In 2000, 89% of the groundfish landed were taken by bottom and midwater trawl gear, a slight increase from 86% in 1999. Line gear accounted for the second largest amount at 9%, a slight decrease from the 12% observed in 1999. 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. Traps again accounted for a little over 1% of total groundfish landings.

California's 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) showed a moderate drop, while lingcod and all rockfish except widow rockfish showed sharp declines in 2000. The declines in lingcod and rockfish, other than widow rockfish, reflect highly restrictive landing limitations adopted by the PFMC in November 1999 to reduce the harvest of depleted stocks. Shoreside landings of Pacific whiting returned to recent levels after dropping in 1999 because of reduced availability in the Eureka–Crescent City area during spring and early summer. The 1999 decline was not related to the health of the whiting stock, but most likely was caused by a disruption in their normal migratory pattern related to the 1999 La Niña.

For 2000 the PFMC continued to set optimal yields (OYs) for Dover sole, shortspine thornyhead (*Sebastolobus alascanus*), longspine thornyhead (*Sebastolobus altivelis*), sablefish, Pacific whiting, lingcod (*Ophiodon elongatus*), bocaccio (*Sebastes paucispinis*), canary rockfish (*Sebastes pinniger*), chilipepper (*Sebastes goodei*), Pacific ocean perch (*Sebastes alutus*), splitnose rockfish (*Sebastes diploproa*), widow rockfish (*Sebastes entomelas*), and yellowtail rockfish (*Sebastes flavidus*). Also, as a result of a new stock assessment, the PFMC established a separate OY for cowcod (*Sebastes levis*) in the Monterey and Point Conception INPFC areas.

In early 1999 the NMFS notified the PFMC that lingcod, bocaccio, and Pacific ocean perch were overfished. In response the PFMC was required to prepare rebuilding plans with the goal of rebuilding stocks within 10 years, if possible. The rebuilding harvest levels contained within the rebuilding plans required the PFMC to set 2000 OYs for lingcod and bocaccio at half of what they were in 1999. In addition, canary rockfish and cowcod assessments completed in 1999 indicated that those species were also overfished and required rebuilding plans to be

developed during 2000 for implementation in 2001. In anticipation of the need for a greatly reduced canary rockfish harvest in 2001, the 2000 OY for that species was also reduced. The PFMC again used cumulative landing limits as well as trip limits to meet their objective of staying within the annual OYs for all groundfish while continuing to provide for a year-round fishery.

In order to constrain landings of the overfished rockfish species and lingcod to the yields recommended in the draft rebuilding plans, it was necessary to also limit the take of species normally associated with them. While the fully assessed rockfish species were managed with discrete OYs, the rockfish that had not been fully assessed had been aggregated into a single management category—"the *Sebastes* complex"—with a single OY. The PFMC, faced with drastic rockfish harvest reductions, recognized that the overfished species are shelf species associated with other shelf species, and thus it was not necessary to reduce the harvest of all rockfish. So, for this and other reasons, the PFMC separated the unassessed rockfish into three management assemblages, each with their own OY. The assemblages—minor nearshore, minor shelf, and minor slope—can now be managed with their own OYs and trip limits affording protection for depleted stocks while still providing fishing opportunities for more abundant stocks.

For 2000 the PFMC adopted highly restrictive landing limits for lingcod and the shelf rockfish group. These limits were designed to constrain total catch of lingcod, bocaccio, and canary rockfish to the small optimum yields necessary to rebuild their stocks. An exception was made for widow rockfish and chilipepper, which could be taken in larger amounts if a vessel had only midwater trawl gear onboard. The use of this option is reflected in the relatively higher widow rockfish landings (table 2); however, fishers were unable to catch chilipepper rockfish in any quantity with midwater trawl gear. In order to further discourage targeting on shelf rockfish, the PFMC also adopted an idea proposed by industry that prohibits the landing of anything other than the DTS complex or slope rockfish when large footrope trawl gear (footrope greater than 8 inches) is onboard a vessel. Vessels fishing for shelf flatfish must use a net with a footrope smaller than 8 inches.

During the year 2000, stock assessment teams reported on coastwide lingcod, bank rockfish (*Sebastes rufus*), darkblotched rockfish (*Sebastes crameri*), widow rockfish, and yellowtail rockfish. These assessments were reviewed by stock assessment review (STAR) panels, whose recommendations were forwarded to the Groundfish Management Team (GMT) for development of 2001 management measures. The GMT addressed the STAR panel recommendations as well as the NMFS notice that widow rockfish and darkblotched rockfish were overfished and that in 2001 the PFMC needed to develop rebuilding plans for implementation in the 2002 management cycle.

Also in 2001 the PFMC will continue to investigate a groundfish industry capacity-reduction program, and implement a groundfish observer program. Stock assessments planned for 2001 include black rockfish (*Sebastes melanops*), Dover sole, shortspine thornyhead, sablefish, and Pacific whiting. Another goal is the implementation of a permit-stacking option in the limited-entry fixed-gear sablefish fishery.

Ocean Salmon

In 2000, 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 (*Oncorhyncus tshawytcha*) of 122,000 to 180,000 hatchery and natural adults combined; (2) a 13.8% 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 (*Oncorhynchus kisutch*) stocks coastwide.

In 2000, commercial fishing for ocean salmon (all species except coho) in California was allowed coastwide 1 May to 30 September, with various time and area closures. The minimum size limit was 26 inches (TL), and 27 inches after 30 June to help reduce retention of the generally smaller Sacramento River winter chinook salmon; however, a continuation of the 1999 Bodega Bay test fishery in July maintained a minimum size limit of 26 inches (TL). Approximately 2,050 t (429,200 fish) of dressed chinook salmon were landed by commercial trollers, who fished approximately 17,700 days (fig. 5). Ex-vessel prices for dressed salmon averaged $1.96 per pound, and the total ex-vessel value of the fishery exceeded $8.8 million.

Recreational fishing regulations in California were less restrictive than in 1999, with various time and area closures (open 12 Feb.–12 Nov.). Statewide recreational landings increased by almost 105% compared to the previous year (fig. 6), totaling 179,900 chinook salmon during 208,700 angler trips (catch per unit angler = 0.86). Anglers were limited to two salmon per day (all species except coho) with a minimum size limit of 20 inches TL, except that prior to 1 June the minimum size limit was 24 inches TL. 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

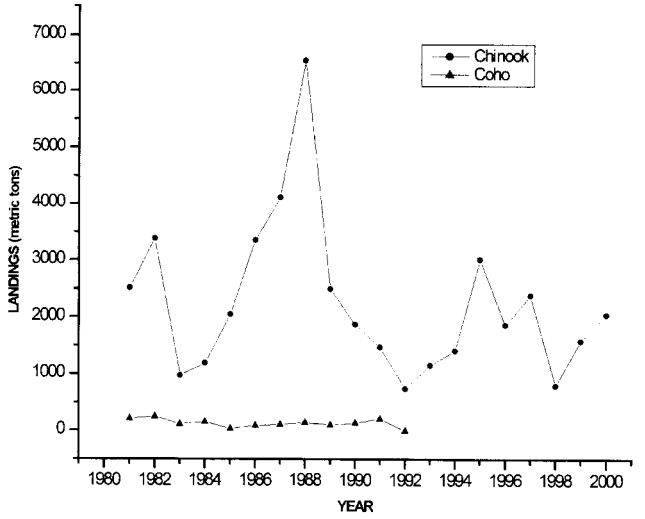

Figure 5. California commercial landings of ocean salmon, 1981–2000.

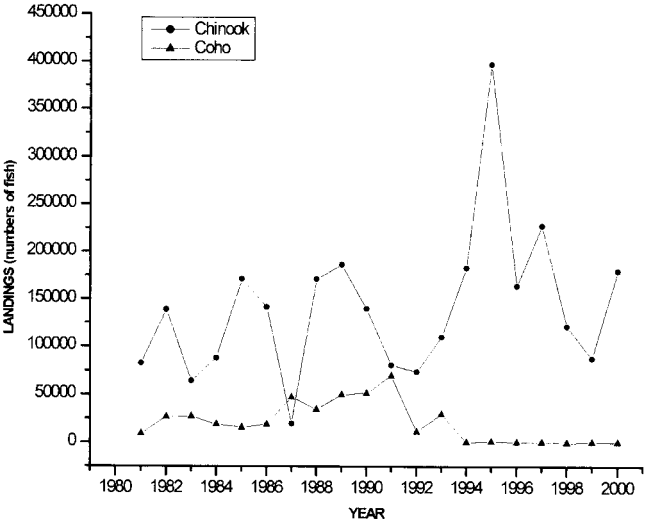

Figure 6. California recreational landings of ocean salmon, 1981–2000.

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: (1) 27 May–6 July, and 29 July–10 September, open all days a week. The bag limit was one salmon per day (all species except coho) during the first season and two salmon per day during the second season, with no more than 6 salmon in 7 consecutive days; there was a 20-inch TL limit north of Horse Mountain. In the California portion of the KMZ, anglers landed 13,200 chinook salmon during 20,000 angler trips made primarily on private skiffs.

Pacific Sardine

Increases in the Pacific sardine (*Sardinops sagax*) fishery continued in 2000, with the year's total landings of 57,935 t being the second highest since the reopening of the directed fishery in 1986 (table 3, fig. 7). The 2000 ex-vessel value of the fishery was $6.3 million, up from $5.0 million in 1999. Approximately 43% of the 2000 harvest guideline was landed, and the directed fishery remained open until year's end. The Coastal Pelagic Species Fishery Management Plan (FMP) states that the annual sardine harvest guideline is to be allocated two-thirds to southern California (south of San Simeon Point, San Luis Obispo County, to the Mexican border) and one-third to northern California (fig. 1). Based on a 1 July 1999 biomass estimate of 1,581,346 t, the harvest formula generated an initial 2000 southern fishery allocation of 124,527 t and a northern allocation of 62,264 t. Neither of these allocations were taken by the fishery during the 2000 season.

The sardine population biomass (age 1+) as of 1 July 2000 was estimated at 1,182,465 t by means of a modified version of the integrated stock assessment model called catch at age analysis of sardine-two area model (CANSAR-TAM). CANSAR-TAM is a forward-casting, age-structured analysis that uses fishery-dependent and fishery-independent data to obtain annual estimates of sardine abundance, year-class strength, and age-specific fishing mortality for 1983 through 1999. CANSAR was modified to account for the expansion of the Pacific sardine stock northward to include waters off the northwest Pacific coast. Based on the 2000 estimate of total biomass (age 1+) and the formula in the FMP, the 2001 sardine fishery opened on 1 January with a harvest guideline of 134,737 t for the California fishery, 28% less than the 2000 allocation.

The ex-vessel price for sardines remained relatively low in 2000. Prices ranged from $22 to $132 per t and averaged $77 per t. Other important target species for the southern California wetfish fleet include Pacific mackerel (*Scomber japonicus*) and market squid (*Loligo opalescens*) in the winter, and tunas in summer. In northern California, Pacific herring (*Clupea pallasi*) is also an important target species from January to March. Squid and tuna command significantly higher ex-vessel prices than sardines: $220 per t for market squid and $240–$1,600 per t for tuna. During 2000, sardine landings varied by month because of availability, demand, and fleet participation in these other fisheries.

In 2000, most Pacific sardine landings in California were sold to market processors (83%) or to canneries (17%). Of the percentage sold to canneries, approximately 13% were canned domestically for human consumption and 4% were processed for pet food. In December 2000, the last southern California cannery to can sardines for human consumption was bought out. The cannery now produces canned tuna and on occasion cans sardine for human consumption. In northern

TABLE 3
Landings of Pelagic Wetfishes 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	58,725	5,179	9,527	963	2,432	90,322	164,945
2000	57,935	11,396	21,053	1,126	3,724	117,686	212,920

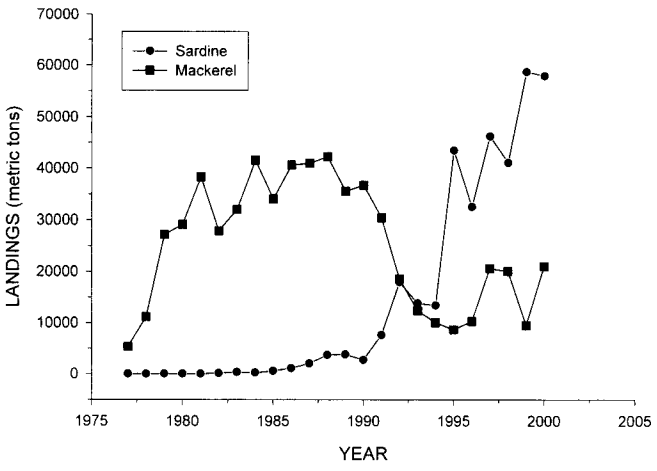

Figure 7. California commercial landings of Pacific sardine and Pacific mackerel, 1977–1999.

California, one cannery continues to can fish for human consumption.

Currently, sardines are processed for human consumption (fresh or canned), pet food, or export. Most of the exports are sold for human consumption or used as feed in aquaculture facilities. Approximately 71% of California's sardine landings were exported in 2000, primarily (95%) as frozen blocks. In 2000, 41,172 t of sardines were exported, up from the 1999 total of 36,089 t. Export revenues totaled $23.33 million at approximately $567 per t. Australia is the major importer of sardines for fish food in aquaculture facilities, while Japan continues to be a large market for sardine for human consumption after the failure of its own sardine fishery.

Aside from the wetfish fishery for sardine, there is a small live bait fishery that is not subject to a harvest guideline and usually takes less than 5,000 t per year. In 2000, the ex-vessel value of the sardine live bait fishery was approximately equal to that of the directed fishery.

Pacific Herring

Pacific herring (*Clupea pallasi*) fisheries for 2000 continued their recovery from the devastating effects of the 1997–98 El Niño. Statewide landings for the 1999–2000 sac roe season (December–March) totaled 3,058 t, a 16.0% increase from the previous season's landings of 2,637 t. Annual sac roe landings increased from 2,207 t to 3,724 t, up 59.3% from the previous year (table 3). Success of the sac roe fisheries continued to be mixed. The San Francisco gill net fleet, composed of three platoons (428 permits), landed 3,051 t, 38.5% under the 4,964 t quota. The Tomales Bay fishery landed a total of 38 t of the 364 t quota. A total of 6.5 t was landed in Crescent City from the 27 t quota, and Humboldt Bay landings totaled 1 t, 2% of the 49 t quota.

Ex-vessel prices for herring with 10% roe recovery averaged about $800 per short ton for gill net landings, with an additional 10% of the base price paid for each percentage point above 10%. The ex-vessel price per ton was higher than in the previous season, reflecting confidence in an improving Japanese economy. Statewide ex-vessel value of the sac roe fishery was an estimated

$3.8 million, a 35.7% increase from last season; however, this was well below the average for the previous fifteen seasons ($9.5 million).

For the third consecutive season, the San Francisco Bay herring eggs-on-kelp fishery landings were well below average. Landings totaled 31 t, 34.4% less than the 90.2 t quota, and the second lowest total on record. Total estimated value of the 1999–2000 eggs-on-kelp harvest was $470,000, based on an estimated ex-vessel price of $7.00 per pound—approximately $2.00 more than prices paid in the previous season. The cost of processing was higher, thus landing marginal product was economically infeasible. As in the 1998–99 season, permittees reported that giant kelp (*Macrocystis pyrifera*) lasted longer while suspended because of higher salinities in the bay; higher salinities were probably due to the lack of early winter storms.

Hydroacoustic and spawn-deposition surveys were conducted by the CDFG 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 1999–2000 herring spawning biomass estimate for the San Francisco Bay population was 24,909 t, a decline of 44.2% from the previous season. Although there was a return to favorable oceanic conditions, and returning herring were in good physical condition, an apparent displacement or loss of older year-class fish (5-year-olds and older) contributed to an unexpected decline in the spawning biomass. Younger herring (2-, 3-, and 4-year-olds) constituted 89% of the biomass.

The Tomales Bay herring spawning biomass continued its tendency to fluctuate widely. The 1999–2000 spawning biomass estimate was 1,828 t, about one-half of the previous season's 3,699 t biomass. The 1999–2000 biomass was well below the 25-year long-term average of 4,343 t, and 25% less than the 7-year average of 2,435 t since the Tomales Bay herring fishery reopened in the 1992–93 season. Length-at-age samples from the 1999–2000 season suggest that age groups 4 and older decreased from the 1998–99 season.

Favorable ocean conditions continued with the prevailing La Niña, and herring fisheries were expected to improve in the 2000–2001 season. But 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 showed normal gonadal development.

Kazunoko remains an integral part of traditional Japanese New Year's festivities. However, continuing volatility in the Japanese economy and changes in the Japanese culture have affected 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 decline with concern for the Japanese economy, and herring buyers were proceeding cautiously and offering lower prices than in the 1999–2000 season.

Pacific Mackerel

The 2000 annual landings of Pacific mackerel (*Scomber japonicus*) in California totaled 21,053 t, a 121% increase from the 1999 total of 9,527 t (table 3, fig. 7). Effort was focused on traditional fishing grounds from Monterey south to the U.S./Mexican border. Ninety-seven 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 2000 because cold oceanic conditions decreased mackerel availability to the northern California fishery.

On the basis of an estimated biomass of 239,286 t on 1 July 1999, the CDFG did not establish a quota for the first half of the 1999–2000 season. On 1 January 2000, management authority for Pacific mackerel was transferred from the CDFG to the National Marine Fisheries Service through the Pacific Fisheries Management Council under the Coastal Pelagic Species Management Plan (FMP). After the transfer of authority, the PFMC used the CDFG biomass estimate to set a harvest guideline of 46,428 t for the period beginning 1 July 1999. The 3,609 t estimated harvest of Pacific mackerel between 1 July 1999 and 31 December 1999 was subtracted from the harvest guideline; therefore, the harvest guideline available to the fishery beginning 1 January 2000 was 42,819 t. Between 1 January 2000 and 30 June 2000 only 3,196 t were landed, 62% in June, when schools of large fish appeared off southern California. The season closed with 39,623 t of the harvest guideline remaining.

Based on an estimated biomass of 128,898 t on 1 July 2000, the PFMC set the harvest guideline at 20,740 t for the 2000–2001 season. The 1 July 2000 biomass estimate was derived from a tuned virtual population analysis (VPA) model called ADEPT and from certain assumptions about recruitment in January of 1999 and fishing mortality during the first half of 2000. The maximum sustainable yield control rule for Pacific mackerel specified in the Coastal Pelagic Species Fishery Management Plan (Amendment 8) was used to calculate the 2001 harvest guideline.

After more than a year of scarce mackerel landings, relatively large mackerel appeared off southern California during the summer of 2000, and the fleet landed 19,617 t (95% of the harvest guideline) by October. Because the harvest guideline includes incidental landings of mack-

erel, the directed fishery for Pacific mackerel was closed on 27 October 2000, with 952 t left of the harvest guideline. An incidental harvest of up to 20% by weight of Pacific mackerel in landings of other species was in effect until the harvest guideline of 20,740 t was reached on 12 March 2001. After 27 March, only 1 ton was allowed per load. This closure will remain in effect until the beginning of the fishing season on 1 July 2001.

The ex-vessel price paid for Pacific mackerel (landings over 1 t) ranged from $44 to $882 per t, with an average of $154 per t. The sale of the catch generated approximately $2.75 million paid to fishermen. The majority of landings less than one t were sold to small specialty markets and dealers. The ex-vessel price for these landings ranged from $22 to $4,410 per t, with an average of $926. Although these landings totaled only 110 t, they generated approximately $64,000.

Approximately 10,200 t (48%) of California's Pacific mackerel landings were exported in 2000, up from the 1999 total of 1,915 t. Export revenues totaled approximately $4.0 million.

Nearshore Live-Fish

Nearshore finfish species are those found within 3 miles of shore and in waters shallower than 40 fathoms. These nearshore species are primarily found in association with kelp beds or on rocky reefs. In accordance with the Marine Life Management Act (MLMA) of 1998, the California Department of Fish and Game is in the process of developing a management plan for the nearshore finfish fishery.

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. Recognition of these important factors was a key reason for developing the Marine Life Management Act. The MLMA mandates the development and enactment of a Nearshore Fishery Management Plan by the beginning of the year 2002 to insure continued viability of these nearshore species at sustainable yield levels. The Nearshore Fishery Management Plan will include a total of 19 species which the CDFG has identified as the nearshore finfish species in need of immediate management attention. These are cabezon, California scorpionfish, California sheephead, kelp and rock greenlings, monkeyface prickleback, and the following rockfish: black, black-and-yellow, blue, brown, calico, China, copper, gopher, grass, kelp, olive, quillback, and treefish. The above 19 species represent the most common species in the nearshore live-fish fishery. All but three (California sheephead, monkeyface prickleback, and rock greenling) of the 19 species are designated as groundfish under the PFMC's fishery management plan for Pacific coast groundfish.

The Nearshore Fishery Management Act of 1998 (NFMA) implemented commercial size limits for the following nearshore species: black-and-yellow rockfish, cabezon, California sheephead, China rockfish, gopher rockfish, grass rockfish, greenlings, kelp rockfish, and the California scorpionfish. The NFMA also requires the possession of a Nearshore Fishery Permit to take, possess, or land any of the ten species.

The nearshore live-fish fishery began in the mid-1980s. Initially, the fishery supplied live fish destined for the California Asian community. The live-fish market has expanded since the 1980s and now supplies California markets as well as markets in other states and, in some cases, other countries. The primary gears used in nearshore waters to capture live fish are various hook-and-line methods and trap gear. Hook-and-line gear includes rod-and-reel, vertical longlines, "sticks," and set horizontal longlines.

Before the start of the nearshore live-fish fishery, the price paid to fishermen (ex-vessel value) for rockfishes, cabezon, California sheephead, and greenlings was low, especially in comparison to fish such as salmon and California halibut. Since the development of the live-fish fishery, fish buyers and consumers have been willing to pay much higher prices. For example, the average ex-vessel value of cabezon was less than $.50 per pound in 1989, but was $3.63 per pound in 2000. The target species and the fishing methods of the current fishery are driven by this demand for high-quality, fresh, live fish. In 2000, the ex-vessel value for live fish was approximately $2.5 million.

Landing receipts, also commonly called market receipts, are the primary source of data used to describe commercial fishing activity. By law, a fish buyer must complete a landing receipt at the time fish are delivered. The buyer must provide data for each transaction and include weight of the fish landed, price paid to the fishers, and the condition of the fish (e.g., live). Fish are recorded as market categories rather than under species-specific names. This often means that a particular market category (e.g., China rockfish) may actually contain several different species. In the nearshore fishery, fish that have been landed live are not always recorded as live on the landing receipt. In such cases it can be difficult to discern live landings from dead landings. Sometimes, price per pound serves as an indicator of fish condition: a higher price can indicate a live fish. Because of this discrepancy, landing weights given in this review should be assumed to be low estimates of the actual live-fish landing weights. It should also be noted that the condition (live or dead) of fish being landed was not required on landing receipts prior to 1993. Therefore, data used

in this text generally refer to the period from 1993 through 2000.

Several regional differences exist in the nearshore live-fish fishery. Many of these are due to the fact that several of the 19 species have different geographic ranges. South of Point Conception, California sheephead and California scorpionfish are the primary species landed live. In central California, from Point Conception to Cape Mendocino, the species composition of the live-fish landings is more diversified. While the "group bolina" (consisting mostly of brown rockfish) is the most common market category, landings of several other market categories such as cabezon, kelp greenling, black rockfish, blue rockfish, and China rockfish are also reported for central California.

The year 2000 was the first year that the PFMC put into place a regularly scheduled two-month fishery closure for all nearshore rockfish. South of Lopez Point (Monterey County), taking nearshore rockfish was prohibited during January and February. Between Lopez Point and Cape Mendocino (Humboldt County), taking nearshore rockfish was prohibited during March and April. There was no closed season north of Cape Mendocino. In January 2000, a two-month cumulative limit for nearshore rockfish (defined by PFMC as the 13 rockfish species listed above and California scorpionfish) was set at 2,400 pounds for limited entry fixed gear permits north of Cape Mendocino, and 1,000 pounds south of Cape Mendocino. The open access fishery two-month cumulative limits were set at 1,000 pounds north of Cape Mendocino and 550 pounds south of Cape Mendocino.

Although final landings data from commercial landing receipts for the nearshore live-fish fishery have not yet been tallied for the 2000 season, it is expected and evidenced in preliminary summaries that the closures and two-month cumulative limits did indeed lower the annual harvest of all nearshore rockfish species. However, landings of live nearshore rockfish species decreased only slightly in 2000 (fig. 8) and consequently accounted for 76% of the overall nearshore catch. In the previous seven years since the CDFG has been recording live landings, the next highest percentage of live fish in nearshore species landings was 58% in 1999. This was most likely because fishermen could not land as many total nearshore rockfish in 2000 and therefore sought to sell what they could land in live condition, thereby receiving a higher price per pound.

CDFG observations have shown that during the rockfish closures, fishing effort in some areas was shifted toward other nearshore species that can be marketed live. One such example are the surfperch (Embiotocidae) in the San Francisco port area. Although surfperch have been commonly landed commercially in the area for the past several years, they were marketed primarily live only

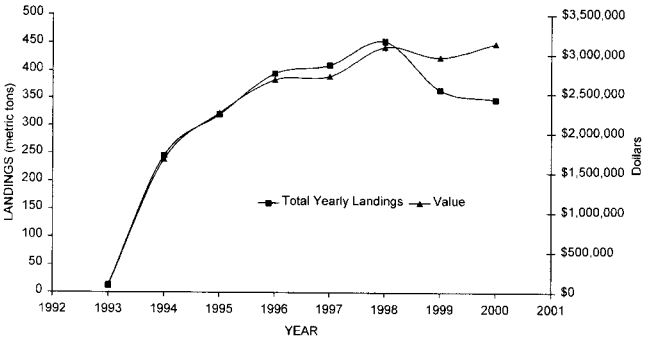

Figure 8. California nearshore live-fish landings, 1993–2000.

during and after the PFMC two-month rockfish closures. Presumably, fishers and dealers needed to sell the surfperch live (at premium prices) to make up for profit losses due to the rockfish closures.

Although total landing weight of live nearshore finfish declined slightly in 2000 (346 t), landings have remained relatively high over the past several years since the dramatic increase in the live-fish fishery in the early 1990s (fig. 8). The value of the nearshore live-fish fishery has continued to increase since the beginning of the fishery; 1999 and 2000 were the first years in which the value of the fishery continued to increase while annual landings decreased (fig. 8). This is presumably because live fish reach higher and higher ex-vessel values as supplies decrease because of environmental factors, depleted stocks, and regulatory changes. Given this scenario, it is likely that the percentage of nearshore finfish marketed live will remain high and possibly continue to increase.

There were 618 vessels landing nearshore fish species in 2000. The number of hook-and-line vessels landing nearshore species peaked in the early 1990s (at 1,138 vessels in 1990) and has declined by approximately 43% since 1990. Throughout the period from 1990 through 2000, more than half the vessels landed less than 1,000 pounds of nearshore fish per year, with from 16% to 22% landing less than 100 pounds. Most vessels (85%–92%) made fewer than 25 landings per year. Presumably, many of the smaller landings were primarily live fish. Most of the hook-and-line and trap vessels (which account for most of the live fish landed) used in the nearshore region ranged from 20 to 39 feet in length.

As the nearshore live-fish fishery continues, and in some port areas increases, there is a real potential for localized depletion of targeted fish stocks. Conflicts among user groups are also a major concern, particularly as the issue of resource allocation among groups is discussed by fishery managers and constituents involved in the development of the Nearshore Fishery Management Plan. There is a clear need to determine accurate fishing patterns on both temporal and spatial scales. Developing

TABLE 4
California Commercial Halibut Landings (Metric Tons)

Port	1999 Catch (t)	1999 Percentage of catch	1999 Value ($)	2000* Catch (t)	2000* Percentage of catch	2000* Value($)
Eureka	2.95	0.5	13,027	0.421	0.11	2,016
Fort Bragg	0	0	0	0.476	0.12	150
Bodega Bay	10.89	1.8	54,615	6.84	1.8	41,818
San Francisco	203.53	34.19	1,052,119	126.57	33.36	731,298
Monterey	90.16	15.15	368,063	20.61	5.43	101,754
Morro Bay	35.16	5.91	187,792	18.23	4.81	109,789
Santa Barbara	134.62	22.62	808,956	94.86	24.99	620,640
Los Angeles	99.33	16.7	673,155	86.48	22.79	630,617
San Diego	18.6	3.13	114,589	24.96	6.59	175,108
Totals	595.24	100	3,272,316	379.53	100	2,413,190

*Preliminary data

TABLE 5
CPFV Landings of California Halibut (Numbers of Fish Caught), 1993–2000

Location	Year 1993	1994	1995	1996	1997	1998	1999	2000*
State total	5,335	7,549	19,345	19,092	15,574	12,191	14,339	15,328
N. California	1,449	4,134	13,664	13,263	7,964	7,357	5,054	5,098
S. California	3,886	3,415	5,681	5,289	7,880	4,834	9,285	10,230

*Preliminary data

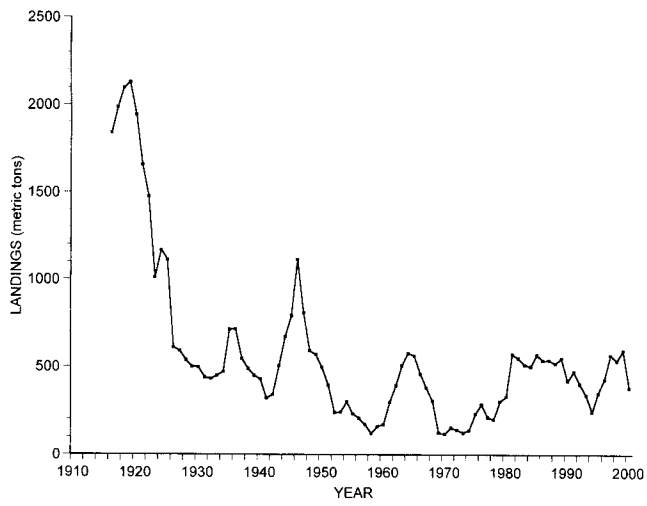

Figure 9. California commercial landings of California halibut, 1916–2000.

indices of abundance is also likely to become a top priority among fishery managers and researchers hoping to promote a sustainable nearshore fishery.

California Halibut

Commercial landings of California halibut (*Paralichthys californicus*) totaled approximately 380 t in 2000 (table 4), a 36% decrease from the 595 t landed in 1999 (fig. 9), which was the highest yearly landing since 1947. Except for a small decline 1998, landings in 2000 marked the end of an upward trend that began in 1995. Northern California ports dominated halibut catch statewide from 1995 to 1999.

San Francisco led the state in halibut landings, with 33% of the total catch by weight, followed by Santa Barbara (25%), and Los Angeles (23%). Halibut landings decreased at all ports except Fort Bragg and San Diego; only 41% of the landings came from Monterey and ports to the north, compared to 52% in 1999. The shift in landings to more southerly ports reverses a trend that began with the statewide increase in commercial halibut landings in 1995. However, there is some evidence from sport fishery data to indicate the reemergence of the northern California ports' dominance.

The 1995 statewide increase in commercial halibut landings was echoed by the increased sport catch of halibut by commercial passenger fishing vessels (CPFVs; table 5) and other recreational modes of sportfishing (table 6). During the dramatic 1995 increase, the greatest portion of the catch came from northern California. Unpublished CDFG halibut creel survey data from northern California in 1995 showed a very large year-class of halibut approaching sport and commercial legal size (22 in). On the basis of published growth rates for California halibut, this was estimated to have been the 1992 year-class. El Niño conditions existed along much of the California coast in 1992, possibly conducive to good reproductive success for halibut in northern California and beyond. Little subsequent recruitment of halibut in northern California was detected by sport creel

TABLE 6
Estimated Annual Catch (Fish Kept) in Thousands of California Halibut by Marine Recreational Anglers for All Modes of Fishing in All Marine Areas

	Year							
Location	1993	1994	1995	1996	1997	1998	1999	2000*
State total	66	104	337	147	92	106	130	165
N. California	31	52	267	87	46	44	25	59
S. California	35	52	70	60	46	62	105	106

Source: Marine Recreational Fisheries Statistics Survey
*Preliminary data

TABLE 7
Yellowfin Tuna Prices by Gear Type, 2000

	Price per pound ($)			Average/metric ton (2,240 lbs)	Total pounds
Gear	Average	Minimum	Maximum		
Hook-and-line	1.20	0.50	1.75		11,309
Trawl	1.16	0.32	2.00		258
Gill net	1.35	0.50	2.50		1,327
Purse seine	0.66	0.11	1.50	1,478.40	2,436,399

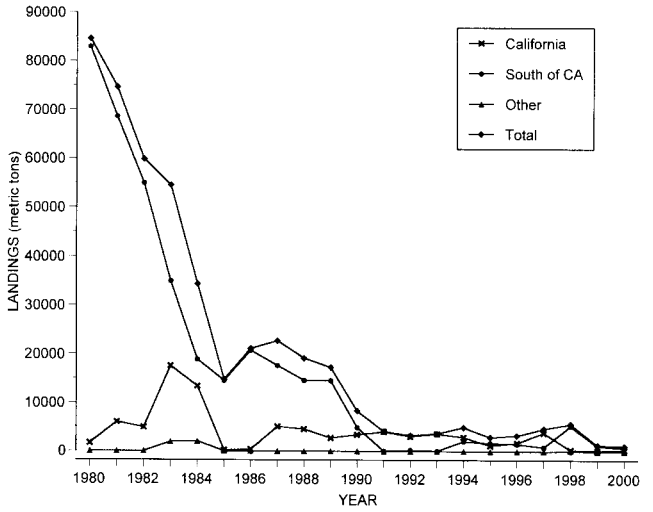

Figure 10. Commercial yellowfin tuna landings, 1980–2000.

surveys or reported by commercial fishermen until 2000, when sublegal halibut (1997 El Niño year-class) were caught and released in large numbers by both commercial and sport fishers.

Total preliminary value for halibut landings in California for 2000 was $2.41 million. The statewide ex-vessel price per pound for halibut ranged from $1.00 to $7.50, with an average of $2.88 per pound. Ports south of Monterey averaged about $.50 more per pound than ports to the north, probably because of a more developed live-fish market in southern California. Some northern California commercial fishers landed dressed or bled fish in order to receive a higher price per pound. Total commercial trawl effort for halibut has increased because of increased restrictions on groundfish species. The increased availability of commercial halibut can flood local markets and depress ex-vessel price per pound.

Yellowfin Tuna

Total commercial landings of yellowfin tuna (*Thunnus albacares*) have declined dramatically since 1980, when landings were almost 100 times as high as in 2000 (fig. 10). Much of this decline may be due to the shift in fishing effort and processing to the western Pacific. Commercial landings and imports of yellowfin tuna in 2000 were slightly under 1,140 t. Domestic fishers reported landing 368 t from California waters. Landings from Mexico and areas to the south accounted for 761 t, and landings from other areas accounted for 11 t. One reason for this sharp decline in California waters was that Mexico closed its waters to U.S. fishers in 1981–82. Most of the yellowfin tuna was taken by purse seine vessels, with minor landings from hook-and-line, troll, and longline vessels. Most of the fish were canned; the remainder were delivered to the fresh fish market, where tuna command higher ex-vessel prices of $240–$1,600 per ton (table 7).

Yellowfin tuna are occasional visitors to southern California: their presence depends on oceanographic conditions. When there is a strong El Niño event, such as that in 1983, yellowfin tuna can be found in abundance. They are also frequently taken when local warming of the ocean extends from Baja California, Mexico, into southern California. Such episodes can occur independently, yet the local abundance of tuna can match that during El Niño events. The year 2000 was a period of local warming, and yellowfin tuna were relatively abundant in California.

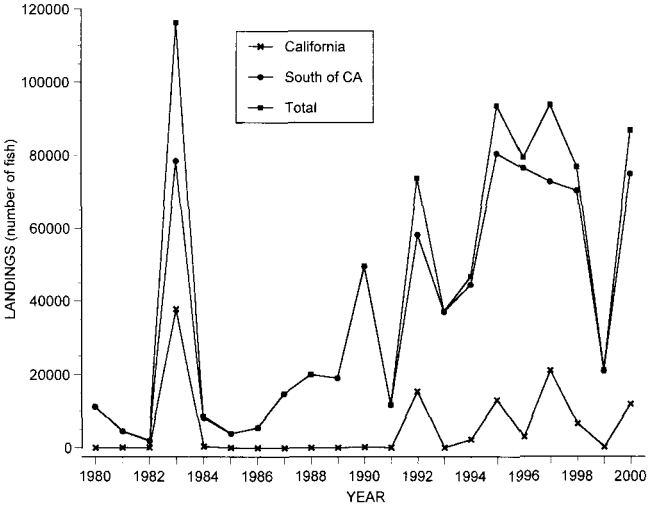

Figure 11. Recreational yellowfin tuna landings, 1980–2000.

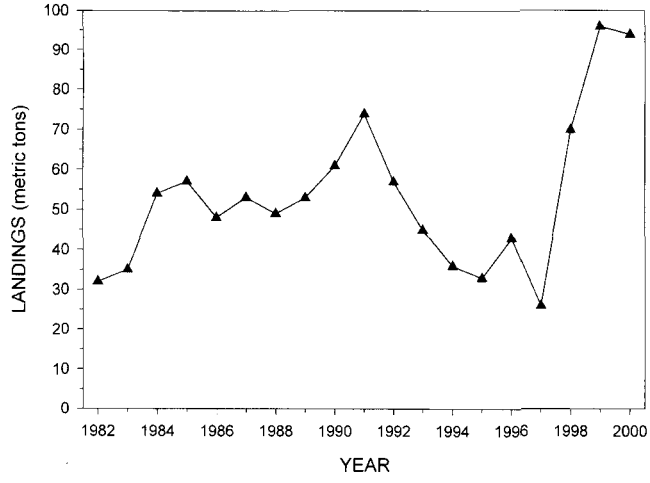

Figure 12. California commercial landings of white seabass, 1982–2000.

Sport anglers operating from California ports landed 119,797 yellowfin tuna in 2000 (fig. 11). Commercial passenger fishing vessels reported catching 11,940 fish in U.S. waters and 74,857 in Mexican waters. Private boat catches for vessels in U.S. waters were estimated by the Marine Recreational Fisheries Statistics Survey (MRFSS) at 33,000 fish. No catch estimates for private boats were available for trips in Mexican waters. Average weights from MRFSS sampling indicate that CPFV anglers landed a minimum 626 t of yellowfin tuna while private boat anglers landed 181 t. These figures represent low estimates, since longer trips, which usually catch bigger fish, were not sampled.

White Seabass

White seabass (*Atractoscion nobilis*) is the largest member of the Sciaenid family harvested from California's nearshore waters and islands. It can grow to 1.5 m and

TABLE 8
California 2000 Commercial White Seabass Landings

Port	Catch (t)	Ex-vessel value
Los Angeles	45	$188,630
Santa Barbara	30	$138,278
Monterey	11	$46,251
San Diego	7	$37,237
Morro Bay	2	$8,070
San Francisco	1	$5,534

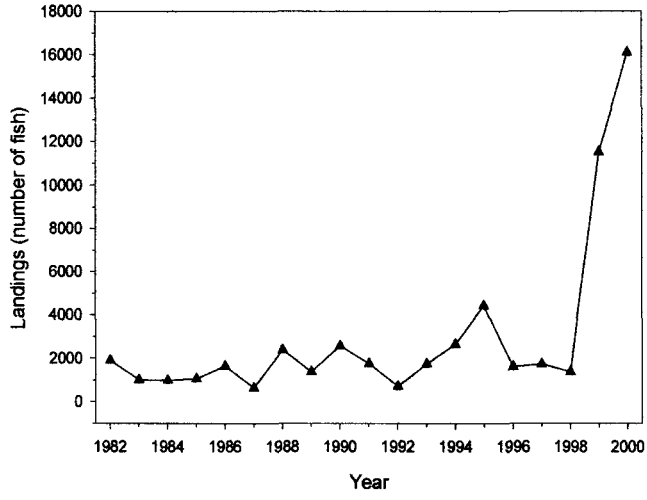

Figure 13. California commercial passenger fishing vessel (CPFV) landings of white seabass, 1982–2000.

weigh 36 kg, making it one of California's premier game fish. The commercial component of this fishery supports a relatively low-volume, high-quality domestic industry.

A summary of CDFG's Commercial Fisheries Information System preliminary data indicates that white seabass landings totaled 96 t in 2000, a 14% decrease from 1999 (fig. 12). Fish markets from San Diego to San Francisco reported white seabass landings; most were made at fish markets south of Point Conception (table 8). Fish dealers paid from $.50 to $7.00 per pound for white seabass, for an estimated total annual ex-vessel price of $424,000. The average price per pound was $2.20, up $.29 from 1999, when landings reached an 18-year high.

Over 80% of the commercial landings statewide were made between June and August, following the 15 March–15 June seasonal closure. In 2000, white seabass were harvested primarily by gill net gear: 69% by set gill net and 16% by drift gill net. Additional gears used to harvest white seabass included hook-and-line (14%) and trawl (1%). The percentage of white seabass harvested by hook-and-line gear increased threefold from 1999 to 2000. Premium hook-and-line-caught white seabass commanded the highest price per pound in 2000.

A summary of CPFV logbook data indicated that recreational anglers landed approximately 16,100 white seabass in 2000, up 28% from 1999 (fig. 13). Over 60%

of the reported landings were made between April and August, despite a reduction in the daily bag limit from three to one fish per angler from 15 March to 15 June. Logbook data indicated that most fish (67%) were caught around southern California's Channel Islands; the rest (33%) were taken at isolated spots along the mainland from San Diego to San Francisco.

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 important to sport or commercial fishing in California waters south of Point Arguello. Since 1989, white seabass has been OREHP's primary species for research. Approximately 333,918 OREHP-produced juvenile white seabass were released into the ocean from 1990 through 2000, when 27,845 were released. Each OREHP-produced fish is tagged with coded wire at the hatchery before being transported to a grow-out facility. There are now twelve grow-out facilities located 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 from the grow-out site or nearby. As of May 2001, only four legal-size (711 mm) OREHP-produced fish are known to have recruited into the white seabass fishery.

Under the authority of the Marine Life Management Act of 1998, the CDFG is revising the original white seabass FMP submitted to the Fish and Game Commission and the state legislature in 1996 for adoption as a management tool. At that time, the FMP required the approval of both the commission and the legislature before it could be implemented. The commission adopted the FMP as a management tool, but the legislature did not, so the plan was not implemented. The current FMP is being revised according to the guidelines outlined in the MLMA. One of the key aspects of the 1998 act was the transfer of regulatory authority over most commercial fisheries from the legislature to the commission. The revised white seabass FMP is due to the commission in June 2001 for adoption by 1 January 2002.

KELP

Giant kelp (*Macrocystis pyrifera*) has been commercially harvested along the California coast since the early 1900s. It was initially harvested for potash and acetone for use in manufacturing explosives during World War I. The Kelco Company (now ISP Alginates Inc.) began harvesting in 1929 and processing giant kelp for algin, which is used in a wide variety of food processing, pharmaceutical, and manufacturing operations. Revenues generated from algin manufactured in California by ISP

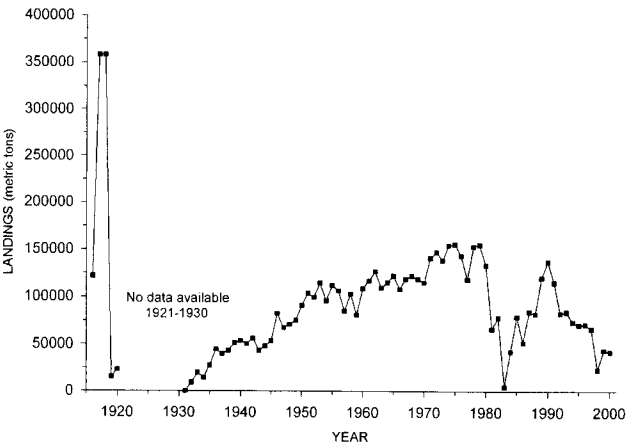

Figure 14. California harvest of giant kelp, 1916–2000.

Alginates during the 1990s were approximately $40 million annually. In 2000, the algin industry accounted for approximately 92% of the total harvest, and total landings in California were 41,913 t (fig. 14). Giant kelp is also harvested for abalone food by the abalone aquaculture industry, and spawning substrate is harvested by the herring-roe-on-kelp fishery. Recreational users harvest kelp for food, basket making, ceramic art, and compost. The estimated annual harvest by recreational users is less than 0.1% of the total harvest.

Giant kelp is harvested in California state waters from the U.S./Mexico border north to Monterey Bay. There are 88 designated kelp beds statewide, 34 of which are open to harvest by anyone possessing a valid kelp-harvesting permit. Specific beds may be leased for up to 20 years, but no more than 25 square miles or 50% of the total kelp bed area may be leased by any single harvester. The CDFG has designated 34 beds as nonleasable to ensure that smaller harvesters will have access to kelp and not be shut out by lease agreements. In addition to the purchase of a kelp-harvesting permit, regulations require that harvesters cut kelp no deeper than 1.2 m below the surface, and weigh and report the amount they harvest by date and bed number. Kelp harvesters paid approximately $79,000 in royalties to the CDFG in 2000, or $1.71 per ton of wet kelp harvested.

Annual harvests have varied considerably, from a high of nearly 360,000 t in 1917–18 to less than 900 t in the early 1930s (fig. 14). The annual harvest during the 1970s averaged nearly 136,000 t, whereas in the 1980s the annual average was only 72,800 t. This decline was due to the intense El Niño of 1982–83 and the "200-year storm" in January 1988, both of which destroyed much of the existing canopies in southern and central California. The steep decline in landings since 1990 is due primarily to changes in the world sodium alginate market and is not a result of reduced kelp canopies. In response to increased competition from overseas harvesters, ISP Alginates

streamlined its California production strategy and shifted its emphasis toward high-quality algin products. As a result, ISP Alginates has reduced its kelp harvest in California waters by nearly 50% since 1990.

ISP Alginates operates several kelp-harvesting vessels ranging in length from 43 to 49 m and capable of harvesting up to 544 t of wet kelp in one day. The abalone aquaculture industry harvests kelp with a variety of vessels ranging from small skiffs to a modified 18 m U.S. Navy landing craft. North of the Monterey Peninsula, kelp is harvested primarily by hand from small skiffs.

In the year 2000 biologists studied the results of the 1999 kelp fly-over to repeat assessments made in 1967 and 1989. The total area occupied by kelp canopy decreased from approximately 70 square miles in 1967 to 40.7 in 1989 and 17.8 in 1999. Kelp canopies throughout the state have declined, particularly those in southern California. This decline can be attributed to both natural disturbances such as warm-water stress and intense storms associated with El Niño, and human-caused disturbances such as increased turbidity and siltation associated with coastal development, pollution, and fishing activities. Commercial and recreational fishers remove animals such as California sheephead and California spiny lobster, which help sustain kelp forests through trophic interactions.

Bull kelp (*Nereocystis luetkeana*) is another commercially important species. Unlike the perennial giant kelp, bull kelp is an annual that grows in the cool, nutrient-rich waters of northern and central California. Bull kelp is harvested primarily by the abalone mariculture industry for abalone feed, although small amounts are harvested incidentally by the algin industry and for human consumption. Bull kelp accounts for a tiny fraction (<1%) of the total kelp harvested in California waters, mainly because it has low algin content and is considered inferior to giant kelp for abalone feed.

The CDFG has recently completed an environmental review of giant and bull kelp commercial and sport harvesting regulations. As a result of this review, and based on public and interagency input, a number of amendments to the regulations governing the commercial harvest of kelp have been adopted. The more substantial amendments include (1) requiring harvesters to obtain Fish and Game Commission approval of a harvest plan before a mechanical harvester can be used for giant kelp in central and northern California; (2) adding a seasonal closure (1 April–31 July) for harvesting bull kelp from open beds that lie partially or totally within the boundary of the Monterey Bay National Marine Sanctuary; (3) increasing the number of beds closed to harvest; (4) closing a portion of a bed in Monterey County that experiences heavy seasonal harvest pressure; and (5) creating a mechanism for restricting harvest by imposing temporary harvest controls where necessary for resource protection.

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