# APPENDIX A
# DESCRIPTION OF THE COASTAL PELAGICS FISHERY

Page

## 1.0 DESCRIPTION OF THE COASTAL PELAGICS FISHERY

The fishery for coastal pelagic species (CPS) consists of fish stocks and parties involved in their commercial harvest, commercial use, recreational harvest, and recreational use. Table 1.0-1 lists the CPS that are currently or could potentially be harvested. Not all of those species will be included under the fishery management plan (FMP) for CPS at the outset. The species to be included are northern anchovy, jack mackerel, Pacific sardine, Pacific (chub) mackerel, and market squid. Of these, only Pacific sardine and Pacific (chub) mackerel will be actively managed at the outset. Northern anchovy, jack mackerel, and market squid will be monitored only. Species included in the plan and the type of management applied to each species can be changed in the future under framework management procedures without amending the FMP.

Most CPS and the fishing they support are distributed internationally with components in the exclusive economic zones (EEZ) of Canada and Mexico as well as in international waters outside the U.S. EEZ. Individual components of the CPS fishery may include U.S. commercial fisheries; foreign catcher and processor vessels in U.S., Mexican, Canadian, and international waters; foreign vessels engaged in joint ventures (JVs) with domestic commercial vessels; party and charter boats; and anglers who target CPS or use them as bait. No tribal fisheries utilize CPS in the U.S. at this time, although a small Tribal fishery exists in British Columbia.

CPS are taken directly or as bycatch in fisheries that use many types of gear and vessels. Gears used to harvest CPS by directed fishing are primarily "round-haul" gear including purse seines, drum seines, lampara nets, and dip nets. CPS are taken incidentally with midwater trawls, pelagic trawls, gillnets, trammel nets, trolls, pots, hook-and-line, and jigs.

TABLE 1.0-1. CPS, other pelagic, or midwater fish.

| | |
|---|---|
| Pacific saury | *Cololabis saira* |
| northern anchovy (central subpopulation)[a/] | *Engraulis mordax* |
| northern anchovy (northern subpopulation) | *Engraulis mordax* |
| market squid[a/] | *Loligo opalescens* |
| Pacific bonito | *Sarda chiliensis* |
| Pacific herring | *Clupea harengus* |
| Pacific sardine[a/] | *Sardinops sagax* |
| Pacific (chub or blue) mackerel[a/] | *Scomber japonicus* |
| jack (Spanish) mackerel[a/] | *Trachurus symmetricus* |

a/ Fisheries actively managed under this plan.

### 1.1 Northern Anchovy

Information about the biology of northern anchovy is available in Frey 1971; PFMC 1983 and 1990a; and in the references cited below.

#### 1.1.1 Distribution and Habitat

Northern anchovy are distributed from the Queen Charlotte Islands, British Columbia to Magdalena Bay, and Baja California, and anchovy have recently colonized the Gulf of California. The population is divided into northern, central and southern subpopulations or stocks. The northern subpopulation supports a small bait fishery (one boat to four boats) off the coasts of Oregon and Washington that is described below. The southern subpopulation is entirely within Mexican waters. The central subpopulation, which supports significant commercial fisheries in the U.S. and Mexico, ranges from approximately San Francisco, California; to Punta Baja, Baja California. The bulk of the central subpopulation is located in the Southern California Bight, a 20,000-square-nautical-mile area bounded by Point Conception, California, in the north and Point Descanso, Mexico, (about 40 miles south of the U.S.-Mexico boarder) in the south.

Northern anchovy in the central subpopulation are typically found in waters that range from 12°C to 21.5°C; however, laboratory-defined lethal temperatures occur at 7°C and 29°C (Brewer 1976). There is a great deal of regional variation in age composition and size with older and larger anchovy found farther offshore and to the north (Parrish et al. 1985). The pattern is accentuated in warm years and during the summer (Methot 1989).

### 1.1.2 Life History

Northern anchovy are small, short-lived fish typically found in schools near the surface. Northern anchovy rarely exceed four years of age and 18 cm total length, although individuals as old as seven years and 23 cm have been recorded. Natural mortality is thought to be M = 0.6 yr to 0.8 $yr^{-1}$, which means that 45% to 55% of the total stock would die each year of natural causes if no fishing occurred. Northern anchovy eat phytoplankton and zooplankton by either filter feeding or biting, depending on the size of the food.

Anchovy spawn during every month of the year, but spawning increases in late winter and early spring and peaks from February to April. Preferred spawning temperature is 14°C and eggs are most abundant at temperatures of 12°C to 16°C. Females spawn batches of eggs throughout the spawning season at intervals as short as seven days to ten days. The eggs, found near the surface, are typically ovoid and translucent and require two days to four days to hatch, depending on water temperatures. Both the eggs and larvae are found near the surface. Anchovy in the central subpopulation are all sexually mature at age two. The fraction of one-year-olds that is sexually mature in a given year depends on water temperature and has been observed to range from 47% to 100% (Methot 1989). This phenomenon affects estimates of spawning population.

Northern anchovy are subject to natural predation throughout all life stages. Eggs and larvae fall prey to an assortment of invertebrate and vertebrate planktivores. As juveniles, anchovy are vulnerable to a wide variety of predators, including many recreationally and commercially important species of fish. As adults, anchovy are fed upon by endangered salmon stocks, endangered birds (California brown pelican *Pelecanus occidentalis californicus* and least tern *Sterna albifrons browni)*, numerous fish (some of which have recreational and commercial value), mammals, and birds. Links between brown pelican breeding success and anchovy abundance have been documented (Anderson et al. 1980, 1982; Jacobson and Thomson 1989). Other species known or suspected to feed on northern anchovy are listed in Table 1.1.2-1.

TABLE 1.1.2-1. Known or suspected predators of northern anchovy, Pacific sardine, squid, and other small pelagic fish.

| | |
|---|---|
| **MARINE MAMMALS** | |
| *Callorhinus ursinus* | Northern fur seal |
| *Arctocephalus townsendi* | Guadalupe fur seal |
| *Eumetopias jubatus* | Steller's sea lion |
| *Zalophus californianus* | California sea lion |
| *Mirounga angustirostris* | Northern elephant seal |
| *Phoca vitulina* | Harbor seal |
| *Delphinus delphis bairdi* | Common dolphin |
| *Phocoena phocoena* | Harbor porpoise |
| *Phocoenoides dalli* | Dall's porpoise |
| *Lagenorhynchus obliquidens* | Pacific white-sided dolphin |
| *Tursiops truncatus* | Bottlenose dolphin |
| *Globicephala macrorhynca* | Pilot whale |
| *Balaenoptera musculus* a/ | Blue whale a/ |
| *Balaenoptera physalus* a/ | Fin whale a/ |
| *Balaenoptera borealis* | Sei whale |
| *Balaenoptera acutorostrata* | Minke whale |
| *Balaena glacialis* a/ | Pacific right whale a/ |
| *Megaptera novaeangliae* a/ | Humpback whale a/ |
| *Eschrichtius robustus* a/ | California grey whale |
| **MARINE BIRDS** | |
| *Diomedea nigripes* | Black-footed albatross |
| *Fulmarus glacialis* | Fulmar |
| *Puffinus griseus* | Sooty shearwater |
| *Puffinus puffinus* | Manx shearwater |
| *Oceanodroma leucorhoa* | Leach's petrel |
| *Oceanodroma homochroa* | Ashy petrel |
| *Loomelania melania* | Black petrel |
| *Pelecanus occidentalis* a/ | Brown pelican a/ |
| *Phalacrocorax auritus* | Double-crested cormorant |
| *Phalacrocorax penicillatus* | Brandt's cormorant |
| *Phalacrocorax pelagic us* | Pelagic cormorant |
| *Lards glaucescens* | Glaucous-winged gull |

TABLE 1.1.2-1. Known or suspected predators of northern anchovy, Pacific sardine, squid, and other small pelagic fish.

| | |
|---|---|
| *Lards occidentalis* | Western gull |
| *Lards heermanni* | Heerman's gull |
| *Lards delawarensis* | Ring-billed gull |
| *Lards californicus* | California gull |
| *Rissa tridactyla* | Black-legged kittiwake |
| *Uria aalge* | Common murre |
| *Cepphus columba* | Pigeon guillemot |
| *Brachyramphus marmoratum* | Marbled murrelet |
| *Endomychura craveri* | Craveri's murrelet |
| *Endomychura hypoleuca* | Xantu's murrelet |
| *Synthliboramphus antiquum* | Ancient murrelet |
| *Ptychoramphus aleutica* | Cassin's auklet |
| *Cerorhinca monocerata* | Rhinoceros auklet |
| *Fratercula corniculata* | Horned puffin |
| *Lunda cirrhata* | Tufted puffin |
| *Haliaeetus leucocephalus* a/ | Bald eagle a/ |
| *Pandion haliaetus* | Osprey |
| *Sterna elegans* | Elegant tern |
| *Sterna caspia* | Caspian tern |
| *Sterna forsteri* | Forster's tern |
| *Sterna albifrons browni* a/ | Least tern a/ |
| **MARINE FISH** | |
| *Engraulis mordax* | Northern anchovy |
| *Sardinops sagax caeruleus* | Pacific sardine |
| *Merluccius productus* | Pacific whiting |
| *Alopias vulpinus* | Common thresher shark |
| *Isurus oxyrinchus* | Bonito shark |
| *Galeorhinus zyopterus* | Soupfin shark |
| *Prionace glauca* | Blue shark |
| *Torpedo californica* | Pacific electric ray |
| *Oncorhynchus kisutch* | Silver (coho) salmon |
| *Oncorhynchus tshawytscha* | King (chinook) salmon |
| *Oncorhynchus mykiss* | Steelhead |
| *Sebastes spp.* | Rockfish (many species) |
| *Roccus saxatilis* | Striped bass |
| *Paralabrax nebulifer* | Barred sand bass |
| *Paralabrax clathratus* | Kelp bass |
| *Paralabrax maculatofasciatus* | Spotted sand bass |
| *Caulolatilus princeps* | Ocean whitefish |
| *Trachurus symmetricus* | Jack mackerel |
| *Seriola dorsalis* | Yellowtail |
| *Atractoscion nobilis* | White seabass |
| *Seriphus politus* | Queenfish |
| *Menticirrhus undalatus* | California corbina |
| *Genyonemus lineatus* | White croaker |
| *Embiotocidae spp.* | Surfperches (many species) |
| *Sphyraena argentea* | California barracuda |
| *Scomber japonicus* | Pacific (chub) mackerel |
| *Sarda chiliensis* | Pacific bonito |
| *Thunnus alalunga* | Albacore |
| *Thunnus thynnus* | Bluefin tuna |
| *Xiphias gladius* | Swordfish |
| *Tetrapturus audax* | Striped marlin |
| *Onchorhynchus mykiss* | Steelhead salmon |
| *Ophiodon elongatus* | Lingcod |
| *Scorpaena guttata* | Scorpionfish |
| *Squalus acanthius* | Dogfish |
| *Stereolepis gigas* | Giant seabass |
| *Hypoglossus stenolepis* | Pacific halibut |
| *Paralichthys californicus* | California halibut |
| **INVERTEBRATES** | |
| *Loligo opalescens* | Market squid |
| *Decapoda (oegopsida)* | Ocean squids |

a/ An endangered species.

### 1.1.3 Abundance, Recruitment, and Population Dynamics

Information about changes in anchovy abundance during 1780 through 1970 is available from scale counts from sediment cores obtained from the Santa Barbara and Soledad basins off California (Soutar and Issacs 1969; 1974). These data indicate significant anchovy populations existed throughout the period and that biomass levels during the late 1960s were modest relative to levels during most of the 19th century and early 20th century. Scale counts and recent experience indicate that northern anchovy vary less over time than Pacific sardine.

Recent biomass estimates (fish age over one year) for the central subpopulation of northern anchovy from 1964 to 1995 (Jacobson et al. 1995) indicate that biomass averaged 326,000 metric tons (mt) until 1970, increased rapidly to 1,598,000 mt in 1974, and then declined to 521,000 mt in 1978 (Table 1.1.3-1). During the early 1990s biomass declined to about 150,000 mt and then increased to 388,000 mt in 1995 (Jacobson et al. 1995). No new stock assessment has been made, but available evidence indicates that the 1997 abundance is at least as high as during 1995 (Jacobson et al. 1997)

Recruitment of northern anchovy is more variable than for most clupeoid fish (Beddington and Cooke 1983; Myers et al. 1990). The standard deviation of annual log scale recruitment estimates for northern anchovy from 1964 to 1990 was 0.71 (Jacobson and Lo 1991). Strong year classes were observed in about seven years during that period (Table 1.1.3-1).

The age at which northern anchovy become vulnerable to fishing depends on location and type of fishery. They probably become vulnerable to the live bait fishery at an earlier age than to the reduction fishery. Substantial numbers of zero and one-year-old fish are taken by both fisheries in most years.

Maximum sustainable yield (MSY) for northern anchovy in the central subpopulation is estimated to be 123,000 mt per year at a total biomass level of about 733,000 mt (Conrad 1991). As for other pelagic species, MSY should be viewed as a rough indicator of stock productivity or long-term average harvest potential rather than as a management goal, because stock size and potential catches may vary dramatically from year to year (Beddington and May 1977).

### 1.1.4 Fishery Utilization

Northern anchovy in the central subpopulation are harvested by commercial fisheries in California and Mexico for reduction, human consumption, live bait, dead bait, other nonreduction commercial uses. Anchovy landed in Mexico are used primarily for reduction, although small amounts are probably used as bait. Small quantities of the northern subpopulation are taken off Oregon and Washington for use as bait. Anchovy catch and landings data are given in Tables 2.1.1-1, 2.1.1.3-2, and 2.1.1.4-1.

Anchovy landed by the reduction fisheries are converted to meal, oil, and soluble protein products sold mainly as protein supplements for poultry food and also as feed for pigs, farmed fish, fur-producing animals, laboratory animals, and household pets. Meal obtained from anchovy is about 65% protein (meal from other fish is 50% to 55% protein).

Anchovy harvested by the live bait fishery in California are not landed, but are kept alive for sale to anglers as bait and chum (in contrast anchovy sold as "live" bait off Oregon and Washington may be killed at time of sale). Transactions between buyers and sellers of live bait take place either at sea or at bait wells tied up at docks. Bait dealers generally supply party boats on a contract basis and receive a percentage of the fees paid by passengers. Bait is also sold by the scoop to anglers in private vessels.

Anchovy landed by the nonreduction (other than live bait) fishery are used as dead frozen bait, fresh fish for human consumption, canned fish for human consumption, animal food, and anchovy paste.

### 1.1.5 Current Management

As of December 31, 1992, northern anchovy were managed by the Council under the Northern Anchovy FMP. The Northern Anchovy FMP was first adopted during 1978; management before then was by the state of California. Detailed descriptions of the management of northern anchovy are given in PFMC (1983 and 1990a).

### 1.1.6 Northern Subpopulation

The northern subpopulation of anchovy ranges from Monterey north to British Columbia with a major spawning center off Oregon and Washington that is associated with the Columbia River plume. The northern stock supports a small (one boat to four boats in Oregon and Washington), but locally important bait fishery.

There is relatively little information available about the biology and abundance of anchovy in the northern subpopulation. Spawning biomass estimates for an area off Oregon and Washington during 1975 through 1976 based on the "Smith Larva Method" (Smith 1972) ranged from 737,000 mt to 1,005,263 mt (Richardson 1981). These estimates, based on abundance of anchovy larvae, are too high, because anchovy were erroneously assumed to spawn only once per season. Estimates of spawning biomass from the Smith Larva Method for the central subpopulation during 1964 through 1966 (Smith 1972), were about 8.6 times larger on average than more recent estimates (Lo and Methot 1989). Thus, an educated guess for spawning biomass in the northern population during 1975 through 1976, based on estimates from the Smith Larva Method and a correction factor of 8.6, is 87,000 mt to116,000 mt. Landings of anchovy in Oregon and Washington during 1981 through 1994 (less than 60 mt per year) were small relative to the revised estimates of spawning biomass.

TABLE 1.1.3-1. Total biomass (mt on February 15), spawning biomass (mt on February 15), and recruitment estimates (mt age-0 fish on July 1) for northern anchovy, 1964 to 1995. All estimates from (Jacobson et al. 1995).

| Year | Total | CV | Spawning | CV | Recruits | CV |
|---|---|---|---|---|---|---|
| 1964 | 636,807 | 39% | 611,947 | 39% | 166,216 | 47% |
| 1965 | 378,972 | 30% | 356,272 | 33% | 206,829 | 48% |
| 1966 | 261,290 | 28% | 236,177 | 27% | 464,458 | 50% |
| 1967 | 274,943 | 31% | 229,927 | 29% | 247,758 | 48% |
| 1968 | 214,371 | 30% | 205,661 | 30% | 241,230 | 45% |
| 1969 | 186,550 | 29% | 173,049 | 29% | 830,351 | 48% |
| 1970 | 330,575 | 33% | 198,006 | 29% | 257,794 | 47% |
| 1971 | 221,007 | 30% | 172,431 | 31% | 867,978 | 54% |
| 1972 | 360,021 | 38% | 137,774 | 28% | 679,802 | 57% |
| 1973 | 390,503 | 37% | 382,657 | 37% | 4,348,342 | 47% |
| 1974 | 1,597,737 | 36% | 474,403 | 28% | 1,495,367 | 76% |
| 1975 | 1,245,680 | 35% | 931,981 | 31% | 2,651,986 | 75% |
| 1976 | 1,325,539 | 35% | 1,068,744 | 31% | 990,287 | 59% |
| 1977 | 901,543 | 31% | 900,606 | 31% | 495,690 | 56% |
| 1978 | 520,683 | 32% | 519,875 | 32% | 654,417 | 55% |
| 1979 | 395,165 | 32% | 337,401 | 30% | 1,770,193 | 37% |
| 1980 | 673,167 | 24% | 654,146 | 24% | 960,584 | 40% |
| 1981 | 513,099 | 20% | 490,381 | 19% | 631,225 | 40% |
| 1982 | 356,415 | 22% | 320,201 | 20% | 2,050,309 | 25% |
| 1983 | 713,707 | 19% | 711,225 | 19% | 221,994 | 42% |
| 1984 | 396,595 | 20% | 395,006 | 20% | 1,934,712 | 35% |
| 1985 | 822,157 | 22% | 555,245 | 18% | 1,115,221 | 60% |
| 1986 | 722,768 | 32% | 715,217 | 32% | 303,723 | 41% |
| 1987 | 411,576 | 30% | 408,704 | 30% | 216,887 | 42% |
| 1988 | 240,711 | 29% | 226,903 | 28% | 1,285,251 | 39% |
| 1989 | 440,586 | 29% | 167,168 | 29% | 186,449 | 38% |
| 1990 | 245,416 | 30% | 239,345 | 29% | 136,300 | 35% |
| 1991 | 153,457 | 29% | 151,970 | 29% | 269,658 | 36% |
| 1992 | 172,300 | 27% | 170,557 | 27% | 174,301 | 37% |
| 1993 | 145,315 | 28% | 144,536 | 28% | 235,177 | 40% |
| 1994 | 155,832 | 31% | 153,863 | 31% | 938,190 | 51% |
| 1995 | 392,266 | 38% | 387,618 | 38% | 560,523 | 13% |

### 1.2 Jack Mackerel

Biological information about jack mackerel is available in MacCall et al. (1980), MacCall and Stauffer (1983), and in references cited below.

#### 1.2.1 Distribution and Habitat

Jack mackerel are a pelagic schooling fish that ranges widely throughout the northeastern Pacific, from the Pacific coast to an offshore limit approximated by a line running from Cabo San Lucas, Baja California, to the eastern Aleutian Islands, Alaska. Much of the range lies outside the 200-mile U.S. EEZ. There is no evidence of stock structure in jack mackerel along the West Coast.

Small jack mackerel (10 cm to 30 cm fork length and up to six years of age) are most abundant in the Southern California Bight, where they are often found near the mainland coast and islands and over shallow rocky banks. Older, larger fish (50 cm to 60 cm fork length and 16 years to 30 years) range from Cabo San Lucas, Baja California, to the Gulf of Alaska, where they are generally found offshore in deep water and along the coastline to the north of Point Conception. Large fish rarely appear in southern inshore waters. Fish of intermediate lengths (30 cm to 50 cm tail length; nine years to 20 years of age) were found in considerable numbers during the spring of 1991 around the 200-mile limit of the U.S. EEZ off southern California; fish of five to nine years of age were the most numerous and fish ten to 20 years old were common (Nebenzahl 1997). Jack mackerel sampled over several years by trawl surveys off Oregon and Washington ranged from 30 cm to 62 cm and four to 36 years old. More than half of the fish sampled were greater than 20 years old, and fish greater than 30 years-old were common (Nebenzahl 1997).

Jack mackerel off southern California move inshore and offshore as well as north and south. They are more available on offshore banks in late spring, summer, and early fall than during the remainder of the year. In southern California waters, jack mackerel schools are often found over rocky banks, artificial reefs, and shallow rocky coastal areas. They remain near the bottom or under kelp canopies during daylight and venture into deeper surrounding areas at night. Young juvenile fish sometimes form small schools beneath floating kelp and debris in the open sea.

#### 1.2.2 Life History

Jack mackerel grow to about 60 cm and live 35 years or longer. Estimates of natural mortality are uncertain, but the natural mortality rate (M) averaged over the life span of a typical fish is probably less than 0.20 to 0.25 $yr^{-1}$. This means that about 18% to 22% of the total stock would die each year of natural causes if no fishing occurred.

Small jack mackerel taken off southern California and northern Baja California eat large zooplankton (copepods, pteropods, and euphausiids), juvenile squid, and anchovy. Larvae feed almost entirely on copepods.

Although immature jack mackerel can be found off southern California at all times of the year, 50% or more of all females reach sexual maturity during their first year of life. Older jack mackerel, in samples taken about 200 miles offshore from Southern California, spawned about every five days, and the average female may spawn as many as 36 times per year (Macewicz and Hunter 1993).

The spawning season for jack mackerel off California extends from February to October, with peak activity from March to July (MacCall and Prager 1988). Young spawners off southern California begin spawning later in the year than older spawners. Little is known of the maturity cycle of large fish offshore, but peak spawning appears to occur later in more northerly waters.

Large predators like tuna and billfish eat jack mackerel, but, except as young-of-the-year and yearlings, jack mackerel are probably a minor forage source for smaller predators. Older jack mackerel probably do not contribute significantly to food supplies of marine birds, because they are too large to be eaten by most bird species and school inaccessibly deep. Little information is available on predation of jack mackerel by marine mammals. Jack mackerel are not often eaten by California sea lions, *Zalophus californianus* or northern fur seals, *Callorhinus ursinus*.

### 1.2.3 Abundance, Recruitment, and Population Dynamics

The best current estimate of average spawning biomass for jack mackerel, based on California Cooperative Oceanic Fisheries Investigations (CalCOFI) data, is about 1.2 million mt to 2.6 million mt, with roughly 50% of the total spawning biomass found off California and Mexico. This estimate, which is based on scanty information about the distribution and reproductive biology of jack mackerel, is little more than an educated guess.

CalCOFI ichthyoplankton surveys and fish-spotter data are the only available sources of information about year-to-year changes in abundance of jack mackerel (Table 1.2.3-1). Neither CalCOFI surveys nor fish spotters cover the entire range of the population, so relationships between the indices and biomass may be obscured.

MacCall and Prager (1988) used general linear models and analysis of variance with CalCOFI data to estimate relative abundance of jack mackerel larvae from 1950 through 1980. The index of relative abundance for jack mackerel larvae shows considerable year-to-year fluctuation, but no long-term trends (Table 1.2.3-1).

Two indices of relative abundance from fish-spotter data for 1963 through 1990 are available for jack mackerel: a catch-per-unit-effort like index (Jim Squire, NMFS, Southwest Fisheries Science Center, personal communication) and an index based on lognormal linear models (N. C. H. Lo, NMFS, Southwest Fisheries Science Center, personal communication). The catch-per-unit-effort index was calculated from data collected by pilots flying at night over a "core" area where jack mackerel are naturally abundant (Squire 1972, 1983). The index based on general linear models was calculated with the model for northern anchovy described by Lo et al. (1992). Both indices (Table 1.2.3-1) indicate that abundance or availability increased dramatically during the mid-1970's, and jack mackerel biomass or availability can remain at low levels for long periods (ten or more years).

Detecting changes in jack mackerel abundance using existing CalCOFI or fish-spotter indices would probably be difficult. None of the indices appear precise, because variability in each is larger than the variability in abundance that could probably be expected for a long-lived fish like jack mackerel (MacCall and Stauffer 1983; MacCall and Prager 1988). In addition, the three indices are not well correlated.

The only information available for recruitment in jack mackerel is a rough index of year-class strength, obtained by summing the percentage contributions of a year-class to the various seasons in which it was fished (Table 1.2.3-2). An average year class will, using this measure, have a relative strength of 100%. Long-term trends cannot be detected since a year-class is effectively compared only to year-classes immediately preceding and following it (Mason 1991).

Virtual year-class strengths for 1947 through 1958 show a pattern in which strong year-classes appear every five years (Table 1.2.3-2). Recruitment was relatively low from 1959 to 1966. After 1966, strong year- classes appeared every two to three years.

The age at which jack mackerel recruit to fisheries depends on the location of the fishery. Jack mackerel begin to recruit to the southern California purse seine fishery in their first year.

MSY for jack mackerel has not been estimated, but crude estimates of potential yield (Gulland 1970; MacCall and Stauffer 1983) have been developed. Potential yield of jack mackerel is not meant to be an estimate of sustainable harvest, but rather an interim limit for catches while data sufficient for management are accumulated. Ages 0.5 through eight are harvested by the inshore fishery off southern California and have a potential yield of about 100,000 mt to 200,000 mt. The potential yield of large jack mackerel in offshore and northern regions is about 10,000 mt to 25,000 mt. The potential yield of fish ages nine years to 15 years is about 20,000 mt to 50,000 mt. The total stock has a potential yield of 130,000 mt to 275,000 mt, but larger harvests might be sustained as the nearly virgin stock is fished down.

### 1.2.4 Fishery Utilization

The southern California segment of the stock has been fished since the late 1940s, when jack mackerel served as a substitute for the failing sardine fishery. Landings data are given in Table 2.1.1-1. Purse seiners prefer Pacific (chub) mackerel, because jack mackerel tend to occur further from port and over rocky bottoms where there is increased risk of damage to nets. Mason (1991) describes the history of management for the jack mackerel fishery off southern California. Landings have been greatly reduced during the 1990s; 1996 landings (1,485 mt) were the lowest in more than 50 years.

Offshore, large adult jack mackerel are sometimes taken incidentally in trawls for Pacific whiting. During the 1970s, foreign trawl fisheries may have caught 1,000 mt to 2,000 mt annually, but catches by foreign and joint-venture fishers in the 1980s ranged from nil to about 100 mt.

### 1.2.5 Current Management

Jack mackerel was included in the Pacific Fishery Management Council's Groundfish FMP, because of foreign trawl fishery catches in the 1970s. Before 1991, an annual quota of 12,000 mt (north of 39° N latitude) was used to account for the incidental harvest while avoiding constraints on fishing for other groundfish species, particularly Pacific whiting. Beginning in 1991, in response to increased interest in fishing for jack mackerel, the Council adopted a coastwide quota of 46,500 mt for jack mackerel.

TABLE 1.2.3-1. Indices of relative abundance for jack mackerel from CalCOFI and fish-spotter data.

| | | Fish Spotter | | | | Fish Spotter | |
|---|---|---|---|---|---|---|---|
| Year | CalCOFI | CPUE | Lo-GLM | Year | CalCOFI | CPUE | Lo-GLM |
| 1952 | 2.41 | | | 1972 | 1.63 | 0.07 | 0.61 |
| 1953 | 0.69 | | | 1973 | | 0.05 | 0.02 |
| 1954 | 1.19 | | | 1974 | | 0.15 | 0.18 |
| 1955 | 0.81 | | | 1975 | 0.35 | 0.19 | 0.69 |
| 1956 | 0.35 | | | 1976 | | 0.51 | 0.61 |
| 1957 | 1.35 | | | 1977 | | 1.13 | 4.80 |
| 1958 | 0.35 | | | 1978 | 0.13 | 5.19 | 3.93 |
| 1959 | 0.17 | | | 1979 | | 2.01 | 1.06 |
| 1960 | 0.30 | | | 1980 | | 2.23 | 0.64 |
| 1961 | 1.08 | | | 1981 | 0.08 | 2.93 | 0.41 |
| 1962 | 0.81 | | 0.28 | 1982 | | 1.50 | 0.53 |
| 1963 | 0.73 | 0.64 | 1.21 | 1983 | | 1.51 | 0.12 |
| 1964 | 0.17 | 0.84 | 0.77 | 1984 | | 0.35 | 0.39 |
| 1965 | 0.79 | 0.30 | 0.77 | 1985 | | 0.70 | 0.33 |
| 1966 | 1.25 | 0.21 | 0.24 | 1986 | | 0.84 | 0.14 |
| 1967 | 1.70 | 0.22 | 0.80 | 1987 | | 0.58 | 0.09 |
| 1968 | 2.60 | 0.21 | 1.27 | 1988 | | 3.14 | 0.05 |
| 1969 | 1.57 | 0.19 | 0.30 | 1989 | | 2.66 | 0.15 |
| 1970 | | 0.07 | 0.15 | 1990 | | 0.39 | 0.04 |
| 1971 | 0.0 | 0.66 | | | | | |

All data series were rescaled to a mean of 1.0 for years of overlap. The label "CalCOFI" is for estimates of relative abundance (number larvae per area) from a general linear model fit to CalCOFI larval data (MacCall and Prager 1988, data from Alec MacCall, NMFS, SWFSC, personal communication). The label "CPUE" is for a catch-per-unit-effort-like index from fish-spotter data (Jim Squire, NMFS, SWFSC, personal communication). The label "Lo-GLM" is for estimates from general linear models fit to fish-spotter data (N. C-H. Lo, NMFS, SWFSC, pers. comm.).

TABLE 1.2.3-2. Virtual year-class strength estimates from jack mackerel catch-at-age data for 1959 through 1966.

| Year | Year-class Strength | Year | Year-class Strength |
|---|---|---|---|
| 1947 | 1.629 | 1964 | 0.708 |
| 1948 | 0.382 | 1965 | 0.678 |
| 1949 | 0.392 | 1966 | 0.906 |
| 1950 | 0.355 | 1967 | 1.591 |
| 1951 | 0.646 | 1968 | 0.955 |
| 1952 | 2.366 | 1969 | 1.163 |
| 1953 | 1.312 | 1970 | 1.647 |
| 1954 | 0.468 | 1971 | 0.771 |
| 1955 | 0.403 | 1972 | 0.857 |
| 1956 | 0.414 | 1973 | 0.564 |
| 1957 | 0.860 | 1974 | 1.721 |
| 1958 | 2.039 | 1975 | 0.402 |
| 1959 | 1.215 | 1976 | 1.336 |
| 1960 | 1.125 | 1977 | 0.419 |
| 1961 | 0.661 | 1978 | 1.556 |
| 1962 | 0.512 | 1979 | 0.495 |
| 1963 | 0.536 | 1980 | 2.065 |

Source: J. Mason, NMFS, Southwest Fisheries Science Center, personal communication.

## 1.3 Pacific Sardine

Biological information about Pacific sardine, *Sardinops sagax caerulea*, is available in Frey (1971), Clark and Marr (1955), Ahlstrom (1960), Murphy (1966), MacCall (1979), and in the references cited below. Other common names for Pacific sardine include California pilchard, pilchard (in the northern part of its range), and sardina monterey (in the southern part of its range).

### 1.3.1 Distribution and Habitat

Sardines as a group of species are small pelagic schooling fish that inhabit coastal subtropical and temperate waters. The genus *Sardinops* is found in eastern boundary currents of the Atlantic and Pacific, and in western boundary currents of the Indo-Pacific oceans. Recent studies indicate that sardines in the Alguhas, Benguela, California, Kuroshio, and Peru currents, and off New Zealand and Australia are a single species (*Sardinops sagax*, Parrish et al. 1989), but stocks in different areas of the globe may be different at the subspecies level (Bowen and Grant 1997).

Pacific sardine have at times been the most abundant fish species in the California Current. When the population is large it is abundant from the tip of Baja California (23° N latitude) to southeastern Alaska (57° N latitude), and throughout the Gulf of Mexico. In the northern portion of the range, occurrence tends to be seasonal. When sardine abundance is low, as during the late 1960s and 1970s, sardine do not occur in commercial quantities north of Point Conception.

It is generally accepted that sardine off the West Coast of North America form three subpopulations or stocks. A northern subpopulation (northern Baja California to Alaska), a southern subpopulation (off Baja California), and a Gulf of California subpopulation were distinguished on the basis of serological techniques (Vrooman 1964). A recent electrophoretic study (Hedgecock et al. 1989) showed, however, no genetic variation among sardine from central and southern California, the Pacific coast of Baja California, or the Gulf of California. A fourth, far northern subpopulation, has also been postulated (Radovich 1982). Although the ranges of the northern and southern subpopulations overlap, the stocks may move north and south at similar times and not overlap significantly. The northern stock is exploited by U.S. fisheries and is included in this FMP.

Pacific sardine probably migrated extensively during historical periods when abundance was high, moving north as far as British Columbia in the summer and returning to southern California and northern Baja California in the fall. Tagging studies (Clark and Janssen 1945) indicate that the older and larger fish moved farther north. Migratory patterns were probably complex, and the timing and extent of movement were affected by oceanographic conditions (Hart 1973) and stock biomass. During the 1950s to 1970s, a period of reduced stock size and unfavorably cold sea surface temperatures apparently caused the stock to abandon the northern portion of its range. At present, the combination of increased stock size and warmer sea surface temperatures are causing the stock to reoccupy grounds off northern California, Oregon, Washington, and British Columbia. Abandonment and recolonization of the higher latitude portion of their range has been associated with changes in abundance of sardine populations around the world (Parrish et al. 1989).

### 1.3.2 Life History

Pacific sardine may reach 41 cm, but are seldom longer than 30 cm. They may live as long as 13 years, but individuals in historical and current California commercial catches are usually younger than five years. In contrast, the most common ages in the historical Canadian sardine fishery were six years to eight years. There is a good deal of regional variation in size at age and size at age increases from south to north (Phillips 1948). Size and age at maturity may decline with a decrease in biomass, but latitude and temperature also are important (Butler 1987). At low biomass, levels, sardine appear to be fully mature at age one, whereas at high biomass levels only some of the two-year-olds are mature (MacCall 1979).

Age-specific mortality estimates are available for the entire suite of life history stages (Butler et al. 1993). Mortality is high at the egg and yolk sac larvae stages (instantaneous rates in excess of 0.66 $d^{-1}$). Adult natural mortality rates has been estimated to be M=0.4.$yr^{-1}$ (Murphy 1966; MacCall 1979) and 0.51 $yr^{-1}$ (Clark and Marr 1955). A natural mortality rate of M=0.4 $yr^{-1}$ means that 33% of the sardine stock would die each year of natural causes if there were no fishery.

Pacific sardine spawn in loosely aggregated schools in the upper 50 meters of the water column. Spawning occurs year-round in the southern stock and peaks April through August between Point Conception and Magdalena Bay, and January through April in the Gulf of California (Allen et al. 1990). Off California, sardine eggs are most abundant at sea surface temperatures of 14°C to 16°C and larvae are most abundant at 13°C to 16°C. Temperature requirements are apparently flexible, however, because eggs are most common at 17°C to 21° C and in the Gulf of California and at 22°C to 25°C off Southern Baja (Lluch-Belda et al. 1991).

The spatial and seasonal distribution of spawning is influenced by temperature. During periods of warm water, the center of sardine spawning shifts northward and spawning extends over a longer period of time (Butler 1987; Ahlstrom 1960). Recent spawning has been concentrated in the region offshore and north of Point Conception (Lo et al. 1996). Historically, spawning may also have been fairly regular off central California. Spawning was observed off Oregon, and young fish were seen in waters off British Columbia in the early fishery (Ahlstrom 1960) and during recent years (Hargreaves et al. 1994). The main spawning area for the historical population off the U.S. was between Point Conception and San Diego, California, out to about 100 miles offshore, with evidence of spawning as far as 250 miles offshore (Hart 1973).

Sardine are oviparous multiple-batch spawners with annual fecundity that is indeterminate and highly age or size dependent. Butler et al. (1993) estimate that two-year-old sardine spawn on average six times per year whereas the oldest sardine spawn 40 times per year. Both eggs and larvae are found near the surface. Sardine eggs are spheroid, have a large perivitelline space, and require about three days to hatch at 15°C.

Sardine are planktivores that consume both phytoplankton and zooplankton. When biomass is high, Pacific sardine may consume a significant proportion of total organic production in the California Current system. Based on an energy budget for sardine developed from laboratory experiments and estimates of primary and secondary production in the California Current, Lasker (1970) estimated that annual energy requirements of the sardine population would have been about 22% of the annual primary production and 220% of the secondary production during 1932 to 1934, a period of high sardine abundance.

Pacific sardine are taken by a variety of predators throughout all life stages. Sardine eggs and larvae are consumed by an assortment of invertebrate and vertebrate planktivores. Although it has not been demonstrated in the field, anchovy predation on sardine eggs and larvae was postulated as a possible mechanism for increased larval sardine mortality from 1951 through 1967 (Butler 1987). There have been few studies about sardine as forage, but juvenile and adult sardine are consumed by a variety of predators, including commercially important fish (e.g., yellowtail, barracuda, bonito, tuna, marlin, mackerel, hake, salmon, and sharks), seabirds (pelicans, gulls, and cormorants), and marine mammals (sea lions, seals, porpoises, and whales). In all probability, sardine are fed on by the same predators (including endangered species) that utilize anchovy (Table 1.1.2-1). It is also likely that sardine will become more important as prey as their numbers increase. For example, while sardine were abundant during the 1930s, they were a major forage species for both coho and chinook salmon off Washington (Chapman 1936).

### 1.3.3 Abundance, Recruitment, and Population Dynamics

Extreme natural variability and susceptibility to recruitment overfishing are characteristic of clupeoid stocks like Pacific sardine (Cushing 1971). Estimates of the abundance of sardine from 1780 through 1970 have been derived from the deposition of fish scales in sediment cores from the Santa Barbara basin off southern California (Soutar and Issacs 1969, 1974; Baumgartner et al. 1992). Significant sardine populations existed throughout the period with biomass levels varying widely. Both sardine and anchovy populations tend to vary over periods of roughly 60 years, although sardine have varied more than anchovy. Sardine population declines were characterized as lasting an average of 36 years; recoveries lasted an average of 30 years. Biomass estimates of the sardine population inferred from scale-deposition rates in the 19th and 20th centuries (Soutar and Isaacs 1969; Smith 1978) indicate that the biomass peaked in 1925 at about six million mt (Table 1.3.3-1).

Sardine age-three and older were fully recruited to the historical fishery until 1953 (MacCall 1979). Recent fishery data indicate that sardine begin to recruit at age. Age-dependent availability to the fishery likely depends upon the location of the fishery; young fish are unlikely to be fully available to fisheries located in the north and old fish are unlikely to be fully available to fisheries south of Point Conception.

Sardine spawning biomass (Table 1.3.3-1) estimated from catch-at-age analysis averaged 3.5 million mt from 1932 through 1934, fluctuated between 1.2 million mt to 2.8 million mt over the next ten years, then declined steeply during 1945 through 1965, with some short-term reversals following periods of particularly successful recruitment (Murphy 1966; MacCall 1979). During the 1960s and 1970s, spawning biomass levels were thought to be less than about five thousand to ten thousand mt (Barnes et al. 1992). The sardine stock began to increase by an average rate of 27% annually in the early 1980s (Table 1.3.3-1, Barnes et al. 1992). Recent estimates (Hill et al. 1998) indicate that the total biomass of sardine age one or older had increased to about 420,000 mt to 570,000 mt by 1997.

Recruitment success in sardine is generally autocorrelated and affected by environmental processes occurring on long (decadal) time scales. Lluch-Belda et al. (1991) and Jacobson and MacCall (1995) demonstrated relationships between recruitment success in Pacific sardine and sea surface temperatures measured over relatively long periods (i.e., three years to five years). Their results suggest that equilibrium spawning biomass and potential sustained yield is highly dependent upon environmental conditions associated with elevated sea surface temperature conditions.

Recruitment of Pacific sardine is highly variable (Table 1.3.3-1). Analyses of the sardine stock recruitment relationship have been controversial, with some studies showing a density-dependent relationship (production of young sardine declines at low levels of spawning biomass) and others finding no relationship (Clark and Marr 1955; Murphy 1966; MacCall 1979). The most recent study (Jacobson and MacCall 1995) found that both density-dependent and environmental factors to be significant and important.

MacCall (1979) estimated that the average potential population growth rate of sardine was 8.5% during the historical fishery while the population was declining. He concluded that, even with no fishing mortality, the population on average was capable of little more than replacement. Jacobson and MacCall (1995) obtained similar results for cold, unproductive regimes, but also found that the stock was very productive during warmer regimes.

MSY for the historical Pacific sardine was estimated to be 250,000 mt annually (MacCall 1979; Clark 1939), which is far below the catch of sardine during the peak of the historical fishery. Jacobson and MacCall (1995) found that MSY depends on environmental conditions.

### 1.3.4 Fishery Utilization

The sardine fishery was first developed in response to demand for food during World War I. Landings increased from 1916 to 1936, and peaked at over 700,000 mt. The Pacific sardine supported the largest fishery in the western hemisphere during the 1930s and 1940s, with landings along the coast in British Columbia, Washington, Oregon, California, and Mexico. The fishery declined, beginning in the late 1940s and with some short-term reversals, to extremely low levels in the 1970s. There was a southward shift in the catch as the fishery decreased, with landings ceasing in the northwest in 1947 through 1948, and in San Francisco in 1951 through 1952. Sardine were primarily used for reduction to fish meal, oil, and as canned food, with small quantities taken for live bait. An extremely lucrative dead bait market developed in central California in the 1960s.

In the early 1980s, sardine began to be taken incidentally with Pacific (chub) mackerel and jack mackerel in the southern California mackerel fishery and primarily canned for pet food, although some were canned for human consumption. As sardine continued to increase in abundance, a directed purse-seine fishery was reestablished. Sardine landed in the directed sardine fisheries off southern and central California are mostly canned for human consumption and sold overseas, with minor amounts sold fresh for human consumption and animal food. Small quantities are harvested for dead bait and live bait. Sardine landed in Mexico are used primarily for reduction. Sardine landings data are given in Table 2.1.1-1.

### 1.3.5 Current Management

Pacific sardine are currently managed by California Department of Fish and Game (CDFG) with technical assistance and data from NMFS. State regulations allow a directed sardine fishery in years when the sardine spawning biomass exceeds 18,200 mt (20,000 short tons).

In recent years, California sardine quotas have been set using the formula Quota=(Biomass-50,000) x 20% x 59% where 20% is a target harvest rate for the entire stock and 59% is the portion of the stock available to the California fishery. One third of the total California sardine is allocated to boats operating north of San Simeon Point (San Luis Obispo County, California), and two thirds is allocated to boats operating to the south. On October 15 of each year, the total remaining state-wide quota is allocated 50-50 to the northern and southern areas. Tolerance limits for sardine (similar to bycatch allowances in this FMP) are used to manage bycatch and may be, by law, 15% to 45% by weight in each delivery. The 1998 California quota, based on a total biomass estimate of 464,000 short tons (421,000 mt), was 48,000 short tons (44,000 mt).

TABLE 1.3.3-1. Estimates of sardine biomass (1,000 mt). Data prior to 1984 are biomass of sardine age two and older and recruits in millions of age-two fish. Data beginning in 1984 are biomass of sardine age one and older and recruits in millions of age-one fish. Age-two fish prior to 1984 and age-one fish beginning in 1984 were of similar size, maturity, and biologically equivalent.[a/] Biomass estimates for recent years are for the stock available to the California fishery and likely underestimate biomass for the stock as a whole.

| | Spawning Biomass | | | | | Spawning Biomass | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Scale Deposition[b/] | Catch At-age[c/] | GLM[d/] | Recruits | Year | Scale Deposition[b/] | Catch At-age[c/] | GLM[d/] | Recruits |
| 1910 | 1738 | | | | 1955 | | 170 | 166 | 382 |
| 1915 | 2444 | | | | 1956 | | 108 | 124 | 264 |
| 1920 | 5055 | | | | 1957 | | 90 | 132 | 588 |
| 1925 | 6226 | | | | 1958 | | 177 | 284 | 1586 |
| 1930 | 5300 | | | | 1959 | | 122 | 267 | 905 |
| 1932 | | 3523 | | 3981 | 1960 | | 88 | 176 | 288 |
| 1933 | | 3414 | | 8860 | 1961 | | 54 | 78 | 111 |
| 1934 | | 3624 | | 14202 | 1962 | | 27 | 24 | 74 |
| 1935 | | 2844 | | 4098 | 1963 | | 21 | 30 | 56 |
| 1936 | | 1688 | | 2821 | 1964 | | 11 | | 11 |
| 1937 | | 1206 | | 5383 | 1965 | | 3 | | |
| 1938 | | 1201 | | 6940 | | Data Not Available 1966 through 1982 | | | |
| 1939 | | 1607 | | 6763 | 1983 | | 5 | | 125 |
| 1940 | | 1760 | | 11808 | 1984 | | 13 | | 172 |
| 1941 | | 2457 | | 14442 | 1985 | | 18 | | 151 |
| 1942 | | 2064 | | 6152 | 1986 | | 25 | | 561 |
| 1943 | | 1677 | | 3268 | 1987 | | 56 | | 536 |
| 1944 | | 1206 | | 3720 | 1988 | | 81 | | 910 |

TABLE 1.3.3-1. Estimates of sardine biomass (1,000 mt). Data prior to 1984 are biomass of sardine age two and older and recruits in millions of age-two fish. Data beginning in 1984 are biomass of sardine age one and older and recruits in millions of age-one fish. Age-two fish prior to 1984 and age-one fish beginning in 1984 were of similar size, maturity, and biologically equivalent.[a/] Biomass estimates for recent years are for the stock available to the California fishery and likely underestimate biomass for the stock as a whole.

| | Spawning Biomass | | | | | Spawning Biomass | | | |
|---|---|---|---|---|---|---|---|---|---|
| Year | Scale Deposition[b/] | Catch At-age[c/] | GLM[d/] | Recruits | Year | Scale Deposition[b/] | Catch At-age[c/] | GLM[d/] | Recruits |
| 1945 | | 720 | | 2385 | 1989 | | 122 | | 708 |
| 1946 | | 566 | | 1625 | 1990 | | 135 | | 2754 |
| 1947 | | 405 | | 1667 | 1991 | | 159 | | 3235 |
| 1948 | | 740 | | 3875 | 1992 | | 243 | | 1984 |
| 1949 | | 793 | | 4261 | 1993 | | 217 | | 4732 |
| 1950 | | 780 | | 3690 | 1994 | | 323 | | 6818 |
| 1951 | | 277 | 176 | 290 | 1995 | | 357 | | 5511 |
| 1952 | | 136 | 101 | 397 | 1996 | | 476 | | 237 |
| 1953 | | 202 | 6 | 972 | 1997 | | 418 | | |
| 1954 | | 239 | 216 | 1197 | | | | | |

a/ For example, there were 3,532,000 mt of sardine in 1932, and the 1932 year class produced 3,981,000 age-two recruits.
b/ Estimates from scale-deposition rates converted to biomass (Smith 1978).
c/ Catch-at-age estimates of biomass and recruitment from VPA for 1932 to 1944 (Murphy 1966), VPA for 1945 through 1965 (MacCall 1979), and CANSAR/TAM for 1983 through 1997 (Hill et al. in preparation).
d/ Estimates from a general linear model (Barnes et al. 1992).

## 1.4 Pacific (Chub) Mackerel

Pacific (chub) mackerel (*Scomber japonicus*) found off the Pacific coast of the U.S. are often called "blue" or "chub" mackerel and are the same species as mackerel of various names found elsewhere in the Pacific, Atlantic, and Indian oceans (Collett and Nauen 1983). A synopsis of the biology of Pacific (chub) mackerel is available in Schaefer (1980) and references cited below. The northeastern Pacific stock (see below) is included in this FMP.

### 1.4.1 Distribution and Habitat

Pacific (chub) mackerel in the northeastern Pacific range from Banderas Bay, Mexico, to southeastern Alaska, including the Gulf of California (Hart 1973). They are common from Monterey Bay, California, to Cabo San Lucas, Baja California, but are most abundant south of Point Conception. Pacific (chub) mackerel usually occur within 20 miles of shore, but have been taken as far offshore as 250 miles (Fitch 1969; Frey 1971; Allen et al. 1990; MBC 1987).

There are three spawning stocks along the Pacific coasts of the U.S. and Mexico: one in the Gulf of California, one in the vicinity of Cabo San Lucas, and one extending along the Pacific coast north of Punta Abreojos, Baja California (Collette and Navem 1983; Allen et al. 1990; MBC 1987). The latter "northeastern Pacific" stock is harvested by fishers in the U.S. and Mexico and included in this FMP.

Pacific (chub) mackerel adults are found in water ranging from 10.0°C to 22.2°C (MBC 1987), and larvae may be found in water around 14°C (Allen et al. 1990). As adults, Pacific (chub) mackerel may move north in summer and south in winter between Tillamook, Oregon, and Magdalena Bay, Baja California: northerly movement in the summer peaks during El Niño events (MBC 1987). There is an inshore-offshore migration off California, with increased inshore abundance from July to November and increased offshore abundance from March to May (Cannon 1967; MBC 1987). Adult Pacific (chub) mackerel are commonly found near shallow banks. Juveniles are found off sandy beaches, around kelp beds, and in open bays. Adults are found from the surface to depths of 300 meters (Allen et al. 1990). Pacific (chub) mackerel often school with other pelagic species, particularly jack mackerel and Pacific sardine.

### 1.4.2 Life History

The largest recorded Pacific (chub) mackerel was 63 cm long and weighed 2.8 kg, but Pacific (chub) mackerel taken by commercial fishing seldom exceed 40 cm or one kilogram (Hart 1973; Roedel 1938). The oldest recorded age for a Pacific (chub) mackerel was 11 years, but most caught commercially are less than four-years-old (Fitch 1951). Some Pacific (chub) mackerel mature as one-year-olds, and all are sexually mature by age four (Prager and MacCall 1988). The annual rate of natural mortality (M) is thought to be about 0.5 $yr^{-1}$, which means that 39% of the stock would die each year of natural causes in the absence of fishing (Parrish and MacCall 1978).

Pacific (chub) mackerel larvae eat copepods and other zooplankton including fish larvae (Collette and Nauen 1983; MBC 1987). Juveniles and adults feed on small fish, fish larvae, squid, and pelagic crustaceans such as euphausids (Clemens and Wilby 1961; Turner and Sexsmith 1967; Fitch 1969; Fitch and Lavenberg 1971; Frey 1971; Hart 1973; Collette and Nauen 1983).

Pacific (chub) mackerel in the northeastern Pacific stock spawn from Eureka, California, south to Cabo San Lucas in Baja California (Frey 1971; MBC 1987) between three and 320 km from shore. They seldom spawn north of Point Conception (Fritzsche 1978; MBC 1987) although young-of-year mackerel have been recently reported as far north as Oregon and Washington due, perhaps, to current warm sea surface temperatures. Spawning peaks from late April to July (MacCall and Prager 1988). Like most coastal pelagic species, Pacific (chub) mackerel have indeterminate fecundity and seem to spawn whenever sufficient food is available and appropriate environmental conditions prevail. Actively spawning fish appear capable of spawning every day or every other day (Dickerson et al. 1992).

Pacific (chub) mackerel larvae are subject to predation from a number of invertebrate and vertebrate planktivores. Juveniles and adults are eaten by larger fish, marine mammals, and seabirds. Predators include porpoises, California sea lions (*Zalophus californianus*), brown pelican (*Pelecanus occidentalis*), striped marlin (*Terapturus audax*), black marlin (*Makaira indica*), sailfish (*Istiophorus platypterus*), bluefin tuna (*Thunnus thynnus*), white sea bass (*Atractoscion nobilis*, yellowtail (*Seriola dorsalis*), giant sea bass (*Stereolepis gigas*), and various sharks (MBC 1987). Although consumed in significant numbers by a wide variety of predators, Pacific (chub) mackerel are likely not as important as forage than Pacific sardine or northern anchovy which are smaller in size (i.e., available to a wider variety of predators) and often more abundant.

### 1.4.3 Abundance, Recruitment, and Population Dynamics

Biomass of Pacific (chub) mackerel (Table 1.4.3-1) declined from more than 200,000 mt in the early 1930s to less than 100,000 mt by 1945 and to very low levels in the late 1960s and early 1970s. Strong year- classes appeared in the late 1970s, and abundance increased dramatically after 1977. After 1982, Pacific (chub) mackerel biomass declined steadily, but remained greater than 200,000 mt until 1992. During 1993 through 1996, Pacific (chub) mackerel biomass off the Southern California Bight declined further to about 121,000 mt (Yaremko et al., In press). Analyses of scale-deposition data for Pacific (chub) mackerel (Soutar and Issacs 1974) indicate that the prolonged period of high biomass levels during the late 1970s and 1980s was an unusual event that might be expected to occur, on average, about once every 60 years (MacCall et al. 1985).

Recruitment of Pacific (chub) mackerel is variable and loosely linked to spawning biomass. Reproductive success, measured as spawning biomass divided by number of recruits, is highly variable and somewhat cyclic (MacCall et al. 1985).

MacCall et al. (1985) estimated that Pacific (chub) mackerel might sustain average yields of from 26,000 mt to 29,000 mt per year under management systems similar to that currently used to manage the stock.

### 1.4.4 Fishery Utilization

Pacific (chub) mackerel in the northeastern Pacific are harvested by commercial fisheries in California and Mexico; some recreational harvest also occurs. Pacific (chub) mackerel are sold as fresh fish, canned for human consumption, pet food, and reduced to fish meal and oil. Landings data are given in Table 2.1.1-1.

Pacific (chub) mackerel are often taken by anglers and in considerable numbers, though seldom as a target species (Allen et al. 1990). During 1980 through 1989, the recreational catch averaged 1,330 mt per year (Wolf 1989,) and Pacific (chub) mackerel was numerically the most important species taken in the California commercial passenger fishing boat fleet during the period of 1978 through 1989.

### 1.4.5 Current Management

Pacific (chub) mackerel are currently managed by the State of California. If the estimated biomass is greater than 135,000 mt, then the commercial catch is not restricted by a quota. If the biomass is between 18,000 mt and 135,000 mt, then a quota equal to 30% of the biomass above 18,000 short tons is applied. If the biomass is below 18,000 mt, commercial fishing stops. The history of Pacific (chub) mackerel fishery and management is described in Klingbeil (1983).

TABLE 1.4.3-1. Biomass estimates (1,000 mt) for Pacific (chub) mackerel from Hill et al. (In press).

| Year | Biomass | Year | Biomass |
|---|---|---|---|
| 1929 | 156 | 1964 | 27 |
| 1930 | 223 | 1965 | 5 |
| 1931 | 297 | 1966 | 3 |
| 1932 | 367 | 1967 | 2 |
| 1933 | 353 | 1968 | 2 |
| 1934 | 292 | 1969 | 1 |
| 1935 | 194 | 1970 | 0 |
| 1936 | 129 | 1971 | 1 |
| 1937 | 115 | 1972 | 1 |
| 1938 | 106 | 1973 | 2 |
| 1939 | 117 | 1974 | 4 |
| 1940 | 91 | 1975 | 10 |
| 1941 | 86 | 1976 | 12 |
| 1942 | 114 | 1977 | 82 |
| 1943 | 105 | 1978 | 142 |
| 1944 | 83 | 1979 | 452 |
| 1945 | 64 | 1980 | 594 |
| 1946 | 40 | 1981 | 684 |
| 1947 | 20 | 1982 | 1,176 |
| 1948 | 53 | 1983 | 1,049 |
| 1949 | 56 | 1984 | 902 |
| 1950 | 39 | 1985 | 772 |
| 1951 | 21 | 1986 | 692 |
| 1952 | 7 | 1987 | 638 |
| 1953 | 22 | 1988 | 526 |
| 1954 | 53 | 1989 | 453 |
| 1955 | 49 | 1990 | 371 |
| 1956 | 54 | 1991 | 307 |
| 1957 | 29 | 1992 | 202 |
| 1958 | 19 | 1993 | 171 |
| 1959 | 38 | 1994 | 146 |
| 1960 | 43 | 1995 | 120 |
| 1961 | 65 | 1996 | 124 |
| 1962 | 78 | 1997 | 126 |
| 1963 | 56 | | |

### 1.5 Market Squid

Market squid (*Loligo opalescens*) along the West Coast of North America were studied during 1960-1980 (Recksiek and Frey 1978; Symposium of the 1978 CalCOFI Conference[1/]), but little research applicable to fisheries management was carried out until the 1997 CalCOFI Squid Symposium. The 1997 CalCOFI Symposium initiated an intensive research program conducted collaboratively by state, federal and academic biologists and funded by license fees for squid fishing. Results from the ongoing research program are not yet available.

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1/ See papers by various authors published during 1979 in: California Cooperative Oceanic Fishing Investment Report 20: 21-71.

### 1.5.1 Distribution and Habitat

Adult and juvenile market squid (Dickerson and Leos 1992) are distributed throughout the California and Alaska current systems from the southern tip of Baja California, Mexico (23° N Latitude) to southeastern Alaska (55° N Latitude). They are most abundant between Punta Eugenio, Baja California and Monterey Bay, central California. Market squid are harvested near the surface and generally considered pelagic, but are actually found over the continental shelf from the surface to depths of at least 800 meters. They prefer oceanic salinities and are rarely found in bays, estuaries, or near river mouths (Jefferts 1983). Adults and juveniles are most abundant between temperatures of 10°C and 16°C (Roper et al. 1984).

Spawning squid concentrate in dense schools near spawning grounds, but habitat requirements for spawning are not well understood. Spawning occurs over a wide depth range, but the extent and significance of spawning in deep water is unknown. Known major spawning areas are shallow semi-protected near-shore areas with sandy or mud bottoms adjacent to submarine canyons where fishing occurs. In these locations, egg deposition is between five (Jefferts 1983) and 55 meters (Roper and Sweeney 1984), and most common between 20 meters and 35 meters. Off California, squid and squid eggs have been taken in bottom trawls at depths of about 800 meters near Monterey (Bob Leos, California Department of Fish and Game, personal communication) and have been observed at 180 meters near the Channel Islands (Roper and Sweeney 1984).

Attempts to differentiate squid stocks using anatomical and genetic characters have been inconclusive. Thus, the number of market squid stocks or subpopulations along the Pacific Coast is unknown.

### 1.5.2 Life History

Market squid are small short-lived molluscs reaching a maximum size of 30 cm total length, including arms (Roper and Sweeney 1984). Age and growth studies suggest than some individuals may live up to two years, but most mature and spawn when about one-year-old (Spratt 1979). In the laboratory squid have been reared to maturity and spawned at six months of age. Histological examination of squid testes and ovaries using electron microscopy suggests that squid spawn once over a short time period before dying (Greib 1978; Knipe 1978), although this is a topic of current research and some debate.

Spawning occurs year-round (Jefferts 1983). Peak spawning usually begins in southern California during the fall-spring. Off central California, spawning normally begins in the spring-fall. Squid spawning has been observed off Oregon during May to July. Off Washington and Canada, spawning normally begins in late summer. Year-round spawning likely reduces effects of poor temporary local conditions for survival of eggs or hatchlings. Year-round spawning suggests that stock abundance is not dependent on spawning success during a single short season or a single spawning area.

Males on spawning grounds are larger than females. Males reach 19 cm dorsal mantle length, a maximum weight of 130 g and have larger heads and thicker arms than females. Females reach 17 cm dorsal mantle length and a maximum weight of 90 g. Mating has been observed on spawning grounds just prior to spawning, but may also occur before squid move to the spawning grounds. Males deposit spermatophores into the mantle cavity of females and eggs are fertilized as they are extruded (Hurley 1977). Females produce 20 egg to 30 egg capsules and each capsule contains 200 eggs to 300 eggs that are suspended in a gelatinous matrix within the capsule. Females attach each egg capsule individually to the substrate. As spawning continues, mounds of egg capsules covering more than 100 $m^2$ may be formed.

Spawning is continuous and eggs of varying developmental stages may be present at one site. Eggs take three months to hatch at 7°C to 8°C, one month at 13°C, and 12 days to 23 days at 10°C (Jefferts 1983). Newly hatched squid (called "paralarvae") are about 2.5 to 3 mm in length and resemble miniature adults. Hatchlings are dispersed by currents, and their distribution after leaving the spawning areas is largely unknown.

Few organisms eat squid eggs although bat stars and sea urchins have been observed doing so (Jefferts 1983). Like northern anchovy and Pacific sardine (Table 1.1.2-1), market squid are probably important as forage to a long list of fish, birds, and mammals including threatened, endangered, and depleted species (Morejohn et al. 1978). Some of the more important squid predators are king salmon, coho salmon, lingcod, rockfish, harbor seals, California sea lion, sea otters, elephant seal, Dall's porpoise, sooty shearwater, Brandt's cormorant, rhinoceros auklet, and common murre.

Squid feed on copepods as juveniles gradually changing to euphausiids, other small crustaceans, small fish, and other squid as they grow (Karpov and Cailliet 1978).

### 1.5.3 Abundance, Recruitment, and Population Dynamics

Market squid population dynamics are poorly understood. Annual fluctuations in the commercial squid catch (<10,000 tons to nearly 90,000 mt) may reflect squid abundance patterns, but this idea has not been substantiated.

The best information available indicates squid have a very high natural mortality rate (approaching 100% per year) and that the adult population is composed almost entirely of new recruits. No spawner-recruit relationship has been demonstrated. Implications of these ideas are that the entire stock is replaced annually, even in the absence of fishing. Thus, the stock may be dependent on successful spawning each year coupled with good survival of recruits to adulthood. No estimates of MSY are available for market squid. No direct, statistically defendable population estimates are available.

### 1.5.4 Fishery Utilization

Market squid are harvested commercially primarily off southern and central California although some catch occurs throughout their range. Fishing occurs on spawning grounds and occurs during the spawning season. Peak catches occur off southern California during the winter, off Central California during the late spring and summer, and later in the summer off Oregon to Alaska.

Commercial squid fishing vessels use purse seines primarily, although scoop nets are also used in the southern California fishery. Lights are usually used to bring the squid schools up near the surface where they are more easily captured by seine or scoop net. Purse seines used for squid typically do not hang as deep as purse seines used for other species, so contact with the bottom is reduced. However, squid eggs are occasionally observed in purse seines when the seines contact the bottom. Egg mortality associated with purse seining for squid has not been quantified.

The California squid fishery accounts for most of the coast wide landings. Minor amounts of market squid are landed in Canada, Washington, and Oregon (Table 1.5.4-1). The size of the Mexican fishery is unknown, but is thought to be minor. The California annual squid catch set records of 56 thousand mt, 70 thousand mt, and 80 thousand mt during 1994 through 1996.

In California, most squid marketed for human consumption is frozen, but minor amounts are canned or sold fresh. Historically, the domestic demand for frozen squid has been relatively small, and most of the increased production from California during 1994 through 1996 was frozen and exported to Europe, Spain, and China. Squid is also frozen for bait, supplied to domestic commercial and recreational fishers, and is an important source of live bait for the California recreational fishing industry.

After decades of generally low catches, the market squid fishery increased briefly during the late 1990's because of new (primarily Asian) markets and higher prices. At one point (1997), the market squid fishery was the largest and most valuable in California. However, landings declined during the 1997/98 El Nino when squid became harder to catch and as markets collapsed due to poor economic conditions in Asia. It is not known whether markets are likely to recover and once again support a significant market squid fishery in California.

### 1.5.5 Current Management

The California squid fishery is perhaps the last major commercial fishery in the U.S. that is largely unregulated. Prior to the 1990s, California squid catches were relatively small (generally <20,000 tons) due to limited markets and regulations controlling the catch were thought unnecessary. Port sampling procedures for gathering biological data from catches were not developed.

In 1993, California passed legislation making it unlawful to display squid attracting lights from a vessel near Halfmoon Bay unless the vessel's primary purpose was to fish for squid.

In 1997, California passed State Assembly Bill AB 364 (the "Sher Bill") that closed areas north of Pt. Conception to squid fishing between noon Friday and noon Sunday and, in effect, expanded the existing weekend closure near Monterey. The Sher Bill established a new squid permit (fee $2,500) for squid vessels and squid light boats with a three-year moratorium on additional permits after April 1, 1998. The moratorium on additional permits is a means of monitoring and managing fishing effort in the California squid fishery. Income generated from the fishery is dedicated to squid research and management. In addition, the Sher Bill gave the California Fish and Game Commission (CDFG) management authority over the squid fishery and gave the California Department of Fish and Game Director authority to establish a squid scientific advisory board and a fishery advisory committee.

Scientific research underway, improvements to squid port sampling, and the moratorium on new squid permits under California state law constitute a plan for stock assessment and close monitoring of fishing effort that will make it possible to manage the California market squid fishery if conditions in the fishery change and active management is required. CDFG is using funds provided by industry to develop port sampling programs and to coordinate a focused and intensive three year research program involving state, federal and academic biologists. Studies underway involve port sampling, age and growth, reproductive biology, stock structure, distribution and habitat utilization, location of fishing areas, characteristics of spawning areas and means to measure and track trends in squid abundance. State law directs CDFG to develop and recommend fishery management options for the squid fishery at the end of the three year research program.

TABLE 1.5.4-1 Landings of market squid (mt per year) in Washington, Oregon, and California during 1981 through 1997. Data for 1997 are preliminary.

| Year | California | Oregon | Washington | Total |
|---|---|---|---|---|
| 1981 | 23,526 | 0 | 5 | 23,531 |
| 1982 | 16,319 | 51 | 2 | 16,373 |
| 1983 | 1,825 | 135 | 40 | 2,000 |
| 1984 | 564 | 430 | 13 | 1,007 |
| 1985 | 10,283 | 795 | 1 | 11,079 |
| 1986 | 21,292 | 12 | 5 | 21,309 |
| 1987 | 19,997 | 0 | 4 | 20,001 |
| 1988 | 37,257 | 0 | 1 | 37,259 |
| 1989 | 40,920 | 44 | 1 | 40,964 |
| 1990 | 28,466 | 0 | 0 | 28,466 |
| 1991 | 37,414 | 0 | 0 | 37,414 |
| 1992 | 13,119 | 6 | 1 | 13,126 |
| 1993 | 42,858 | 59 | 5 | 42,923 |
| 1994 | 55,930 | 106 | 4 | 56,039 |
| 1995 | 70,298 | 112 | 12 | 70,422 |
| 1996 | 80,374 | 104 | 5 | 80,483 |
| 1997 | 70,824 | 121 | 1 | 70,945 |

## 1.6 California Current Ecosystem

The California Current is one of the world's four major eastern boundary currents characterized by coastal upwelling, high nutrient levels, and high productivity. High nutrient levels in the California Current result from an influx of high-nutrient, subarctic water, plus upwelling of nutrient-rich water within the system.

### 1.6.1 Boundaries

The California Current ecosystem is an open system with no clearly defined boundaries and few sharp gradients. The coastlines of Canada, the U.S., and Mexico bound the ecosystem on the east, but the boundary is not distinct, because anadromous and estuarine spawning fish are significant components of the ecosystem and the region's fisheries. The northern boundary is best described by the northern limit of the West Wind Drift, near the northern end of Vancouver Island in British Columbia. The southern boundary is off southern Baja California where the California Current converges with equatorial waters. The offshore boundary of the California Current is usually given as the boundary region between the subarctic water and the eastern north Pacific central water at about 700 km offshore (435 miles; Sverdrup et al. 1942).

Pelagic fish species dominate the exploitable biomass of the California Current ecosystem, with major concentrations close to the coastline. The offshore boundary of the ecosystem for pelagic fish is rather ephemeral and best described by the mean position of the summer wind stress maximum at about 200 km from the continental margin. In the southern California region, the offshore boundary is defined by the western coasts of the Channel Islands. Thus the California Current ecosystem is essentially a region of divergence and upwelling. The offshore area of convergence and downwelling is placed in the Oceanic Pacific ecosystem; the northern area of convergence and downwelling is placed in the Gulf of Alaska ecosystem.

The California Current ecosystem is characterized by a particularly narrow continental shelf and steep continental slope. This is especially true of the area from Cape Blanco, Oregon, to Point Conception, California, where, except in the coastal bight near San Francisco, the shelf is generally narrower than 25 km, and the continental slope varies from about 20 km to 50 km. Off the Pacific Northwest, the topography is less steep, and the shelf and slope widths often exceed 50 km and 70 km. The area off southern California is a classic "continental borderland" of alternating ridges and troughs, with ridges forming islands surrounded by submerged shelves. These large-scale features are punctuated throughout the region by other dramatic features such as deep submarine canyons, steep seamounts and innumerable banks, basins, troughs, and rock piles of a wide range of sizes.

### 1.6.2 Physical Oceanography

The eastern limb of the North Pacific Subtropical Gyre, off the western U.S. and northern Mexico, forms the California Current. In common with other equatorward eastern boundary currents, the California Current is characterized by a generally sluggish flow with filaments, mesoscale eddies, and counterflows. The large-scale surface flow originates in the subarctic waters at the northern boundary, and subarctic characteristics (temperature and nutrient levels) persist in the northern portions of the system. Underlying the surface flow is a poleward undercurrent, and often during periods of reduced upwelling, an inshore countercurrent. Upwelling of deeper subarctic water along the continental margin helps maintain a general subarctic character in the surface layers of much of the system. The southern, tropical margin of the system has a net equatorward outflow, but a nearshore, poleward flow of subtropical water along Baja California results in a strong subtropical influence in the nearshore region south of Point Conception, California.

The ecosystem is heavily influenced by wind-induced coastal upwelling, with the most intense upwelling centered near Cape Mendocino in northern California during the spring and summer. The cool core of upwelled water near the coast is most pronounced in summer, when it occurs from near Cape Blanco along the northern and central California coasts and extends in a plumelike structure to the southwest of Point Conception. A secondary upwelling zone occurs off Baja California, with a springtime, local maximum near Punta Baja.

The Mexican and southern California sections of the California Current are characterized by nearly continuous, low-intensity upwelling that is interrupted only by brief, though often intense, atmospheric disturbances. From Point Conception to Cape Blanco, the region of maximum upwelling, upwelling is intense in spring and early summer; in winter, storms cause alternating periods of onshore and offshore transport. In winter, the typical wind systems cause a predominance of upwelling in the Point Conception area. This upwelling weakens to the north and progressively changes into a predominance of downwelling in the region north of Cape Blanco. Upwelling occurs during the summer in the region between Cape Blanco and Vancouver Island; however, the seasonal latitudinal shifts of the Pacific Basin's atmospheric pressure systems and intense winter storms result in a net annual onshore transport in this region. Offshore transport occurs only intermittently to the north of Vancouver Island.

The combined effects of the southerly surface currents and coastal upwelling result in cool sea-surface temperatures over most of the northern part of the California Current. Winter sea-surface temperatures off Vancouver Island average 8°C and increase southwards to 22°C in southern Baja California. Summer sea-surface temperatures in the region of maximum upwelling, from Cape Blanco to Point Conception, are particularly cool. July sea-surface temperatures in the nearshore areas of northern California average less than 12°C, which is slightly colder than the July sea-surface temperatures in the northernmost Gulf of Alaska. Mean summer sea-surface temperatures are above 14°C in the region between Cape Blanco and Vancouver Island.

Seasonal and interannual environmental variability within the California Current ecosystem are associated with variations in the Pacific Basin atmospheric pressure systems, which control the local winds and Ekman transport and affect flows of the equatorward California Current, the poleward undercurrent and the inshore countercurrent. Variations on time scales of several years are associated with alterations in the tropical pressure system, i.e., the El Niño/Southern Oscillation phenomenon. El Niño events markedly increase temperature and alter the flow of currents in the California Current.

### 1.6.3 Biology and Ecology

The California Current comprises four relatively distinct, though related, ecological components: the pelagic, the littoral, the demersal, and the anadromous. The component of most concern to the present FMP is the pelagic, which encompasses the offshore surface water layer and the species therein, including coastal pelagic fish (northern anchovy, Pacific sardine, Pacific herring, jack mackerel, Pacific (chub) mackerel, bonito, and saury), squids, seabirds, pinnipeds (sea lions and fur seals), and cetaceans (porpoises and whales). Most of the forage produced in the California Current ecosystem (i.e., phytoplankton and zooplankton) comes from the pelagic component.

The exploitable biomass of fish in the ecosystem is dominated by the pelagic component. As in the other major eastern boundary currents, anchovy, sardine, whiting, jack mackerel, and Pacific (chub) mackerel achieve the largest populations. These populations are extremely important to the trophic dynamics of the entire California Current ecosystem; anchovy and sardines are the only fish in the ecosystem that consume large quantities of primary production (phytoplankton), and all five of the species are significant consumers of zooplankton. All five species, particularly mackerels and whiting, are important predators of the early stages of other fish. The juvenile stages of all five species, and in many cases the adults, are important as forage for seabirds, pinnipeds, cetaceans, and other fish.

Trophic interactions between CPS and higher-trophic-level fish are poorly understood, and it is unknown if populations of individual predaceous fish are enhanced or hindered by large populations of CPS. It is not known if the value of CPS as forage to adult predators outweighs the negative effects of predation by CPS on predator's larvae and juveniles plus competitive removal of phytoplankton, zooplankton, and other fish.

### 1.6.4 Climate and Distribution of Species

Fish that dominate the pelagic component of the California Current ecosystem are all warm-temperate or subtropical species that have their centers of reproduction in the southern portion of the system. These fish are unable to complete the early stages of their development at temperatures much below 13°C, with the exception of Pacific whiting, whose minimum is about 10°C. Much of the region north of Point Conception, California, is seasonally outside the range of acceptable temperatures for early stages of CPS species. The region of maximum upwelling (Cape Blanco, Oregon, to Point Conception, California) is particularly unfavorable to early stages of CPS, because the summer winds and upwelling peak cause low temperatures and extensive offshore transport (Parrish et al. 1981). Although the region is relatively unfavorable for reproduction of the major pelagic fish, adults and subadults use the region extensively for feeding. Sardine and whiting, in particular, migrate across the region to feed in the northern section of the current system and to spawn in the Southern California Bight.

In comparison with the region of maximum upwelling, the Pacific northwest region (Vancouver Island to Cape Blanco) is more favorable for the reproduction of coastal pelagic fish, because coastal upwelling is weaker and of shorter duration; the period of favorable temperatures is longer; summer temperatures are warmer; and the Columbia River Plume provides nutrients that contribute to a favorable spawning environment. Separate stocks of Pacific whiting (Bailey et al. 1982) and anchovy (Parrish et al. 1981) occur in the region, and before its population collapse, sardine commonly spawned in the region (Walford and Mosher 1941). The present biomass of CPS stocks in the Pacific northwest is, however, considerably smaller than the biomass of CPS stocks that spawn off of southern California and northern Baja California.

This distribution and abundance of CPS could change with relatively minor climatic change. Colder sea-surface temperatures of only one or two degrees during the spring and summer could greatly reduce the biomass of the resident whiting or anchovy stocks in the Pacific northwest by lowering temperatures below the tolerance limits of the early life-history stages or by shifting the stocks southward. Conversely, warmer spring and summer temperatures could make the region a prime spawning habitat for the entire pelagic complex. There is some evidence that pelagic fish were much more abundant in the northern portion of the

California Current ecosystem during warm periods. Anchovies were very abundant in Puget Sound during the warm 1890s (Swan 1893). Pacific (chub) mackerel and jack mackerel were very abundant in the region during the 1982 through 1983 El Niño (Pearcy et al. 1985). Sardines were very abundant in Puget Sound during the warming of the 1930s (Lluch-Belda et al. 1989).

The southernmost region in the California Current ecosystem off southern Baja California contains stocks of CPS that are somewhat independent of those farther north. These southern stocks, which occur at the warm end of temperature tolerance limits, are characterized by a young age at maturity, high mortality rates, and much lower growth rates than the dominant stocks that spawn off northern Baja California and southern California.

#### 1.6.5 Perspective on Instability of Pelagic Fish Populations and Fisheries

From a fisheries perspective, the most significant characteristic that CPS have in common is their propensity for rapid change (Lluch-Belda et al. 1989). Population size of individual stocks, biomass of some key species, and fishery yields have changed greatly since the inception of major fisheries on CPS in the 1930s. Populations of sardines and Pacific (chub) mackerel have been particularly variable, with biomass levels declining to considerably less than one percent of maximum levels.

There is evidence that CPS abundance varied considerably before the inception of modern fisheries (Soutar and Issacs 1969, 1974), and such variation is expected to depend heavily on environmental conditions. Fishing probably has exacerbated the natural variability in recent decades, because reduced stock size and loss of old fish increase the speed and magnitude of population decreases during periods of poor reproduction. In addition, the probability of stock collapse is exacerbated, because fish in a highly exploited stock may not live long enough to successfully reproduce. Fishery management approaches based on equilibrium or steady-state concepts that ignore variability in abundance have a long history of failure for CPS in many regions of the world (Troadec et al. 1980).

A second feature that will severely affect fishery yields is the geographical expansion and contraction of range associated with changes in the size of CPS populations (MacCall 1990). Geographic range typically expands when abundance increases and contracts when abundance decreases; thus, a species may become unavailable at the edge of its range during a period of low abundance. In contrast, density at the center of the distribution tends to remain rather constant, so catch rates do not decline as fast as abundance. This characteristic has been an important part of the decline of several CPS fisheries, including the fishery for Pacific sardine.

It should be realized that no management regime will produce stable yields for individual CPS species. Biomass of any species managed under this plan may decline to low levels for extended periods, and periods of low biomass will probably occur more frequently for longer periods of time and be more intense under exploitation. Consequently, managers of CPS should expect considerable interannual variation in abundance and yields, and plan to curtail fisheries during periods of low abundance to protect the reproductive capacity and long-term health of the CPS stocks.

### 1.7 Marine Mammal Predators

CPS are eaten by a number of marine mammals (Table 1.7-1), although their importance as forage varies from predator to predator. A great deal of information is available about the diets of marine mammals, and the total amount of CPS eaten per year has been estimated for a few. It is not currently possible, however, to estimate the total amount of CPS used as forage by all marine mammals in the California Current ecosystem, or the size of CPS populations necessary to sustain predator populations.

#### 1.7.1 Management of Marine Mammals

Marine mammal management is based on the Marine Mammal Protection Act of (MMPA) of 1972 and the Endangered Species Act (ESA) of 1973. Under the MMPA, marine mammals whose abundance falls below the optimum sustainable population level (the number of animals at which productivity is maximum, usually regarded as 60% of carrying capacity or maximum population size) can be listed as depleted. Under the ESA, species in danger of extinction throughout all or a significant portion of their range can be listed as endangered, and species likely to become endangered in the foreseeable future can be listed as threatened.

Populations listed as threatened or endangered under the ESA are automatically depleted under the terms of the MMPA. Fisheries that interact with species listed as depleted, endangered, or threatened may be significantly affected under the terms of the ESA and MMPA.

### 1.7.2 Northern Fur Seal

The California Current ecosystem is an important feeding and breeding ground for northern fur seals (*Callorhinus ursinus*). The total population of northern fur seals in 1983 was estimated to be 1.2 million (Fowler, in press). A small population of 5,000 to 7,000 breeds on San Miguel Island in the Channel Islands; the remainder breed in Alaska and Asia. Northern fur seals are found offshore, most densely along and just beyond the continental shelf from Washington through southern California. Northern fur seals that breed on San Miguel Island forage offshore over the continental shelf between San Miguel Island and Point Conception (Antonelis et al. 1980). Between December and May of each year, the resident population in California is joined by approximately 400,000 adult females from the breeding population at the Pribilof Islands in the Bering Sea.

The abundance of northern fur seals is approximately 50% as high as in the 1950s and 1960s, and northern fur seals are classified as a depleted species under the MMPA. The most useful index of population size is the number of pups born at various rookeries. On St. Paul Island in the Bering Sea, where most of the Pribilof population breeds, pup numbers declined from about 451,000 animals in 1950 to 182,000 in 1985 (Fowler, in press). Reasons suggested for the decline include harvest of adult females between 1956 to 1968 and increased natural mortality at sea beginning in the mid 1960s. Other possible causes under investigation include entanglement in man-made debris, incidental take in drift gill net fisheries, and possible competition with commercial fisheries for prey fish.

Feeding habits of northern fur seals are well known (Mead 1953; Kajimura 1984; Antonelis and Perez 1984; Loughlin and Livingston 1986; Sinclair 1988). Fur seals prey on pelagic schooling fish, squid, and, to a lesser extent, demersal fish. Fur seals probably preyed extensively on sardines when they were abundant along the Pacific coast.

Fur seals prey on CPS covered by this management plan, most heavily on anchovy, followed by jack mackerel, and Pacific (chub) mackerel. Anchovy was the most important prey (43% of the diet) for fur seals in California waters during 1984 (Antonelis and Perez 1984). About 21,000 mt of anchovy were consumed off California between January and June, with peak consumption from January through March. Off Oregon and Washington, anchovy was the third prey species in order of importance (11% of the diet) after herring and rockfish. About 4,000 mt of anchovy were consumed between January and June, with peak consumption during February through April. Northern fur seals are estimated to eat about 700 mt of jack mackerel per year (one percent of the diet) off California. Northern fur seals in Oregon and Washington did not eat jack mackerel.

### 1.7.3 California Sea Lion

California sea lions (*Zalophus californianus*) are found in coastal waters of the Pacific Ocean from southern Mexico to southern Canada. California sea lions breed on islands off southern California and Baja California, as well as in the Gulf of California. The U.S. population is growing at 11% a year and currently numbers about 100,000 to 114,000; the population off western Baja California is stable at 68,000 to 78,000 (Lowry, in preparation). Severe reductions in abundance of California sea lions occurred during the 19th and early 20th centuries. In 1928, Bonnot (1928) counted 1,429 in California. California sea lions are not listed as depleted, threatened or endangered.

During the summer breeding season, virtually all adults are present near rookeries. Males migrate northward in the fall, with the oldest going as far as British Columbia, then back to their rookeries in the spring. Adult females generally do not migrate away from rookery areas. Juveniles remain near rookery areas or move into waters off central California.

Diet studies indicate that California sea lions off southern California eat northern anchovy, jack mackerel, Pacific (chub) mackerel, sardine, other species of fish, and cephalopods (Antonelis et al. 1984; Lowry et al. 1990, 1991). Northern anchovy is eaten more frequently than any other prey. Jack mackerel and Pacific (chub) mackerel are also common prey. At this time, sardine is not eaten in significant quantities, but its occurrence in the diet of California sea lions increased after 1987 as sardine biomass increased (Lowry et al.

1991). The sea lions' diet in southern and central California varies seasonally and yearly depending on abundance and availability of prey (Ainley et al. 1982; Antonelis et al. 1984; Lowry et al. 1990, 1991). No estimates of consumption of individual prey species are available.

### 1.7.4 Northern (Steller's) Sea Lion

The northern, or Steller's, sea lion (*Eumetopias jubatus*) inhabits coastal waters from central California to the Aleutian Islands in the Bering Sea off Alaska and across the north Pacific to the Kuril Islands in the Okhotsk Sea off Japan. The center of the northern sea lion's distribution is the Gulf of Alaska and Aleutian Islands. Off California, northern sea lions breed at Año Nuevo Island, the Farallon Islands, Sugarloaf Island (Cape Mendocino), and St. George Reef (near Crescent City). Off Oregon, northern sea lions breed at Rogue Reef and Orford Reef. Northern sea lions do not breed in Washington waters, although a few hundred animals haul out along the coast year-round. Male sea lions, along with some adult females and juveniles, disperse away from rookeries after the summer breeding season; adult females with pups remain near the rookeries year-round.

Northern sea lions are listed as depleted under the MMPA and as threatened under the ESA. The population has declined over the last 30 years throughout its range, with major reductions from the Gulf of Alaska to the Kuril Islands (Merrick et al. 1987; Loughlin and Merrick 1989). Numbers of juveniles and adults in the Kuril Islands declined 74% between 1969 and 1989. Off Alaska, the number of juveniles and adults declined 80% between the late 1950s and 1990s, and as much as 91% in some areas (Merrick et al. 1987, 1991; Loughlin et al. 1990). Numbers of northern sea lions at rookeries off Oregon are stable; in California they have declined, especially in the southern part of the range. Northern sea lions no longer use San Miguel Island as a rookery; none have been observed there since 1983. Año Nuevo Island, off the central California coast, is now the southernmost rookery.

Declines in abundance of northern sea lion may be due to natural factors or human activities. Insufficient data are available to evaluate the importance of environmental factors. It is likely, however, that declines were at least partly due to commercial harvests, sea lion control programs, fisheries, and subsistence hunting. Development and expansion of commercial fisheries throughout the animals' range may have reduced or altered food supplies.

Northern sea lions in central California mostly eat Pacific whiting, rockfish, flatfish, cusk-eels, and cephalopods, as well as small quantities of anchovy and jack mackerel, and probably sardines when available.

### 1.7.5 Harbor Seal

Harbor seals (*Phoca vitulina*) are distributed along the coast and offshore islands from the northern region of western Baja California, Mexico, to Alaska. The population in 1986 was estimated to be at least 25,000 animals off California, and 11,000 off Oregon and Washington (Boveng 1988). Harbor seal populations are increasing in Washington and Oregon. Huber (1992) estimated that there were about 30,000 harbor seals in Washington waters during 1991 and about 7,000 in Oregon. Current abundance relative to historical levels is unknown. Harbor seals are not listed as depleted, threatened, or endangered.

Off southern California, harbor seals eat rockfish, cusk-eels, plainfin midshipman, shiner surfperch, octopus, and flatfish. Infrequently they eat jack mackerel, other fish, and squid (Stewart and Yochem 1985). Anchovies in estuaries along the coast of Oregon and Washington are one of the most important prey for harbor seals throughout the year; many other species of schooling and demersal fish are also eaten (Tracey 1985).

### 1.7.6 Guadalupe Fur Seal

Guadalupe fur seals (*Arctocephalus townsendi*) breed only on Guadalupe Island, Mexico. They are occasionally found at San Miguel Island, San Nicolas Island, and San Clemente Island off California and have been seen near San Francisco. During the last census conducted during the breeding season in 1984, 1,600 fur seals were counted (Seagars 1984).

Historically, Guadalupe fur seals were very abundant, but the population was reduced to a few animals by commercial sealers in the 19th century. Currently, the population at Guadalupe Island is increasing, and the animals are not listed as depleted, threatened, or endangered.

No data are available on the diet of Guadalupe fur seals, but it is assumed that they (like northern fur seals and California sea lions) eat anchovy, Pacific whiting, jack mackerel, Pacific (chub) mackerel, other small schooling fish, and squid.

### 1.7.7 Northern Elephant Seal

Northern elephant seals (*Mirounga angustirostris*) breed on islands off central Baja California, Mexico, north to the Farallon Islands off California and on isolated and protected beaches of central California. Major rookeries in the U.S. are located at San Miguel Island and San Nicolas Island off southern California.

The population is growing at an annual rate of 8.4%. There are an estimated 35,000 elephant seals in Mexico, 74,000 in the United States, and 109,000 in total (Barlow et al., 1997). The population was nearly extinguished in the 19th century by commercial sealers. The current population is descended from about 50 individuals that bred on Guadalupe Island (Le Boeuf and Bonnell 1980). Northern elephant seals are not listed as depleted, threatened or endangered.

Adult males forage in the Gulf of Alaska and eastern Aleutian Islands. Adult females forage off Oregon and Washington as far as 1,900 km offshore (Stewart and DeLong 1991). Northern elephant seals feed on a variety of prey including squids, fish, crustaceans, and tunicates in several oceanic habitat zones (Antonelis et al. 1987). Stomach contents of stranded juveniles in the Southern California Bight contained small quantities of anchovy (Hacker 1986).

### 1.7.8 Bottlenose Dolphin

Two forms of bottlenose dolphins (*Tursiops truncatus*) exist: a coastal form and an offshore form. The coastal form ranges as far north as Monterey Bay (Wells et al. 1990); the offshore form's range is unknown. The population of the coastal form from La Jolla to San Pedro, California, was estimated at 173 to 240 (Hansen 1990). The offshore form in California waters during 1991 was estimated (preliminary figures) to number 2,400 in summer and fall and 3,800 in winter and spring (Barlow et al., 1997). Bottlenose dolphins in California are not listed as depleted, threatened, or endangered.

The primary prey of coastal bottlenose dolphins in California are fish and invertebrates inhabiting the littoral and sublittoral zones. Croakers and surfperch make up the bulk of the diet, and jack mackerel is a minor component (Walker 1981). The offshore form in California was observed feeding on anchovies near San Clemente Island (Leatherwood 1975).

### 1.7.9 Pacific White-Sided Dolphin

Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) are found on continental slope and offshore zones of the northeastern Pacific and Gulf of Alaska from about 20° N latitude to 61° N latitude (Leatherwood and Walker 1982). Resident populations in the Southern California Bight and western Baja California, Mexico, are augmented by an influx of animals from outside the area from October through February; in summer these migrants disperse west and north. The resident population off California during 1991 (preliminary figures) was estimated at 11,000 in summer and fall and 44,000 in winter and spring (Barlow et al., 1997). Pacific white-sided dolphins in California are not listed as depleted, threatened, or endangered.

Pacific white-sided dolphins primarily eat small schooling fish and cephalopods from the epipelagic and mesopelagic zones. Northern anchovy appear to be important, but jack mackerel, Pacific (chub) mackerel, and sardines are also eaten (Walker et al. 1984).

### 1.7.10 Common Dolphin

Common dolphins (*Delphinus delphis*) are found from 36° N latitude to south of the equator and offshore to 132° W longitude (Leatherwood et al. 1982). Common dolphins are the most abundant cetacean in waters off California. Two forms of this species occur in California waters: the short-beaked form and the long-beaked form (Heyning and Perrin 1991). The long-beaked form inhabits coastal waters shallower than 100 fathoms and is usually found within 100 nautical miles of shore. The short-beaked form can be found from the coastline to thousands of miles offshore. Combined abundance of common dolphin off California during 1991 (preliminary figures) was estimated at 265,000 individuals during winter and spring and 450,000 individuals during summer and fall (Barlow, in preparation; Forney, in preparation). Common dolphins in California are not listed as threatened or endangered.

Common dolphins off southern California eat northern anchovy in the fall and winter and deep-sea fish in spring and summer (Leatherwood et al. 1982).

### 1.7.11 Harbor Porpoise

Harbor porpoise (*Phocoena phocoena*) are distributed from Point Conception, California, to Alaska (Leatherwood et al. 1982). Most are found in water no deeper than 18 m (10 fathoms) although individuals have been observed in water as deep as 183 m (100 fathoms). Harbor porpoise off California, Oregon, and Washington in 1985 were estimated to number 45,713 (Barlow 1988). Harbor porpoise in California are not listed as depleted, threatened, or endangered.

In general, harbor porpoise prey on a variety of cephalopods and fish, especially schooling fish such as anchovy, shad, herring, mackerel, sardines, pollock, and whiting (Leatherwood et al. 1982; Jones 1981). Off California they eat mostly fish such as juvenile rockfish, anchovy, Pacific whiting, and Pacific tomcod (Jones 1981). Off Washington, harbor porpoise prey on Pacific herring, smelt, and market squid (Gearin and Johnson 1991).

### 1.7.12 Dall's Porpoise

Dall's porpoise (*Phocoenoides dalli*) are distributed from California to Alaska. Off California, Dall's porpoise are found along the coast as far south as the Channel Islands and in water deeper than 100 fathoms (Leatherwood et al. 1982). From late October to late May, individuals move south and inshore along the coasts of California and Baja California to Cedros and Guadalupe islands. The southward movement past Point Conception is greatest in cold-water years. Abundance of Dall's porpoise off California in spring 1991 (preliminary figures) was estimated as 4,800 during winter and spring and 27,000 during summer and fall (Barlow, in preparation; Forney, in preparation). Dall's porpoise in California are not listed as depleted, threatened, or endangered.

Dall's porpoise feed on squid, crustaceans, and such fish as anchovy, myctophids, saury, whiting, herring, jack mackerel, and Pacific (chub) mackerel (Norris and Prescott 1961; Stroud et al. 1981; Leatherwood et al. 1982). In southern California, they eat anchovy, saury, whiting, and squid (Stroud et al. 1981).

### 1.7.13 Fin Whale

In winter, fin whales (*Balaenoptera physalus*) are distributed from central California to Cabo San Lucas, Baja California, outside the Channel Islands and farther offshore (Leatherwood et al. 1982). In summer, they range from central Baja California to the Bering Sea. The entire north Pacific population is estimated at about 16,000 (Leatherwood et al. 1982). Fin whales off California during the summer and fall of 1991 (preliminary figure) were estimated to number 800 (Barlow, in preparation). The fin whale was once very abundant, but commercial whaling reduced the population to very low numbers, and the fin whale is now listed as an endangered species.

Fin whales are known to feed on anchovy, krill, herring, pollock, capelin, lanternfish, and squid (Rice 1977; Leatherwood et al. 1982).

### 1.7.14 Humpback Whale

During the summer, humpback whales (*Megaptera novaeangliae*) are found over the continental slope from Point Conception to Alaska and Japan. Three stocks, defined by wintering grounds, are recognized 1) Asian, 2) Hawaiian, and 3) Mexican. The Mexican stock winters in southern Baja California, off the mainland near Manzanillo, off Islas Tres Marias, in the Gulf of California, and off the Revillagigedo Islands (Urban and Aguayo 1987). Humpback whales off California during 1991 (preliminary figures) were estimated to number 400 during winter and spring and 700 during summer and fall (Barlow, in preparation; Forney, in preparation). Another estimate for 1991, by photo-identification techniques, was 500 to 1,000 individuals (J. Calambokitis, Cascadia Research Collective, Olympia, Washington, personal communication).

There were about 15,000 humpback whales in the north pacific before 1905 (Leatherwood et al. 1982). Commercial whaling reduced the population to very low numbers, and the humpback whale is now listed as an endangered species.

Humpback whales are known to feed on anchovy, herring, juvenile rockfish, and euphausiids (Brownell 1964; Rice 1977; Dohl et al. 1983; Kieckhefer 1991). Anchovy is common in the diet of humpback whales in California (Rice 1977).

### 1.7.15 Sei Whale

Sei whales (*Balaenoptera borealis*) are a pelagic temperate-water species. In winter, they are sparsely distributed from central California to the Revillagigedo Islands, Mexico. In summer, they are found west of the Channel Islands, California, to the Gulf of Alaska (Leatherwood et al. 1982). Sei whales are present off central California in considerable numbers in late summer and early fall.

When sei whales were first heavily exploited by commercial whalers in 1963, there were an estimated 42,000 in the north pacific (Tillman 1977). This number was reduced to 8,600 by 1974 (20% of the original pre-exploitation estimate). The sei whale is listed as an endangered species.

Sei whales feed on anchovy, sardine, rockfish, sauries, jack mackerel, and krill (Brownell 1964; Rice 1977; Leatherwood et al. 1982). From June through August the dominant food of sei whales off California is anchovy; in September and October, their main food is krill (Rice 1977). Sardine and jack mackerel are a minor component in their diet.

### 1.7.16 Minke Whale

Minke whales (*Balaenoptera acutorostrata*) are sparsely distributed from the Bering and Chukchi seas to the equator (Leatherwood et al. 1982). During 1991 Minke whales (preliminary figures), were estimated to number 100 in winter and spring and 200 in summer and fall (Barlow, in preparation; Forney, in preparation). Minke whales in California are not listed as threatened or endangered.

Minke whales prey on krill, copepods, and schooling fish such as herring, anchovy, and sand lances (Leatherwood et al. 1982; Dorsey et al. 1990).

TABLE 1.7-1. References describing diets of marine mammals that eat northern anchovy, Pacific sardines, Pacific (chub) mackerel, jack mackerel, and market squid.

| Marine Mammal | Anchovy | Sardine | Pacific (chub) | Jack Mackerel |
|---|---|---|---|---|
| **CETACEANS (whales, dolphins** | | | | |
| *Tursiops truncatus* | 20 | | | 18 |
| *Lagenorhynchus obliquidens* | 8,9,10,11 | 8 | 1,6,7,8 | 6,7,8,9 |
| *Delphinus delphis* | 4,10,19 | 4 | | |
| *Phocoena phocoena* | 9 | 19 | | |
| *Phocoenoides dalli* | | | 4,6 | 19 |
| *Megaptera novaeangliae* | 1,5,17,22 | | | |
| *Baleanoptera acutorostrata* | 19 | | | |
| *Balaenoptera borealis* | 5,17,19 | 5 | | 19 |
| *Balaenoptera physalus* | 5 | | | |
| **PINNIPEDS (seals and sea lions):** | | | | |
| *Callorhinus ursinus* | 3,6,7,9 | | 3 | |
| *Arctocephalus townsendi* | 3 | | 3 | |
| *Zalophus californianus* | 2,3,9,13,14 | 14 | 2,3,13,14 | 2,3,9,13,14 |
| *Eumetopias jubata* | 9 | | | 9,21 |
| *Mirounga angustirostris* | 3,23 | 3 | | |
| *Phoca vitulina* | 15 | | | 16 |

TABLE 1.7-1 References:

1. Dohl et al. 1983
2. Antonelis et al. 1984
3. Antonelis and Fiscus 1980
4. Norris and Prescott 1961
5. Rice 1977
6. Stroud et al. 1981
7. Kajimura et al. 1980
8. Walker et al. 1984
9. Jones 1981
10. Fitch and Brownell 1968
11. Fiscus and Niggol 1965 (see also Jones 1984)
12. Hacker 1986
13. Lowry et al. 1990
14. Lowry et al. 1991
15. Beach et al. 1981
16. Stewart and Yochem 1985
17. Brownell 1964
18. Walker 1981
19. Leatherwood et al. 1982
20. Leatherwood 1975
21. Spalding 1964
22. Kieckhefer 1991

## 1.8 Seabird Predators

Pelagic, schooling fish are key components of marine food webs and primary prey of many seabirds. CPS are important to seabirds, because of their abundance near the sea surface (which is high relative to other sources of food), relatively small size, fusiform shape, and dense concentration. Seabird populations of the California Current system, and other eastern boundary currents, are large relative to areas not driven by large-scale coastal upwelling.

Two important groups of seabirds feed on coastal pelagic fish: year-round residents and seasonal residents that breed elsewhere, migrate long distances between areas, and seasonally tap the rich food supplies available in the California Current. The biomass of seasonally resident seabirds in the California Current greatly surpasses that of permanent residents (Briggs et al. 1987). Seasonal migrants can raise California seabird populations from about two million to seven million birds (Briggs and Chu 1987).

Food is not the only factor that affects abundance of seabirds. Eastern boundary currents, such as the California Current, have abundant fish but few small islands (Parrish et al. 1982). Thus, maximum abundance of year-round residents probably depends more on the availability of island breeding space than on food supplies (Ainley and Boekelheide 1990).

Abundance and reproductive success in seabird communities in eastern boundary current systems are sensitive to fluctuations in prey availability even though maximum abundance of permanent residents depends on breeding space. Seabirds switch from one prey species to another as availability changes seasonally or from year to year. Although anchovies, herring, and market squid are currently the primary year-round forage of seabirds off central California (Baltz and Morejohn 1977; Briggs and Chu 1987; Ainley, Point Reyes Bird Observatory, unpublished data), euphausiids and juvenile Pacific whiting are important in spring, and juvenile rockfish during the summer chick-rearing season. When juvenile rockfish are not available in summer, many seabirds switch to anchovies. When suitable forage is not available, breeding efforts fail (Ainley and Boekelheide 1990). This has occurred in the recent past only during El Niño and El Niño-like events (i.e., 1973, 1976, 1978, 1982 through 1983, and 1986) (Ainley and Boekelheide 1990).

The best example of how the availability of pelagic fish species affects reproductive success and abundance of seabird populations in eastern boundary current areas comes from the Peru and Benguela currents. The commercial importance of seabird guano in these areas led to intensive efforts to understand trophic relationships between seabirds and fish. In the Benguela region, fishing pressure on sardines and anchovies reduced their abundance and caused seabirds to switch to more abundant prey species not exploited by the fishery (Crawford and Shelton 1978). In some cases, the switch in forage changed the breeding distributions of seabirds. Later, when the initially unharvested species were also fished down, seabird populations declined.

In Peru, a well-documented case, the decline in abundance of the anchoveta and the collapse of the fishery in 1972 was accompanied by reduced seabird populations (Idyll 1973; Glantz and Thompson 1981; Tovar et al. 1987). Some seabirds later increased to the south off Chile as sardines increased there.

In the North Sea, which is not an eastern boundary area, intense fishing on herring, mackerel, and cod led to an increase in their prey (sand eels) and a subsequent increase in seabirds. After sand eels were heavily fished, seabird populations declined as well (Furness and Ainley 1984).

### 1.8.1 Coastal Pelagic Species as Forage for Seabirds

CPS are consumed by a large number of seabirds off the coasts of California, Oregon, and Washington (Table 1.8.1-1). One shortcoming in the available data is that most studies were conducted during the summer, when adult seabirds were feeding their young (diet data are relatively easy to collect during the feeding period). There is a paucity of diet data for other periods when CPS might be important as forage. Another shortcoming is that most of the available data were collected during the last 30 years when sardines were not abundant or available to seabirds.

Availability of anchovies is known to directly affect the breeding success of pelicans (Anderson et al. 1982), terns (Schaffner 1982), gulls (Hunt and Butler 1980; Ainley and Boekelheide 1990), and auks (Hunt and Butler 1982; Ainley and Boekelheide 1990) in the California Current region. It is likely that many predators of anchovies will also eat sardines when that population increases.

Owing to their size and occurrence near the surface, Pacific (chub) mackerel are likely to be important to seabirds, especially in southern California. Pacific (chub) mackerel have been observed in the diet of pelicans (D.W. Anderson, Department of Fisheries and Wildlife Biology, University of California, Davis, California, personal communication).

Jack mackerel are probably not important to seabirds, because of their large size and relatively deep schooling habits (MacCall et al. 1980). Studies of seabird diet during autumn, however, when small jack mackerel are nearshore and more available, may indicate their seasonal importance as forage. Baltz and Morejohn (1977) found jack mackerel in the winter diet of murres in Monterey Bay. Much of the data on seabird prey come from identification of otoliths in semidigested gut contents, but mackerel otoliths are small, fragile, and hard to detect in stomach samples. The importance of mackerel may, therefore, be underestimated.

Historically, sardines were probably important as forage for seabirds (Ainley and Lewis 1974). Recently, however, sardines have been too sparse to affect reproductive success of most seabirds. The loss of sardines during the mid 1900s shifted the breeding distribution of pelicans (MacCall 1984). As their abundance increases, sardines will probably again become important forage for marine birds. Recent increased abundance of sardines off southern California was followed by increased breeding success and abundance of brown pelicans (Ainley and Hunt 1991).

TABLE 1.8.1-1. Seabird species of the West Coast known to forage on anchovy, sardine, Pacific (chub) mackerel, or market squid. Endangered species (ES) and threatened species (TS) are indicated.

| | Forage Species | | |
|---|---|---|---|
| *Seabird* | Anchovy | Sardine | Pacific (chub) |
| **GREBES & LOONS** | | | |
| *Gavia pacifica* | | * | |
| *Podiceps grisegena* | | * | |
| **PETRELS & ALBATROSSES** | | | |
| *Diomedea nigripes* | * | | |
| *Fulmarus glacialis* | | * | |
| *Puffinus griseus* | | * | * |
| *Puffinus creatopus* | | * | |
| *Puffinus tenuirostris* | | * | |
| *Puffinus opisthomelas* | | * | |

TABLE 1.8.1-1. Seabird species of the West Coast known to forage on anchovy, sardine, Pacific (chub) mackerel, or market squid. Endangered species (ES) and threatened species (TS) are indicated.

| *Seabird* | | Forage Species | | |
|---|---|---|---|---|
| | | Anchovy | Sardine | Pacific (chub) |
| *Oceanodroma leucorhoa* | | | * | |
| *Oceanodroma homochroa* | | | * | |
| *Oceanodroma melania* | | | * | |
| **PELICANS & CORMORANTS** | | | | |
| *Pelecanus occidentalis(ES)* | | * | * | * |
| *Phalacrocorax auritus* | | | * | * |
| *Phalacrocorax penicillatus* | | | * | |
| *Phalacrocorax pelagicus* | | | * | |
| **GULLS** | | | | |
| *Larus glaucescens* | | | * | |
| *Larus occidentalis* | | | * | |
| *Larus heermanni* | | | * | |
| *Larus delawarensis* | | | * | |
| *Larus californicus* | | | * | |
| *Larus canus* | | | * | |
| *Larus philadelphia* | | | * | |
| *Rissa tridactyla* | | | * | |
| **TERNS** | | | | |
| *Sterna elegans* | | | * | |
| *Sterna caspia* | | | * | |
| *Sterna forsteri* | | | * | |
| *Sterna albifrons* | (ES) | | * | |
| **AUKS** | | | | |
| *Uria aalge* | | | * | |
| *Uria lomvia* | | | * | |
| *Cepphus columba* | | | * | |
| *Fratercula cirrhata* | | | * | * |
| *Cerorhinca monocerata* | | | * | * |
| *Brachyramphus marmoratus* | **(TS)** | | * | |
| *Synthliboramphus antiquus* | | | * | |
| *Synthliboramphus craveri* | | * | | |
| *Synthliboramphus hypoleuca* | | | * | |
| *Ptychoramphus aleuticus* | | | * | |
| **RAPTORS** | | | | |
| *Haleaetus leucocephalus* | (ES) | | * | |
| *Pandion haliaetus* | | | * | |

## 2.0 FISHERY COMPONENTS

West Coast coastal pelagic species (CPS) fisheries are described in this section. The inshore component of the CPS fishery has historically been most important in harvesting CPS. This component involves both commercial and recreational fishing, but consists primarily of small commercial vessels that operate off southern California and take CPS in directed fishing with round haul gear or as bycatch with other types of gear. The following describes CPS landings trends, characterizes harvesters and processors of CPS, and describes recreational and Mexican fishery components.

### 2.1 Inshore Component

The inshore component includes fisheries for Pacific sardine (*Sardinops sagax*), jack mackerel (*Trachurus symmetricus*), Pacific (chub) mackerel (*Scomber japonicus*), northern anchovy *(Engraulis mordax*), market squid (*Loligo opalescens*), and other pelagic species (jointly referred to as coastal pelagic species, or CPS). Although market squid will not be actively managed at the outset of the CPS fishery management plan (FMP), it is included in this description because (1) squid is an important source of income for many round haul vessels that also target CPS; and (2) the squid fleet includes fishers who were formerly involved in the sardine fishery, and might wish to resume participation in that fishery as it recovers. The fisheries for CPS and squid are concentrated in California. CPS fishing also occurs, however, in Oregon, Washington, and Mexico.

#### 2.1.1 History of Landings and Regulations

Commercial landings of CPS and squid in the U.S. are monitored (as are most finfish and shellfish landings) via information from landings receipts provided by processors in the form of "fish tickets". CDFG conducts a port sampling program to estimate the species composition of mixed loads of sardine, Pacific (chub) mackerel and jack mackerel, which are otherwise reported as "unspecified mackerel" on fish tickets. Table 2.1.1-1, which describes commercial landings of CPS and squid from 1916 to 1997, is based on fish ticket data adjusted using port sampling information to more accurately reflect the species composition of mixed loads. Landings of CPS in California fluctuated widely during 1916 to 1997 (Table 2.1.1-1), in response to changes in abundance and market conditions. The CPS fisheries are currently in a period of transition. Sardines are showing signs of recovery after the fishery's collapse in the 1940s, with an apparent population increase of 30% to 40% per year over the past decade. Market squid landings have increased over the same period, reaching a record high of 80,319 mt in 1996. In contrast, market and biological conditions are contributing to declining landings of anchovy and Pacific (chub) mackerel.

##### 2.1.1.1 Pacific Sardine

The sardine fishery developed in response to an increased demand for protein products that arose during World War I. The fishery developed rapidly and became so large that by the 1930s sardines accounted for almost 25% of all fish landed in the U.S. (Frey 1971). Coast wide landings exceeded 350,000 mt each season from 1933 through 1934 to 1945 through 1946; 83% to 99% of these landings were made in California, the remainder in British Columbia, Washington, and Oregon (Table 2.1.1.1-1).

In the late 1940s, sardine abundance and landings declined dramatically (MacCall 1979; Radovich 1981). The decline has been attributed to a combination of overfishing and environmental conditions, although the relative importance of the two factors is still open to debate (Clark and Marr 1955; Jacobson and MacCall 1995). Reduced abundance was accompanied by a southward shift in the range of the resource and landings (Radovich 1981). As a result, harvests ceased completely in British Columbia, Washington, and Oregon in the late 1940s, but significant amounts continued to be landed in California through the 1950s (Table 2.1.1.1-1). Sardine landings in Washington and Oregon have remained virtually nil.

During 1967, in response to low sardine biomass, the California legislature imposed a two-year moratorium that eliminated directed fishing for sardine, and limited the take to 15% by weight in mixed loads (primarily jack mackerel, Pacific [chub] mackerel and sardines); incidentally-taken sardines could be used for dead bait. In 1969, the legislature modified the moratorium by limiting dead bait usage to 227 mt (250 short tons). From 1967 to 1974, a lucrative fishery developed that supplied dead bait to striped bass anglers in the San Francisco Bay-Delta area. Sardine biomass remained at low levels and, in 1974, legislation was passed to permit incidentally-taken sardines to be used only for canning or reduction. The law also included a recovery plan for the sardine population, allowing a 907 mt (1,000-short ton) directed quota only when the spawning population reached 18,144 mt (20,000 short tons), with increases as the spawning stock increased further.

In the late 1970s and early 1980s, CDFG began receiving anecdotal reports about the sighting, setting, and dumping of "pure" schools of juvenile sardines, and the incidental occurrence of sardines in other fisheries, suggesting increased abundance (CDFG 1986). In 1986 the state lifted its 18-year moratorium on sardine harvest on the basis of sea-survey and other data indicating that the spawning biomass had exceeded 18,144 mt (20,000 short tons). The state also passed other legislation during the mid- and late 1980s to establish live and dead bait quotas for sardine.

In accordance with the recovery plan specified by law, the annual directed quota was 907 mt (1,000 short tons) during 1986 to 1990; it was increased to 10,886 mt (12,000 short tons) in 1991, 18,597 mt (20,500 short tons) in 1992, 18,144 mt in 1993, 9,072 mt in 1994, 47,305 mt in 1995, 34,791 mt in 1996, 48,988 mt in 1997, and 43,545 mt in 1998. Legislation passed in 1988 permitted an annual dead bait quota of 227 mt (250 short tons) when the directed quota was less than 2,268 mt (2,500 short tons) and 454 mt (500 short tons) when the directed quota exceeded 2,268 mt. In accordance with the law, the dead bait quota was 227 mt (250 short tons) during 1986 to 1990 and 454 mt (500 short tons) thereafter. A live bait quota of 68 mt (75 short tons) was established in 1984; it was increased to 136 mt (150 short tons) in 1985, 318 mt (350 short tons) in 1988, and 907 mt (1,000 short tons) thereafter.

#### 2.1.1.2 Jack Mackerel

Before 1947, jack mackerel was marketed as fresh fish. It was taken in small amounts in loads consisting primarily of sardine and Pacific (chub) mackerel (Frey 1971; Mason 1991). The market for jack mackerel was small, since Pacific (chub) mackerel was preferred by consumers. In 1947, the industry began marketing jack mackerel as a substitute for Pacific (chub) mackerel and sardine as landings and biomass of these two species declined. In 1948, in a move that facilitated consumer acceptance of jack mackerel products, the U.S. Food and Drug Administration authorized use of the label "jack mackerel" for *Trachurus symmetricus* instead of "horse mackerel" (Frey 1971). During 1947 to 1978, jack mackerel dominated "mackerel" landings in all but three years. The general decline in jack mackerel landings after 1978 coincided with an increase in Pacific (chub) mackerel abundance and landings (Table 2.1.1-1). Since 1947, jack mackerel has been sold largely as canned products for human consumption and pet food.

Jack mackerel is also harvested in Californias' recreational fishery incidentally, as bait, and occasionally as a target species. Available information on catch indicates that anglers catch jack mackerel in small amounts.

In 1983, jack mackerel, which was taken incidentally in the expanding Pacific whiting fishery, was added to the list of species covered by the Council's Groundfish FMP. Each year from 1983 to 1990, the FMP specified an allowable biological catch (ABC) of 12,000 mt and an equivalent amount as a quota. The possibility of a joint-venture fishery for jack mackerel prompted the Council to raise the ABC to 52,600 mt and the quota to 46,500 mt in 1991. Exploratory offshore fishing for jack mackerel by factory trawlers has resulted in little success to date. There may be significant bycatch of Pacific (chub) mackerel and sardine in any offshore fishery for jack mackerel (NMFS 1991).

Current participants in the CPS fisheries do not have the capability to fully utilize jack mackerel, because older fish are difficult to take in purse seines and distributed offshore and north of current fishing grounds. Jack mackerel are not harvested in any significant quantities off Mexico. All current regulations in the FMP for groundfish apply to the fishery north of 39° N latitude; the fishery south of 39° N latitude, which includes southern California's coastal fishery, is not regulated.

#### 2.1.1.3 Pacific (Chub) Mackerel

Before 1928, Pacific (chub) mackerel was taken incidentally with sardines and sold as fresh fish (Frey 1971). As markets developed for canned Pacific (chub) mackerel, landings increased to a high of 66,419 mt in 1935 (Table 2.1.1-1). Harvests subsequently underwent a long-term decline, reaching record low levels in the early

1970s. In 1970 the state of California imposed a moratorium on harvest, with a small allowance for incidental catch in mixed loads.

The incidental take of Pacific (chub) mackerel with jack mackerel increased dramatically in 1977 as the result of a very successful spawning in 1976 (Prager and MacCall 1988). The state responded by increasing the tolerance for Pacific (chub) mackerel in mixed loads, and establishing a directed quota. By 1979, with the advent of another strong year class in 1978, Pacific (chub) mackerel was contributing more than jack mackerel to the "mackerel" fishery (Klingbeil 1983), a pattern which continues (CDFG 1991b). Pacific (chub) mackerel is sold mostly in the form of canned products for human consumption and pet food.

Current state regulations on the commercial fishery (1) specify a quota of 30% of the population above 18,144 mt (20,000 short tons) when total biomass is between 18,144 mt and 136,079 mt (20,000 short tons to 50,000 short tons) and (2) allow unrestricted harvest when the biomass exceeds 136,079 mt.

Pacific (chub) mackerel is also harvested in California's recreational fishery as bait and incidental take and as a target species. During 1981 to 1997, the recreational harvest of Pacific (chub) mackerel in southern California averaged about 1,001 mt (2.4 million fish) per year and accounted for 11% to 19% by weight (13% to 27% by number) of the sport harvest (Table 2.1.1.3-1). Pacific (chub) mackerel is also caught by anglers in northern California but in very modest amounts. The statewide sport harvest constitutes a small fraction (two percent to three percent by weight) of total combined sport and commercial landings of Pacific (chub) mackerel.

There is no directed fishery for mackerel in Oregon or Washington. Small amounts are taken incidentally by commercial jig boats and trawlers. Incidental take (reported landings) of Pacific (chub) and jack mackerel peaked in 1997, with 1,984 mt landed in Oregon, and 157 mt landed in Washington (Table 2.1.1.3-2).

#### 2.1.1.4 Northern Anchovy

Anchovy landings, which were relatively low during 1916 to 1946, surged in 1947, when the scarcity of Pacific sardines prompted processors to begin canning anchovies in quantity (Frey 1971). Landings for reduction were limited by restrictions imposed by the California Fish and Game Commission. Over the next two decades anchovy landings increased and then declined with changes in consumer demand for canned anchovies (Table 2.1.1.4-1).

In late 1965 the California Fish and Game Commission authorized a quota for an experimental anchovy reduction fishery. Increases in abundance and in prices for fish meal and oil raised reduction landings to record highs by the mid 1970s. Reduction landings declined somewhat in the late 1970s and early 1980s, when fishers diverted more effort to Pacific (chub) mackerel, which was increasing in abundance. Anchovy landings have been extremely low since 1983, because low exvessel prices offered by reduction processors prompted the fleet to fish for other species (Thomson 1990; Thomson et al. 1991; Jacobson and Thomson 1993). The effects of low prices have been compounded in recent years by low abundance (Jacobson et al. 1995).

Modest amounts of anchovy were harvested for live bait before World War II. Live bait harvests fell to zero during the war years and, since that time, have ranged from 3,500 mt to 7,000 mt per year. Landings for other nonreduction uses (such as dead bait and canned, fresh or frozen products for human consumption) during 1965 to 1997 ranged from about 250 mt to 5,800 mt and were almost always lower than live bait harvests (Table 2.1.1.4-1).

Small amounts of anchovy (from the northern subpopulation) are harvested by commercial albacore vessels in Oregon and Washington. Only two boats in Washington and none in Oregon are known to sell anchovy as bait to the recreational fishery, where Pacific herring is the preferred bait (Table 2.1.1.3-2).

In 1978 the Northern Anchovy FMP was drafted, and federal authorities assumed management of the anchovy fisheries. The FMP has been amended six times, most recently in 1991 (Council 1983, 1990). Current regulations specify an optimum yield (OY) for the reduction fishery of (1) zero, if the estimated spawning biomass is less than or equal to 300,000 mt, or (2) 100% of the spawning biomass above 300,000 mt, up to a limit of 200,000 mt, if the spawning biomass is greater than 300,000 mt.

The FMP imposes no numeric limit on live bait catch and provides a 7,000 mt quota for other nonreduction uses. Over fishing is defined in the FMP using a spawning biomass criterion. If the spawning biomass falls below 50,000 mt for two consecutive years, all harvests (including those for live bait and other nonreduction purposes) are disallowed until the spawning biomass exceeds 50,000 mt.

Although Mexico also harvests anchovy, there is no bilateral agreement between the U.S. and Mexico regarding anchovy management. In the absence of an agreement, the FMP for northern anchovy allocates 70% of total OY to the U.S. reduction fishery and 30% to Mexican fisheries. Similarly, 70% or 4,900 mt of the 7,000 mt quota for nonreduction uses (other than live bait) can be taken in the U.S. exclusive economic zone.

#### 2.1.1.5 Market Squid

The squid fishery in California was established in 1863 by immigrant Chinese fishers in Monterey Bay. The method of fishing involved three skiffs: one carried a torch at its bow to attract squid while the other two encircled the school with a small purse seine. The harvest was sun-dried and exported to China. In 1905, Italian fishers introduced the more efficient lampara net, which soon became the principal gear in the squid fishery. Asian immigrants continued to dry and market squid abroad (Frey 1971).

Domestic markets for canned squid developed in 1920 and for frozen squid in 1926. These products became dominant when the Asian market declined in 1933. Squid harvests increased during World War II, peaking in 1946 as a result of demand by United States and international aid programs (Frey 1971). Landings have steadily increased since 1950, averaging 4,945 mt per year during 1950 to 1960, 7,947 mt during 1961 to 1970, 11,547 mt during 1971 to 1980, 19,609 mt during 1980 to 1990, and 52,959 mt during 1991 to 1997 (Table 2.1.1.5-1). Most of the harvest is canned or frozen for export; smaller amounts are used domestically for human consumption and as live and dead bait.

The commercial squid fishery consists of two distinct segments: a southern California fall-winter fishery and a central California (Monterey Bay) spring-summer-fall fishery. Southern California's share of statewide squid landings, which averaged 54% during 1970 to 1985, increased to about 76% during 1986 to 1997 (Table 2.1.1.5-1). Fishing in southern California is concentrated around the Channel Islands.

During the 1970s, scoop boats, using a power-assisted brail or dip net in conjunction with attracting lights, were the major harvesters in the southern California fishery (Kato and Hardwick 1975). Local purse seiners also targeted squid when CPS were not available. During the 1980s, however, purse seines became the predominant gear in southern California. Many of the scoop boats now work in partnership with the purse seiners; for a percentage of the landed value a scoop boat will use lights to attract squid, which are subsequently wrapped and landed by a seiner.

Purse seines were outlawed in Monterey Bay in 1953, and attracting lights in 1959; lampara nets have predominated in that area until very recently (Kato and Hardwick 1975). On the basis of preliminary results from a 1987 to 1988 study indicating that purse seines have no greater impact on squid spawning or egg-case mortality than lampara nets, CDFG began allowing purse seine gear in Monterey Bay in 1989. Other legislation passed that same year allowed attracting lights in the bay. Many of the Monterey lampara boats have invested in light systems and switched to half-purse drum seines, which require fewer crew members than the traditional purse seine (CDFG 1991a).

Squid are subject to natural cyclical changes in abundance. They are short-lived with a maximum life span probably about two years. There are no regulatory restrictions on squid harvest.

In 1997, the state of California passed legislation which requires possession of special permits to fish for market squid in California waters (see Appendix B, Section 2.2.5.2.3.8 for details on Californias' market squid regulations). The new law applies to both fishing and light boat vessels. A three-year moratorium on the sale of new permits was effective May 1, 1998. Approximately 270 permits were sold by the final purchase deadline of May 31, 1998. Information on the coastwide composition of permit holders is not yet available, but vessel owners from as far north as Alaska have expressed interest in Californias' squid resource. Further decline of Pacific herring off Alaska (NMFS, 1996) may lead to increased interest in the future.

### 2.1.2 Commercial Fisheries

This section describes the harvesting and processing sectors of the commercial fisheries as they relate to CPS and squid.

#### 2.1.2.1 Harvesters

Tables 2.1.2-1 through 2.1.2-7 are based on vessel summaries generated from Washington, Oregon, and California fish ticket data converted to Pacific Coast Fisheries Information Network (PacFIN) format. Several points should be kept in mind in interpreting the tables:

1. The PacFIN gear category "ONT" or "Other Net" includes (a) round haul gears (encircling nets such as purse seines, drum seines and lampara nets) and (b) net gears of unspecified type. Thus, in addition to round haul gears, ONT may also include gill net, trawl and other net gears not specifically identified on fish tickets. All gears coded as ONT in the PacFIN data base are loosely referred to as "round haul" in Tables 2.1.2-1 through 2.1.2-7, although they include unspecified net gears as well as round haul gears.

2. The gear category described in Tables 2.1.2-1 through 2.1.2-7 as "Other/Unknown" includes (a) specific gears other than round haul/unspecified net, line, pot/trap, dip net, trawl or gill net (i.e., dredge and harpoon), and (b) gears that were unreadable or missing from fish tickets and, therefore, unknown. Thus, in addition to dredge and harpoon, "Other/Unknown" also includes gear types that were unidentifiable on the fish tickets.

CPS and squid are landed largely with round haul gear, and modest amounts are taken incidentally with other gears (Table 2.1.2-1). During 1981 to 1997, nearly all of the anchovy, mackerel and sardine landings were made with round haul or other/unknown gear. Other/unknown probably includes some round haul landings that were not specified as such on the fish tickets. During 1981 to 1997, nearly all of the squid landings were made with round haul, dip net or other/unknown gears.

Table 2.1.2-2 describes the number of vessels that landed any CPS or squid during 1981 to 1997, according to the vessel's principal gear. Principal gear is defined by plurality of landings (i.e., the gear with which the vessel made most of its landings during the year). The vessels are further categorized according to where (California, Oregon, or Washington) they made most of their landings. On an annual basis, about 50% to 75% of boats landed CPS but no squid; the remainder is split between boats landing both CPS and squid and boats landing squid but no CPS. In each year, most boats landing CPS or squid were round haulers; line vessels (e.g., trollers, longliners) were the second most common.

Table 2.1.2-3 distinguishes vessels that landed any CPS or squid during 1981 to 1997 on the basis of whether or not their principal gear was round haul, and on where (California, Oregon, Washington) they made most of their landings. It further categorizes the round haul vessels according to whether they landed (1) less than 50 mt of CPS+squid, (2) ≥50 mt of squid but no CPS, (3) some CPS and at least 50 mt of CPS+squid, or (4) at least 50 mt of CPS during the year.

The number of round haulers in category (1) with less than 50 mt of CPS+squid decreased from an average of 40 vessels in the early 1980s to about 25 vessels between 1986 and 1992. The number increased again in the early-1990s to mid-1990s to an average of 42 vessels (Table 2.1.2-3).

Landings categories (2) through (4) include round haul vessels that landed at least 50 mt of squid, CPS+squid or CPS annually during 1981 to 1997. The 49 vessels to 98 vessels included in these categories represent the more active participants in the fishery. Since round haul gear is customarily used to target CPS and squid, these vessels are likely to be true round haulers and not affected by the ambiguities discussed above.

Table 2.1.2-4 describes the total number of vessels in Washington, Oregon, and California that landed any CPS or squid during 1981 to 1997 and the proportion of these vessels in five categories: non-round haul vessels, and round haulers in each category described in Table 2.1.2-3. The table also describes total annual landings of CPS and squid in Washington, Oregon, and California during 1981 to 1997 and the proportion of these landings accounted for by vessels in each of the five categories. Three general patterns can be discerned from the table:

1. Although the non-round haulers and round haulers in landings category (1) together made up most of the vessels that landed any CPS or squid each year, these vessels accounted for a very small proportion of total CPS and squid landings. For instance, these vessels constituted 91.2% of all vessels that landed any CPS or squid in 1990, but accounted for only 3.7% of total CPS landings and 3.2% of squid landings in that year.

2. Round haulers in landings categories (2) and (3) harvested zero to negligible amounts of CPS, but a disproportionate amount of squid. For instance, in 1990 these vessels constituted 1.6% of all vessels that landed any CPS or squid and accounted for 0.2% of total CPS landings and 24.7% of total squid landings.

3. Category (4) round haulers landed a disproportionate amount of both CPS and squid during 1981 to 1997. For instance, while these vessels constituted 7.3% of all vessels landing any CPS or squid during 1990, they accounted for 96.1% of total CPS landings and 70.0% of total squid landings during that year.

Tables 2.1.2-5 through 2.1.2-7 describe vessels in landing categories (1) to (4) in terms of selected characteristics. The main points are:

1. Category (1) vessels are dispersed throughout southern and central California (Table 2.1.2-5). Prior to 1993, the major ports of landing for vessels in categories (2) and (3) were in the Monterey area and, to a lesser extent, in Ventura and Santa Barbara counties. From 1993 to 1997, there was a dramatic increase in the number of category (2) and (3) vessels in Ventura and Santa Barbara counties, primarily due to expansion of the market squid fishery off southern California. Category (4) vessels are geographically concentrated in Orange and Los Angeles counties (particularly San Pedro) and, to a lesser extent, in Ventura and Santa Barbara counties (Port Hueneme) and in Monterey Bay.

2. During 1981 to 1990, category (1) vessels landed about 87 mt of fish (all species, Table 2.1.2-6) with an exvessel value of about $85,300 (Table 2.1.2-7). During 1991 to 1997, category (1) vessel landings doubled to 170 mt, and average exvessel revenues increased to an average of $169,600.

3. During 1981 to 1997, vessels in categories (2) and (3) exhibited very similar patterns of fishing activity (Tables 2.1.2-6 to 2.1.2-7). For the period, both groups averaged about 591 mt per vessel per year in landings and about $239,000 per vessel per year in revenues. For both groups, squid accounted for 80% of total landings and over 60% of total revenues.

4. During 1981 to 1997, category (4) vessels averaged 2,156 mt per vessel per year with an average exvessel value of $633,000 (Tables 2.1.2-6 and 2.1.2-7). CPS finfish accounted for about 61% of their landings and 34% of their revenues, while squid accounted for abut 25% of landings and 22% of revenue activity (Tables 2.1.2-6 to 2.1.2-7).

In addition to CPS finfish and squid, round haul vessels also target Pacific bonito (*Sarda chiliensis*) and bluefin tuna (*Thunnus thynnus*) in southern California, and Pacific herring (*Clupea harengus pallasi*) in central California (Table 2.1.2-8). These three species account for most of the non-CPS and non-squid landings made by vessels in categories (2) to (4).

### 2.1.2.2 Markets and Exvessel Prices

Table 2.1.2-8 describes mean exvessel real prices[1/] of anchovy, mackerel, sardine, squid, bonito and bluefin tuna caught with round haul gear during 1981 to 1997. All prices are based on Washington, Oregon, and California fish ticket data converted to PacFIN format.[2/]

Prices and markets can be described as follows:

1. Anchovy is used for a variety of purposes, including reduction, live and dead bait, and human consumption. Although live bait harvest is not regulated, all other harvests are subject to separate reduction and nonreduction quotas.[3/] California Department of Fish and Game (CDFG) distinguishes between landings (without relying on the disposition code on fish tickets) by attributing landings received at known reduction plants to the reduction quota and all other landings to the nonreduction quota.

   Reduction landings, which generally receive a much lower exvessel price than nonreduction landings, have been exceedingly low since 1983 (Table 2.1.1-4-1), when the price fell below $50/mt. Nonreduction landings have increased in recent years, largely as a result of increased exports for human consumption. While still low, nonreduction landings now dominate total anchovy landings.

   The predominance of reduction landings during 1981 to 1982 is reflected in the low average prices (Table 2.1.2-8) during those years. From 1983 onward, total landings were lower (Table 2.1.1.4-1) but prices were higher (Table 2.1.2-8), reflecting the shift from reduction to higher-priced uses.

2. Commercially harvested mackerel is processed into canned products for pet food and human consumption, and a small but increasing amount is sold to fresh fish markets that cater to California's growing Asian immigrant population. Sardines landed in mixed loads with mackerel receive the same price as mackerel and are processed into the same products. Thus the mackerel prices described in Table 2.1.2-8 pertain to sardine taken incidentally with mackerel as well as to "pure" mackerel landings.

3. Because of the moratorium on sardine landings, pre-1986 landings were too low (Table 2.1.1-1) to provide any meaningful information about prices for different uses (e.g., canned or dead bait). Thus all prices in Table 2.1.2-8 are averages for all types of products. The average sardine price, which was $244/mt in 1986 when the moratorium was lifted, declined to $79/mt by 1997.

4. Squid are generally frozen or canned and exported for human consumption. Smaller amounts are sold domestically in the fresh markets and used for live and dead bait by commercial and recreational fisheries. Exvessel prices vary with the disposition of catch; landings for human consumption receive a higher price than frozen bait landings. Prices tend to be lower in southern California than in central and northern California. The general increase in landings since the early 1980s (Table 2.1.1-1) was accompanied by a steady decline in average prices until 1992 when prices increased (Table 2.1.2-8).

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1/ Real prices are corrected for inflation over time thus expressing the amount in constant (1990) dollars.

2/ Since prices tend to vary significantly by disposition of catch, it would have been informative to report average prices by disposition. However, the disposition codes reported on the California fish tickets were not deemed sufficiently reliable to do this.

3/ Live bait harvests are reported on logbooks maintained by bait haulers and not on the fish tickets.

5. Bonito and bluefin tuna are important sources of income to category (4) round haulers (i.e., the 50 or so southern California purse seiners that land at least 50 mt of CPS during the year; see Tables 2.1.2-6 and 2.1.2-7). These species vary in availability both seasonally and annually and command considerably higher prices than CPS or squid.

Bonito are generally sold as canned, fresh and frozen products for human consumption. Mean annual prices ranged from $372 to $454/mt and averaged about $411/mt during 1993 to 1997.

The average tuna price was extraordinarily high ($1,455/mt) in 1988, when record-size bluefin were landed by San Pedro purse seiners and sold at premium prices in the Japanese sashimi market (Thomson et al. 1989). The average price during 1993 to 1997 was about $785/mt.

### 2.1.2.3 Fish Dealers

Tables 2.1.2-9 to 2.1.2-12 provide information on west coast fish dealers who received any CPS or squid during 1981 to 1997. These tables are based on dealer summaries generated from PacFIN summary data. Several points should be kept in mind in interpreting the tables:

1. Fish sometimes pass through several dealers between the point of landing and the final market. The dealer reported on the fish ticket represents the first transaction after the fish are landed.

2. Each dealer code is specific to a particular plant belonging to a particular fish processing or distributing company. Thus a company with multiple plants would be represented by multiple dealer codes in the database.

3. Sometimes a dealer will set up receiving stations at several ports and truck the landings to the processing plant. Since the port reported on the fish tickets reflects where the landing is made and not the location of the plant, the tickets sometimes show a single dealer receiving landings in several different ports. Thus each dealer's principal landing area is defined in Tables 2.1.2-9 and 2.1.2-10 as the area in which he received most of his landings.

During 1981 to 1997, 142 to 191 California dealers purchased CPS or squid from commercial fishing vessels each year (Table 2.1.2-9). Tables 2.1.2-10 to 2.1.2-12 categorize these dealers according to whether they purchased (1) less than 500 mt of CPS+squid, (2) at least 500 mt of squid but no CPS, (3) some CPS and at least 500 mt of CPS+squid, or (4) at least 500 mt of CPS during the year. The tables can be summarized as follows:

1. During 1981 to 1997, about 45% of the category (1) dealers received most of their landings in southern California (San Diego to Santa Barbara counties); about 35% received most of their landings in central California (San Luis Obispo to San Francisco Bay); and about 20% received most of their landings in areas north of San Francisco (Table 2.1.2-10).

   California processing companies in category (1) received an average of 242 mt of fish (all species) per year during 1986 to 1997, of which about five percent consisted of CPS and three percent consisted of squid (Table 2.1.2-11). Although these processors accounted for more than 86% of all California processors who received any CPS or squid during the year, they accounted for only 2.4% of total CPS landings and less than three percent of total squid landings made in California (Table 2.1.2-12).

2. During 1981 to 1997, about 55% of category (2) and (3) dealers received most of their landings in southern California; the rest received most of their landings in central California (Table 2.1.2-10). These dealers tend to handle higher volumes of raw product and are much more dependent on squid than category (1) dealers.

   During 1986 to 1997, California processing companies in categories (2) and (3) received an average of about 2,869 mt of fish (all species) per year, about four percent of which was CPS, and about 74% squid (Table 2.1.2-11). While categories (2) and (3) made up less than five percent of all

CPS/squid processing companies in California on average, they received about 30% of total squid landings in California (Table 2.1.2-12).

3. Category (4) dealers are located predominantly in southern California; they derive most of their raw product from CPS or squid and account for most of the CPS and squid landings made in the state. From 1981 to 1997, about 82% of the category (4) dealers received most of their landings in southern California, and about 18% received most of their landings in central California.

   California processing companies in category (4) received an average of about 9,280 mt of fish (all species) per year from 1986 to 1997, about 51% of which was CPS and about 32% squid (Table 2.1.2-11). Although these processors made up only nine percent of California processors receiving any CPS or squid during the year, they accounted for about 96% of total CPS landings and about 69% of total squid landings in California (Table 2.1.2-12).

### 2.1.3 Recreational Fisheries

According to the Marine Recreational Fishery Statistics Survey, between 4.2 and 12.5 million marine recreational fishing trips are taken in California each year from 1980 to 1997 (Table 2.1.3-1). These figures underestimate the true level of fishing activity, because they do not include trips targeted on salmon or striped bass, or trips aboard commercial passenger fishing vessels (CPFV's)[4/] and private boats which originated in the United States but fished in Mexican waters. Annual fishing expenditures are approximately $500 million in southern California (Thomson and Crooke 1991) and $180 million in central and northern California (Thomson and Huppert 1987).

As indicated in Section 2.1.1.3, Pacific (chub) mackerel accounts for about 11% to 19% (by weight) of the total sport harvest of all species in southern California. In addition, anchovy is a major source of bait for the recreational fishery in both southern and northern California. In southern California, anchovy is used as bait on approximately 35% of beach trips, 66% of pier trips, 84% of CPFV trips and 71% of private boat trips (Table 2.1.3-2), and is more likely to be used live than dead on boat-based trips. In northern California, anchovy is used almost exclusively as dead bait.

The live bait fleet consists of approximately 18 boats that are distributed along the southern California coast to conveniently service the principal sportfishing markets. Two types of gear are used in the fishery (1) the lampara net, which is set in shallow water and cannot be used effectively in deep water offshore; and (2) the more versatile drum seine, which can be set in deep as well as shallow water and used to harvest mackerel as well as anchovy. The drum seine is of more recent origin, and about six boats in the fleet currently use this gear. The live bait boats fish for a variety of species other than anchovy, such as squid, sardine, mackerel, white croaker and queenfish. Anchovies, however, are most of the live bait catch during most years.

About 20% of the live bait harvest is sold to anglers aboard private boats for $20 per scoop. Live bait haulers sell the rest of their bait to CPFV's. The value of these sales is difficult to pinpoint, since bait haulers receive 12.5% to 16.0% of the CPFV's gross revenues rather than a fixed price.

### 2.1.4 Mexican Fisheries

In 1962, Mexico began harvesting anchovy, primarily for reduction. Mexico's harvesting and processing capacity increased significantly in the late 1970s, due to the addition of a number of large seiners to the fleet and the construction of a large reduction plant in Ensenada. Mexican anchovy landings reached a high of 258,745 mt in 1981, fell to 174,634 mt in 1982, and ranged from 79,495 mt to 124,482 mt per year during 1983 to 1989. Mexican anchovy landings surpassed U.S. landings during 1977 to 1989 and constituted more than 90% of total landings during 1983 to 1989. In 1990, Mexican anchovy landings fell to a record low of 99 mt and have remained generally low (Table 2.1.1.4-1). In 1991, the large reduction facility in Ensenada

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4/ CPFV's transport paying passengers to and from the fishing grounds and provide bait, food, beverage service, gear rental, and fish cleaning.

closed, although smaller plants remain open. Overfishing, changing environmental conditions and low demand have been cited as reasons for the fishery's demise.

Sardine and Pacific (chub) mackerel are harvested in Mexico as well as in the U.S. (Table 2.1.4-1). Mexican landings in recent years have been roughly equal to or greater than U.S. landings.

## 2.2 Take of Non-CPS in the CPS Fishery

The most important way in which CPS fishing affects non-CPS species (including endangered or threatened species) is via the food chain because many CPS (i.e. northern anchovy, Pacific sardine and market squid) are important food sources (Appendix A, tables 1.1.2-1, 1.6-1 and 1.7.1-1). Ecological effects and requirements of dependent species are important considerations in managing harvests of CPS (Appendix B, Section 4.2.1.1).

Another area of concern is "take" (incidental mortality) of birds, fish and marine mammals (especially threatened, endangered or sensitive species) during fishing for CPS. This potential problem may be exacerbated for CPS because anchovy, sardine and squid are forage for many predators (including threatened or endangered species) that may feed on CPS while fishing gear is deployed, become entangled or captured and drown. The problem is reduced somewhat by the fact that fishing gear used to harvest CPS (mostly purse seines made of small mesh) does not tend to entangle and drown predators although they may be captured within the net as the purse seines are closed.

Available information about take of birds, fish and marine mammals during CPS fishing is summarized below. Data are limited, however, because there have been no observer programs in the CPS fishery.

### 2.2.1 Take of Marine Mammals in the CPS Fishery

Under the terms of the Marine Mammal Protection Act, the California purse seine (CPS) fishery is "Category II." Category II fisheries are characterized by incidental mortality of marine mammals at levels less than 50% of the PBR (potential biological removal) level. Category I fisheries, in contrast, are characterized by higher (>50% of PBR) marine mammal mortality rates while Category III fisheries involve very little or no marine mammal mortality. Category II fisheries can be required to carry observers for monitoring of marine mammal mortality, however, funding limitations generally preclude observer programs in any but Category I fisheries.

Interactions between the CPS fishery and marine mammals occur when mammals contact round haul gear during fishing. Mortality occurs when marine mammals become entangled and drown or when fishers use firearms to kill marine mammals (e.g. California sea lions) interfering with a set. Use of firearms is not legal and frequency of use is unknown.

Precise estimates of mortality rates from these sources in the CPS fishery are not available but a significant amount of qualitative information exists for most marine mammal species along the west coast (Barlow et al. 1997 and Table 2.2.1-1). State and federal biologists indicate that the most significant interaction (in terms of impacts on the marine mammal stock) may be between pilot whales, which are relatively rare along the West Coast, and the squid fishery.

TABLE 2.2.1-1. Summary of information about marine mammal mortality in the CPS fishery (Barlow et al. 1997).

| Marine Mammal | CPS Fishery | Average Annual Mortality for 1991-1995, as Available (Individuals / Year) |
|---|---|---|
| California sea lion | finfish | 2 |
| | squid | 2.67 |
| Harbor seals (California stock) | finfish | 0.67 |
| Risso's dolphin | squid | >0 |
| Bottlenose dolphin | finfish | >0 |
| Short-finned pilot whale | squid (probably) | >0 |

### 2.2.2 Take of Endangered Salmon in the CPS Fishery

A number of salmonid (salmon and trout) species along the west coast are listed under the Endangered Species Act (ESA), eat CPS, and might be taken incidentally during CPS fishing (Table 2.2.2-1). Although not listed under the ESA, Oregon Coastal Native (OCN) coho are at a low abundance level and might also be taken incidentally during CPS fishing.

No data are available concerning catch rates or mortality of salmonids during fishing for CPS although California Department of Fish and Game biologists report that some bycatch and mortality of salmon may occur off central California where salmon abundance is relatively high and CPS fishing occurs. At present, most CPS fishing occurs off southern California where salmon are not common. Salmonid bycatch may grow to be a more significant problem as the sardine stock expands its range in the north and northern fisheries develop.

TABLE 2.2.2-1. Salmonid stocks along the West Coast that are either threatened or endangered under the Endangered Species Act (ESA).

| Species | Stock | Status |
|---|---|---|
| **Chinook Salmon** | | |
| | Sacramento River Winter Run | Endangered |
| | Snake River Spring/summer Run | Threatened |
| | Snake River Fall Run | Threatened |
| **Coho Salmon** | | |
| | Central California | Threatened |
| | Southern Oregon/northern ca | Threatened |
| | Oregon Coast | Threatened |
| **Sockeye Salmon** | | |
| | Snake River | Endangered |
| **Steelhead Trout** | | |
| | Upper Columbia River | Endangered |
| | Lower Columbia River | Threatened |
| | Snake River Basin | Threatened |
| | Central California Coast | Threatened |
| | South-central California Coast | Threatened |
| | Central Valley | Threatened |
| | Southern California | Endangered |
| **Cutthroat Trout** | | |
| | Umpqua River Cutthroat | Endangered |

### 2.2.3 Take of Endangered Birds in the CPS Fishery

Endangered and threatened birds that eat CPS and may encounter fishing gear for CPS are the least tern, marbled murrelet, and bald eagle. No hard data exist but knowledgeable sources report that take of these species in the CPS fishery is likely zero.

TABLE 2.1.1-1. Landings of northern anchovy, Pacific sardine, jack mackerel, Pacific (chub) mackerel and market squid in California (mt), 1916-1997.

| Year | Northern Anchovy | Pacific Sardine | Jack Mackerel | Pacific (chub) Mackerel | Total Mackerel | Squid | Grand Total |
|---|---|---|---|---|---|---|---|
| 1916 | 241 | 7,098 | n.a. | n.a. | 505 | 125 | 7,969 |
| 1917 | 240 | 47,221 | n.a. | n.a. | 1,518 | 199 | 49,178 |
| 1918 | 394 | 71,511 | n.a. | n.a. | 1,817 | 164 | 73,886 |
| 1919 | 730 | 69,798 | n.a. | n.a. | 1,204 | 1,677 | 73,409 |
| 1920 | 258 | 53,761 | n.a. | n.a. | 1,360 | 231 | 55,610 |
| 1921 | 883 | 26,913 | n.a. | n.a. | 1,322 | 196 | 29,314 |
| 1922 | 296 | 42,366 | n.a. | n.a. | 1,119 | 95 | 43,876 |
| 1923 | 139 | 71,741 | n.a. | n.a. | 1,612 | 535 | 74,027 |
| 1924 | 157 | 110,082 | n.a. | n.a. | 1,464 | 3,099 | 114,802 |
| 1925 | 42 | 143,017 | n.a. | n.a. | 1,590 | 858 | 145,507 |
| 1926 | 27 | 130,065 | 107 | 1,638 | 1,745 | 1,422 | 133,259 |
| 1927 | 167 | 155,255 | 210 | 2,145 | 2,355 | 2,728 | 160,505 |
| 1928 | 162 | 190,633 | 244 | 15,990 | 16,234 | 613 | 207,642 |
| 1929 | 174 | 295,642 | 317 | 26,297 | 26,614 | 2,114 | 324,544 |
| 1930 | 145 | 227,734 | 167 | 7,499 | 7,666 | 4,976 | 240,521 |
| 1931 | 140 | 165,269 | 255 | 6,466 | 6,721 | 789 | 172,919 |
| 1932 | 136 | 191,695 | 243 | 5,658 | 5,901 | 1,919 | 199,651 |
| 1933 | 144 | 284,132 | 459 | 31,577 | 32,036 | 374 | 316,686 |
| 1934 | 117 | 507,997 | 717 | 51,641 | 52,358 | 694 | 561,166 |
| 1935 | 81 | 497,033 | 4,529 | 66,419 | 70,948 | 370 | 568,432 |
| 1936 | 89 | 663,859 | 2,086 | 45,606 | 47,692 | 429 | 712,069 |
| 1937 | 103 | 486,025 | 2,967 | 27,641 | 30,608 | 228 | 516,964 |
| 1938 | 334 | 464,206 | 1,875 | 36,219 | 38,094 | 725 | 503,359 |
| 1939 | 974 | 526,533 | 1,706 | 36,700 | 38,406 | 527 | 566,440 |
| 1940 | 2,876 | 410,947 | 650 | 54,660 | 55,310 | 817 | 469,950 |
| 1941 | 1,862 | 572,657 | 938 | 35,456 | 36,394 | 649 | 611,562 |
| 1942 | 769 | 439,874 | 2,426 | 23,838 | 26,264 | 428 | 467,335 |
| 1943 | 713 | 441,019 | 5,760 | 34,117 | 39,877 | 4,157 | 485,766 |
| 1944 | 1,765 | 520,370 | 5,796 | 37,947 | 43,743 | 4,961 | 570,839 |
| 1945 | 733 | 383,318 | 4,097 | 24,366 | 28,463 | 6,906 | 419,420 |
| 1946 | 872 | 231,679 | 6,846 | 24,438 | 31,284 | 17,248 | 281,083 |
| 1947 | 8,591 | 115,900 | 58,536 | 21,082 | 79,618 | 6,596 | 210,705 |
| 1948 | 4,915 | 164,219 | 33,067 | 17,865 | 50,932 | 8,734 | 228,800 |
| 1949 | 1,507 | 287,299 | 23,247 | 22,576 | 45,823 | 3,111 | 337,740 |
| 1950 | 2,213 | 324,105 | 60,444 | 14,810 | 75,254 | 2,720 | 404,292 |
| 1951 | 3,155 | 149,188 | 40,750 | 15,204 | 55,954 | 5,617 | 213,914 |
| 1952 | 25,303 | 6,500 | 66,462 | 9,346 | 75,808 | 1,665 | 109,276 |
| 1953 | 38,935 | 4,295 | 25,288 | 3,403 | 28,691 | 4,045 | 75,966 |
| 1954 | 19,237 | 61,918 | 7,863 | 11,518 | 19,381 | 3,699 | 104,235 |
| 1955 | 20,272 | 66,047 | 16,218 | 10,574 | 26,792 | 6,474 | 119,585 |
| 1956 | 25,819 | 31,550 | 34,366 | 22,686 | 57,052 | 8,838 | 123,259 |
| 1957 | 18,392 | 20,803 | 37,200 | 28,143 | 65,343 | 5,647 | 110,185 |
| 1958 | 5,263 | 92,736 | 10,009 | 12,541 | 22,550 | 3,383 | 123,932 |
| 1959 | 3,254 | 33,733 | 17,013 | 17,056 | 34,069 | 8,914 | 79,970 |
| 1960 | 2,295 | 26,097 | 33,995 | 16,696 | 50,691 | 1,162 | 80,245 |
| 1961 | 3,498 | 19,581 | 44,274 | 20,008 | 64,282 | 4,666 | 92,027 |
| 1962 | 1,254 | 6,969 | 40,814 | 22,035 | 62,849 | 4,249 | 75,321 |
| 1963 | 2,073 | 3,235 | 43,292 | 18,254 | 61,546 | 5,244 | 72,098 |
| 1964 | 2,257 | 5,959 | 40,684 | 12,169 | 52,853 | 7,454 | 68,523 |
| 1965 | 2,601 | 873 | 30,240 | 3,198 | 33,438 | 8,446 | 45,358 |
| 1966 | 28,250 | 398 | 18,535 | 2,100 | 20,635 | 8,630 | 57,913 |
| 1967 | 31,575 | 68 | 17,319 | 529 | 17,848 | 8,891 | 58,382 |
| 1968 | 14,096 | 56 | 25,251 | 1,421 | 26,672 | 11,309 | 52,133 |
| 1969 | 61,362 | 48 | 24,459 | 1,070 | 25,529 | 9,425 | 96,364 |
| 1970 | 87,311 | 201 | 21,658 | 282 | 21,940 | 11,154 | 120,606 |
| 1971 | 40,690 | 135 | 27,162 | 71 | 27,233 | 14,296 | 82,354 |
| 1972 | 62,688 | 169 | 23,187 | 49 | 23,236 | 9,144 | 95,237 |
| 1973 | 120,327 | 69 | 9,351 | 26 | 9,377 | 5,471 | 135,244 |
| 1974 | 75,017 | 6 | 11,547 | 61 | 11,608 | 13,111 | 99,742 |
| 1975 | 143,799 | 2 | 16,683 | 130 | 16,813 | 10,715 | 171,329 |
| 1976 | 113,326 | 24 | 20,207 | 298 | 20,505 | 9,211 | 143,066 |
| 1977 | 101,131 | 5 | 45,508 | 5,420 | 50,928 | 12,811 | 164,875 |
| 1978 | 11,437 | 5 | 31,258 | 11,376 | 42,634 | 17,145 | 71,221 |

TABLE 2.1.1-1. Landings of northern anchovy, Pacific sardine, jack mackerel, Pacific (chub) mackerel and market squid in California (mt), 1916-1997. (Continued).

| Year | Northern Anchovy | Pacific Sardine | Jack Mackerel | Pacific (chub) mackerel | Total Mackerel | Squid | Grand Total |
|---|---|---|---|---|---|---|---|
| 1979 | 48,881 | 16 | 16,602 | 27,643 | 44,245 | 19,689 | 112,831 |
| 1980 | 42,946 | 34 | 20,347 | 29,615 | 49,962 | 15,385 | 108,327 |
| 1981 | 52,308 | 28 | 14,218 | 38,930 | 53,148 | 23,510 | 128,994 |
| 1982 | 42,061 | 132 | 26,408 | 28,372 | 54,780 | 16,308 | 113,281 |
| 1983 | 4,300 | 352 | 18,391 | 32,552 | 50,943 | 1,824 | 57,419 |
| 1984 | 2,956 | 235 | 10,676 | 42,213 | 52,889 | 564 | 56,644 |
| 1985 | 1,626 | 592 | 9,360 | 34,609 | 43,969 | 10,276 | 56,463 |
| 1986 | 1,910 | 1,164 | 11,076 | 41,280 | 52,356 | 21,277 | 76,707 |
| 1987 | 1,447 | 2,095 | 11,843 | 41,631 | 53,474 | 19,984 | 77,000 |
| 1988 | 1,468 | 3,785 | 10,323 | 42,890 | 53,213 | 37,232 | 95,698 |
| 1989 | 2,449 | 3,908 | 19,795 | 36,129 | 55,924 | 40,893 | 103,174 |
| 1990 | 3,201 | 3,125 | 4,667 | 31,794 | 36,461 | 28,447 | 71,234 |
| 1991 | 4,252 | 7,750 | 1,695 | 30,957 | 32,652 | 37,388 | 82,042 |
| 1992 | 1,124 | 17,950 | 1,209 | 18,576 | 19,785 | 13,110 | 51,969 |
| 1993 | 1,959 | 15,346 | 1,673 | 11,819 | 13,492 | 42,830 | 73,627 |
| 1994 | 1,789 | 11,644 | 2,704 | 10,008 | 12,712 | 55,892 | 82,037 |
| 1995 | 1,886 | 40,256 | 1,728 | 8,626 | 10,354 | 70,252 | 122,748 |
| 1996 | 4,419 | 32,553 | 2,176 | 9,599 | 11,775 | 80,320 | 129,067 |
| 1997a/ | 5,719 | 42,816 | 1,160 | 18,191 | 19,351 | 70,919 | 138,805 |

a/ Preliminary.

Sources: 1916-1968 data from CDFG 1970.
1969 data from CDFG 1986.
1970-1989 CPS data and 1970-1990 squid data from CDFG 1991a.
1981-1997 data from PacFIN vessel summaries.

TABLE 2.1.1.1-1. West Coast Pacific sardine landings (mt), 1916-1917 through 1967-1968 seasons.

| Season | British Columbia | Washington | Oregon | California | Baja California | Total |
|---|---|---|---|---|---|---|
| 1916-1917 | 0 | 0 | 0 | 24,975 | 0 | 24,975 |
| 1917-1918 | 73 | 0 | 0 | 65,844 | 0 | 65,917 |
| 1918-1919 | 3,302 | 0 | 0 | 68,529 | 0 | 71,832 |
| 1919-1920 | 2,976 | 0 | 0 | 60,809 | 0 | 63,785 |
| 1920-1921 | 3,992 | 0 | 0 | 34,882 | 0 | 38,873 |
| 1921-1922 | 898 | 0 | 0 | 33,113 | 0 | 34,011 |
| 1922-1923 | 925 | 0 | 0 | 59,067 | 0 | 59,993 |
| 1923-1924 | 880 | 0 | 0 | 76,141 | 0 | 77,021 |
| 1924-1925 | 1,243 | 0 | 0 | 156,963 | 0 | 158,206 |
| 1925-1926 | 14,470 | 0 | 0 | 124,531 | 0 | 139,000 |
| 1926-1927 | 43,999 | 0 | 0 | 138,084 | 0 | 182,083 |
| 1927-1928 | 62,079 | 0 | 0 | 169,881 | 0 | 231,960 |
| 1928-1929 | 73,038 | 0 | 0 | 230,863 | 0 | 303,901 |
| 1929-1930 | 78,327 | 0 | 0 | 294,992 | 0 | 373,319 |
| 1930-1931 | 68,103 | 0 | 0 | 167,940 | 0 | 236,043 |
| 1931-1932 | 66,770 | 0 | 0 | 149,365 | 0 | 216,134 |
| 1932-1933 | 40,234 | 0 | 0 | 227,424 | 0 | 267,659 |
| 1933-1934 | 3,674 | 0 | 0 | 347,845 | 0 | 351,519 |
| 1934-1935 | 39,009 | 0 | 0 | 539,829 | 0 | 578,839 |
| 1935-1936 | 41,114 | 9 | 23,796 | 508,480 | 0 | 573,399 |
| 1936-1937 | 40,325 | 5,951 | 12,882 | 658,735 | 0 | 717,893 |
| 1937-1938 | 43,618 | 15,513 | 15,114 | 377,904 | 0 | 452,149 |
| 1938-1939 | 46,965 | 24,023 | 15,440 | 521,897 | 0 | 608,325 |
| 1939-1940 | 5,008 | 16,112 | 20,258 | 487,405 | 0 | 528,782 |
| 1940-1941 | 26,100 | 735 | 2,867 | 417,839 | 0 | 447,541 |
| 1941-1942 | 54,477 | 15,513 | 14,379 | 532,861 | 0 | 617,230 |
| 1942-1943 | 59,766 | 526 | 1,769 | 457,825 | 0 | 519,887 |
| 1943-1944 | 80,504 | 9,471 | 1,651 | 433,756 | 0 | 525,382 |
| 1944-1945 | 53,633 | 18 | 0 | 503,407 | 0 | 557,058 |
| 1945-1946 | 31,117 | 2,096 | 82 | 366,219 | 0 | 399,513 |
| 1946-1947 | 3,620 | 5,570 | 3,593 | 212,104 | 0 | 224,886 |
| 1947-1948 | 445 | 1,234 | 6,287 | 110,080 | 0 | 118,045 |
| 1948-1949 | 0 | 45 | 4,826 | 166,675 | 0 | 171,547 |
| 1949-1950 | 0 | 0 | 0 | 307,471 | 0 | 307,471 |
| 1950-1951 | 0 | 0 | 0 | 320,319 | 0 | 320,319 |
| 1951-1952 | 0 | 0 | 0 | 117,122 | 14,682 | 131,804 |
| 1952-1953 | 0 | 0 | 0 | 5,181 | 8,312 | 13,493 |
| 1953-1954 | 0 | 0 | 0 | 4,075 | 12,978 | 17,053 |
| 1954-1955 | 0 | 0 | 0 | 62,111 | 11,285 | 73,397 |
| 1955-1956 | 0 | 0 | 0 | 67,551 | 3,817 | 71,367 |
| 1956-1957 | 0 | 0 | 0 | 30,521 | 12,388 | 42,908 |
| 1957-1958 | 0 | 0 | 0 | 20,205 | 9,003 | 29,208 |
| 1958-1959 | 0 | 0 | 0 | 94,322 | 20,261 | 114,583 |
| 1959-1960 | 0 | 0 | 0 | 33,798 | 19,456 | 53,254 |
| 1960-1961 | 0 | 0 | 0 | 26,198 | 18,052 | 44,250 |
| 1961-1962 | 0 | 0 | 0 | 23,159 | 19,296 | 42,455 |
| 1962-1963 | 0 | 0 | 0 | 3,785 | 13,263 | 17,048 |
| 1963-1964 | 0 | 0 | 0 | 2,669 | 16,678 | 19,347 |
| 1964-1965 | 0 | 0 | 0 | 5,537 | 24,603 | 30,140 |
| 1965-1966 | 0 | 0 | 0 | 652 | 20,182 | 20,835 |
| 1966-1967 | 0 | 0 | 0 | 312 | 17,718 | 18,030 |
| 1967-1968 | 0 | 0 | 0 | 64 | 25,090 | 25,155 |

Source: Radovich 1981.

TABLE 2.1.1.3-1. Recreational harvest of Pacific (chub) mackerel and all species in southern California. Includes fish landed in the round (type A) and fish used for bait, filleted or discarded dead (type B1), 1981-1997.

| | Pacific (chub) mackerel | | All Species | |
|---|---|---|---|---|
| Year | Thousands of Fish | Metric Tons | Thousands of Fish | Metric Tons |
| 1981 | 3,029 | 1,233 | 14,000 | 8,152 |
| 1982 | 3,551 | 1,571 | 16,405 | 9,870 |
| 1983 | 3,387 | 1,354 | 12,533 | 8,146 |
| 1984 | 3,450 | 1,257 | 14,197 | 9,728 |
| 1985 | 2,587 | 1,053 | 13,812 | 7,785 |
| 1986 | 2,075 | 986 | 15,570 | 8,995 |
| 1987 | 3,402 | 1,320 | 13,766 | 8,891 |
| 1988 | 1,890 | 848 | 14,115 | 7,135 |
| 1989 | 1,669 | 634 | 10,569 | 5,498 |
| 1990 | No Surveys | | No Surveys | |
| 1991 | No Surveys | | No Surveys | |
| 1992 | No Surveys | | No Surveys | |
| 1993 | 1,607 | 590 | 7,295 | 4,582 |
| 1994 | 2,485 | 994 | 9,185 | 5,238 |
| 1995 | 2,139 | 1,040 | 8,553 | 6,802 |
| 1996 | 1,580 | 678 | 7,755 | 4,174 |
| 1997[a/] | 1,179 | 456 | 4,913 | 3,907 |

a/ Preliminary data.

Source: MRFSS RecFIN database.

TABLE 2.1.1.3-2. Landings of northern anchovy and mackerel (Pacific and jack) in Oregon and Washington (mt), 1981-1997.

| Year | Oregon | | | Washington | | |
|---|---|---|---|---|---|---|
| | Anchovy | Mackerel | Total | Anchovy | Mackerel | Total |
| 1981 | 0.00 | 0.01 | 0.01 | 1.32 | 0.00 | 1.32 |
| 1982 | 0.09 | 0.04 | 0.13 | 5.06 | 0.00 | 5.06 |
| 1983 | 0.00 | 8.28 | 8.28 | 2.87 | 0.00 | 2.87 |
| 1984 | 0.00 | 3.05 | 3.05 | 10.09 | 0.12 | 10.21 |
| 1985 | 0.01 | 0.01 | 0.02 | 11.68 | 0.00 | 11.68 |
| 1986 | 0.00 | 0.00 | 0.00 | 22.10 | 0.00 | 22.10 |
| 1987 | 0.00 | 1.46 | 1.46 | 77.62 | 0.00 | 77.62 |
| 1988 | 0.01 | 0.64 | 0.65 | 40.35 | 0.00 | 40.35 |
| 1989 | 0.01 | 4.74 | 4.75 | 61.85 | 0.23 | 62.08 |
| 1990 | 0.00 | 10.29 | 10.29 | 50.30 | 0.14 | 50.44 |
| 1991 | 0.00 | 19.77 | 19.77 | 54.49 | 0.16 | 54.65 |
| 1992 | 0.00 | 778.80 | 778.80 | 41.66 | 5.86 | 47.52 |
| 1993 | 0.00 | 556.50 | 556.50 | 44.15 | 30.25 | 74.40 |
| 1994 | 0.91 | 454.57 | 455.48 | 69.52 | 33.31 | 102.83 |
| 1995 | 0.22 | 337.74 | 337.96 | 129.58 | 7.48 | 137.06 |
| 1996 | 0.00 | 319.15 | 19.15 | 85.64 | 68.08 | 153.72 |
| 1997 | 0.00 | 1984.06 | 1984.06 | 59.10 | 156.61 | 215.71 |

Source: PacFIN.

TABLE 2.1.1.4-1. Northern anchovy harvest in California, by disposition of catch, and Mexico (mt), 1916-1997.

| Year | Reduction | Nonreduction[b/] | Subtotal | Live Bait | Total | Mexico | Grand Total |
|---|---|---|---|---|---|---|---|
| 1916 | --- | --- | 241 | 0 | 241 | 0 | 241 |
| 1917 | --- | --- | 239 | 0 | 239 | 0 | 239 |
| 1918 | --- | --- | 394 | 0 | 394 | 0 | 394 |
| 1919 | --- | --- | 730 | 0 | 730 | 0 | 730 |
| 1920 | --- | --- | 259 | 0 | 259 | 0 | 259 |
| 1921 | --- | --- | 883 | 0 | 883 | 0 | 883 |
| 1922 | --- | --- | 296 | 0 | 296 | 0 | 296 |
| 1923 | --- | --- | 140 | 0 | 140 | 0 | 140 |
| 1924 | --- | --- | 158 | 0 | 158 | 0 | 158 |
| 1925 | --- | --- | 42 | 0 | 42 | 0 | 42 |
| 1926 | --- | --- | 27 | 0 | 27 | 0 | 27 |
| 1927 | --- | --- | 167 | 0 | 167 | 0 | 167 |
| 1928 | --- | --- | 162 | 0 | 162 | 0 | 162 |
| 1929 | --- | --- | 173 | 0 | 173 | 0 | 173 |
| 1930 | --- | --- | 145 | 0 | 145 | 0 | 145 |
| 1931 | --- | --- | 140 | 0 | 140 | 0 | 140 |
| 1932 | --- | --- | 136 | 0 | 136 | 0 | 136 |
| 1933 | --- | — | 144 | 0 | 144 | 0 | 144 |
| 1934 | --- | --- | 117 | 0 | 117 | 0 | 117 |
| 1935 | --- | — | 82 | 0 | 82 | 0 | 82 |
| 1936 | --- | --- | 89 | 0 | 89 | 0 | 89 |
| 1937 | --- | --- | 103 | 0 | 103 | 0 | 103 |
| 1938 | --- | --- | 334 | 0 | 334 | 0 | 334 |
| 1939 | --- | --- | 974 | 1,364 | 2,338 | 0 | 2,338 |
| 1940 | --- | --- | 2,866 | 1,820 | 4,686 | 0 | 4,686 |
| 1941 | --- | --- | 1,862 | 1,435 | 3,297 | 0 | 3,297 |
| 1942 | --- | --- | 768 | 234 | 1,002 | 0 | 1,002 |
| 1943 | --- | --- | 712 | 0 | 712 | 0 | 712 |
| 1944 | --- | --- | 1,765 | 0 | 1,765 | 0 | 1,765 |
| 1945 | --- | --- | 733 | 0 | 733 | 0 | 733 |
| 1946 | --- | --- | 872 | 2,493 | 3,365 | 0 | 3,365 |
| 1947 | --- | --- | 8,591 | 2,589 | 11,180 | 0 | 11,180 |
| 1948 | --- | --- | 4,915 | 3,379 | 8,294 | 0 | 8,294 |
| 1949 | --- | --- | 1,510 | 2,542 | 4,052 | 0 | 4,052 |
| 1950 | --- | --- | 2,213 | 3,469 | 5,682 | 0 | 5,682 |
| 1951 | --- | --- | 3,154 | 4,665 | 7,819 | 0 | 7,819 |
| 1952 | --- | --- | 25,303 | 6,178 | 31,481 | 0 | 31,481 |
| 1953 | --- | --- | 38,935 | 5,798 | 44,733 | 0 | 44,733 |
| 1954 | --- | --- | 19,237 | 6,066 | 25,303 | 0 | 25,303 |
| 1955 | --- | --- | 20,272 | 5,557 | 25,829 | 0 | 25,829 |
| 1956 | --- | --- | 25,819 | 5,744 | 31,563 | 0 | 31,563 |
| 1957 | --- | --- | 18,392 | 3,729 | 22,121 | 0 | 22,121 |
| 1958 | --- | --- | 5,263 | 3,843 | 9,106 | 0 | 9,106 |
| 1959 | --- | --- | 3,254 | 4,297 | 7,551 | 0 | 7,551 |
| 1960 | --- | — | 2,294 | 4,225 | 6,519 | 0 | 6,519 |
| 1961 | --- | --- | 3,498 | 5,364 | 8,862 | 0 | 8,862 |

TABLE 2.1.1.4-1. Northern anchovy harvest in California, by disposition of catch, and Mexico (mt), 1916-1997. (Continued).

| Year | Reduction | Nonreduction[b/] | Subtotal | Live Bait | Total | Mexico | Grand Total |
|---|---|---|---|---|---|---|---|
| 1962 | --- | --- | 1,254 | 5,595 | 6,849 | 669 | 7,518 |
| 1963 | --- | --- | 2,073 | 4,030 | 6,103 | 944 | 7,047 |
| 1964 | --- | — | 2,257 | 4,709 | 6,966 | 4,599 | 11,565 |
| 1965 | 155 | 2,446 | 2,601 | 5,645 | 8,246 | 9,171 | 17,417 |
| 1966 | 24,810 | 3,440 | 28,250 | 6,144 | 34,394 | 13,243 | 47,637 |
| 1967 | 29,346 | 2,229 | 31,575 | 4,898 | 36,473 | 20,104 | 56,577 |
| 1968 | 12,515 | 1,581 | 14,096 | 6,644 | 20,740 | 14,267 | 35,007 |
| 1969 | 59,153 | 2,209 | 61,362 | 4,891 | 66,253 | 3,871 | 70,124 |
| 1970 | 84,328 | 2,982 | 87,310 | 5,543 | 92,853 | 27,977 | 120,830 |
| 1971 | 39,601 | 1,089 | 40,690 | 5,794 | 46,484 | 20,079 | 66,563 |
| 1972 | 60,435 | 2,252 | 62,687 | 5,307 | 67,994 | 30,047 | 98,041 |
| 1973 | 118,432 | 1,895 | 120,327 | 5,639 | 125,966 | 15,424 | 141,390 |
| 1974 | 73,400 | 1,640 | 75,040 | 5,126 | 80,166 | 44,987 | 125,153 |
| 1975 | 141,586 | 2,214 | 143,800 | 5,577 | 149,377 | 56,877 | 206,254 |
| 1976 | 112,270 | 1,059 | 113,327 | 6,202 | 119,529 | 75,746 | 195,275 |
| 1977 | 99,674 | 1,457 | 101,131 | 6,410 | 107,541 | 142,575 | 250,116 |
| 1978 | 10,339 | 1,118 | 11,457 | 6,013 | 17,470 | 135,036 | 152,506 |
| 1979 | 47,408 | 5,836 | 53,244 | 5,364 | 58,608 | 192,476 | 251,084 |
| 1980 | 43,699 | 5,338 | 49,037 | 4,921 | 56,234 | 242,907 | 299,141 |
| 1981 | 51,290 | 246 | 51,536 | 4,698 | 56,234 | 258,745 | 314,979 |
| 1982 | 43,742 | 1,117 | 44,859 | 6,978 | 51,837 | 174,634 | 226,471 |
| 1983 | 2,854 | 1,446 | 4,300 | 4,187 | 8,487 | 87,429 | 95,916 |
| 1984 | 1,722 | 1,183 | 2,905 | 4,397 | 7,302 | 102,931 | 110,223 |
| 1985 | 825 | 1,184 | 2,009 | 3,775 | 5,784 | 117,192 | 122,976 |
| 1986 | 546 | 1,002 | 1,548 | 3,956 | 5,504 | 93,547 | 99,051 |
| 1987 | 149 | 1,154 | 1,303 | 3,572 | 4,875 | 124,482 | 129,357 |
| 1988 | 234 | 1,234 | 1,468 | 4,188 | 5,656 | 79,495 | 85,151 |
| 1989 | 109 | 2,341 | 2,450 | 4,594 | 7,044 | 81,810 | 88,854 |
| 1990 | 63 | 3,145 | 3,208 | 4,841 | 8,049 | 99 | 8,148 |
| 1991 | 1,037 | 3,215 | 4,252 | 5,039 | 9,291 | 831 | 10,122 |
| 1992 | 0 | 1,124 | 1,124 | 2,572 | 3,696 | 2,324 | 6,020 |
| 1993 | 0 | 1,959 | 1,959 | 2,521 | 4,480 | 284 | 4,764 |
| 1994 | 0 | 1,793 | 1,793 | 1,923 | 3,716 | 875 | 4,591 |
| 1995 | 0 | 1,886 | 1,886 | na | 1,886 | 17,772 | 19,658 |
| 1996 | 1,598 | 2,821 | 4,419 | na | 4,419 | 4,168 | 8,587 |
| 1997[c/] | 2,230 | 3,489 | 5,718 | na | 5,718 | 1,823 | 7,541 |

a/ Separate statistics on reduction and nonreduction landings in California are available beginning in 1965, when a separate reduction quota was first established.

b/ Includes anchovy used for canning, consumption as fresh fish, freezing and dead bait.

c/ Preliminary.

Sources: 1962-1974 Mexican landings from Chavez 1977.
1975-1977 Mexican landings from L. Jacobson, NMFS, SWFSC, La Jolla, California.
1978-1997 Mexican landings from Walterio Garcia-Franco, INP-CRIP, Ensenada, Baja California.
1916-1964 California reduction landings and 1939-1964 live bait catches from Tables 3.2-2 and 3.2-3 in PFMC 1983.
1965-1990 California reduction, nonreduction and live bait catches from Thomson et al. 1991 and previous issues of the same report.
1991 California landings from E. Konno, CDFG, Long Beach.
1994-1997 California landings from PacFIN.

TABLE 2.1.1.5-1. California landings of market squid (mt), 1970-1997.

| Year | Monterey | Southern California | Other | Statewide Total |
|---|---|---|---|---|
| 1970 | 3,914 | 7,241 | 0 | 11,155 |
| 1971 | 7,551 | 6,745 | 0 | 14,296 |
| 1972 | 5,560 | 3,583 | 0 | 9,144 |
| 1973 | 562 | 4,908 | 0 | 5,470 |
| 1974 | 6,575 | 6,536 | 0 | 13,112 |
| 1975 | 2,263 | 8,451 | 0 | 10,715 |
| 1976 | 2,278 | 6,933 | 0 | 9,211 |
| 1977 | 2,027 | 10,784 | 0 | 12,810 |
| 1978 | 9,370 | 7,776 | 0 | 17,145 |
| 1979 | 12,867 | 7,114 | 1 | 19,982 |
| 1980 | 7,127 | 8,255 | 1 | 15,383 |
| 1981 | 12,823 | 10,685 | 2 | 23,510 |
| 1982 | 10,607 | 5,695 | 6 | 16,308 |
| 1983 | 500 | 862 | 462 | 1,824 |
| 1984 | 391 | 76 | 97 | 564 |
| 1985 | 3,813 | 6,386 | 77 | 10,276 |
| 1986 | 5,488 | 14,957 | 832 | 21,277 |
| 1987 | 5,611 | 14,030 | 343 | 19,984 |
| 1988 | 4,897 | 32,006 | 329 | 37,232 |
| 1989 | 7,140 | 33,724 | 29 | 40,893 |
| 1990 | 7,917 | 20,400 | 130 | 28,447 |
| 1991 | 6,700 | 29,212 | 1,476 | 37,388 |
| 1992 | 6,111 | 4,550 | 2,449 | 13,110 |
| 1993 | 6,040 | 33,736 | 3,053 | 42,829 |
| 1994 | 13,648 | 38,580 | 3,664 | 55,892 |
| 1995 | 2,449 | 66,868 | 934 | 70,251 |
| 1996 | 4,672 | 75,097 | 550 | 80,319 |
| 1997[a/] | 8,283 | 62,427 | 208 | 70,918 |

a/ Preliminary.
Sources: 1970-1979 data from CDFG 1991a. 1981-1997 data from PacFIN database.

TABLE 2.1.2-1. Total Washington, Oregon, and California landings (mt) of northern anchovy, Pacific and jack mackerel, Pacific sardine, and market squid, by gear type, 1981-1997. Figures may differ from those in Table 2.1.1-1 because of differences between California and PacFIN databases.

| Year | Round Haul | Trawl | Pot/Trap | Dipnet | Gill Net | Line | Other/Unkwn | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | **Northern Anchovy** | | | | |
| 1981 | 52,261.31 | 0.00 | 0.13 | 0.01 | 0.22 | 22.24 | 25.08 | 52,308.99 |
| 1982 | 41,735.13 | 0.00 | 0.00 | 0.00 | 0.34 | 6.99 | 412.73 | 42,155.19 |
| 1983 | 1,615.61 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 2,813.97 | 4,429.61 |
| 1984 | 2,068.36 | 0.00 | 0.00 | 0.00 | 0.05 | 0.05 | 830.42 | 2,898.87 |
| 1985 | 1,204.09 | 0.00 | 0.00 | 0.00 | 0.15 | 0.11 | 433.30 | 1,637.64 |
| 1986 | 1,113.43 | 0.00 | 0.00 | 0.03 | 0.83 | 0.05 | 443.10 | 1,557.42 |
| 1987 | 1,301.43 | 0.01 | 0.00 | 0.18 | 0.05 | 0.23 | 165.38 | 1,467.29 |
| 1988 | 1,292.10 | 0.04 | 0.16 | 0.41 | 0.83 | 53.96 | 170.72 | 1,518.21 |
| 1989 | 2,254.05 | 0.00 | 0.14 | 0.00 | 10.24 | 0.03 | 246.74 | 2,511.21 |
| 1990 | 2,670.59 | 0.00 | 0.09 | 0.05 | 0.06 | 35.15 | 552.70 | 3,258.65 |
| 1991 | 2,747.19 | 106.61 | 0.02 | 441.19 | 0.00 | 24.26 | 749.01 | 4,068.29 |
| 1992 | 1,018.47 | 0.09 | 0.00 | 19.33 | 0.00 | 4.39 | 123.31 | 1,165.59 |
| 1993 | 1,957.74 | 0.00 | 0.03 | 3.00 | 0.06 | 41.72 | 0.12 | 2,002.68 |
| 1994 | 1,847.57 | 0.02 | 0.00 | 0.00 | 0.00 | 7.60 | 4.22 | 1,859.42 |
| 1995 | 1,995.78 | 0.00 | 0.00 | 0.10 | 0.06 | 16.50 | 3.37 | 2,015.81 |
| 1996 | 4,503.62 | 0.00 | 0.00 | 0.93 | 0.00 | 0.02 | 0.00 | 4,504.57 |
| 1997[a/] | 5,731.38 | 0.00 | 0.00 | 3.30 | 0.02 | 1.95 | 41.13 | 5,777.78 |
| | | | | **Pacific (chub) mackerel** | | | | |
| 1981 | 35,263.34 | 2.57 | 0.16 | 9.08 | 46.91 | 53.51 | 12.53 | 35,388.09 |
| 1982 | 35,287.61 | 5.35 | 0.26 | 36.72 | 55.81 | 42.81 | 636.05 | 36,064.60 |
| 1983 | 32,195.58 | 5.01 | 0.00 | 0.00 | 23.91 | 27.77 | 9,226.94 | 41,479.22 |
| 1984 | 39,631.74 | 2.88 | 0.02 | 4.10 | 142.85 | 145.89 | 4,156.74 | 44,084.22 |
| 1985 | 35,349.11 | 4.35 | 0.15 | 4.33 | 152.14 | 29.39 | 2,232.82 | 37,772.28 |
| 1986 | 43,146.90 | 0.86 | 0.75 | 21.00 | 63.33 | 63.54 | 4,792.85 | 48,089.25 |
| 1987 | 41,416.35 | 1.22 | 0.56 | 0.00 | 272.50 | 37.33 | 4,997.10 | 46,725.06 |
| 1988 | 48,308.30 | 35.25 | 0.76 | 0.23 | 725.47 | 61.08 | 1,732.72 | 50,863.82 |
| 1989 | 45,441.86 | 3.60 | 0.04 | 8.27 | 83.63 | 169.46 | 2,005.91 | 47,712.76 |
| 1990 | 37,357.65 | 11.16 | 0.08 | 253.25 | 59.73 | 39.57 | 2,370.36 | 40,091.81 |
| 1991 | 17,874.12 | 0.49 | 25.79 | 148.89 | 38.99 | 27.11 | 13,903.15 | 32,018.54 |
| 1992 | 15,907.93 | 468.56 | 1.85 | 1,919.75 | 23.15 | 69.69 | 653.87 | 19,044.80 |
| 1993 | 9,389.11 | 314.59 | 1.93 | 2,290.69 | 34.00 | 47.58 | 51.23 | 12,129.13 |
| 1994 | 8,579.51 | 287.15 | 0.61 | 1,075.24 | 8.86 | 71.29 | 270.60 | 10,293.28 |
| 1995 | 8,451.59 | 199.04 | 0.71 | 2.98 | 6.41 | 116.85 | 45.11 | 8,822.69 |
| 1996 | 9,427.15 | 143.67 | 0.52 | 20.30 | 21.49 | 91.42 | 25.71 | 9,730.27 |
| 1997[a/] | 17,860.47 | 1,956.08 | 0.10 | 6.72 | 11.54 | 152.77 | 152.09 | 20,139.78 |
| | | | | **Jack Mackerel** | | | | |
| 1981 | 17,701.72 | 3.36 | 0.03 | 0.00 | 26.79 | 6.15 | 40.12 | 17,778.18 |
| 1982 | 19,437.03 | 1.11 | 0.00 | 7.99 | 3.42 | 0.33 | 167.51 | 19,617.39 |
| 1983 | 6,895.87 | 1.30 | 0.09 | 0.00 | 2.13 | 0.18 | 2,929.69 | 9,829.26 |
| 1984 | 6,248.60 | 0.05 | 0.00 | 0.00 | 0.65 | 0.03 | 2,899.45 | 9,148.78 |
| 1985 | 6,684.29 | 0.04 | 0.00 | 0.00 | 1.83 | 61.29 | 128.22 | 6,875.67 |
| 1986 | 4,334.68 | 0.04 | 0.00 | 0.00 | 4.57 | 6.47 | 431.56 | 4,777.33 |
| 1987 | 5,858.75 | 0.09 | 0.00 | 0.00 | 177.52 | 0.96 | 1,982.89 | 8,020.22 |
| 1988 | 4,759.30 | 0.15 | 0.00 | 0.00 | 193.28 | 37.64 | 77.15 | 5,067.52 |
| 1989 | 9,855.21 | 1.60 | 0.00 | 0.00 | 0.32 | 101.74 | 786.52 | 10,745.40 |
| 1990 | 2,999.40 | 1.43 | 0.00 | 32.27 | 2.26 | 1.50 | 185.76 | 3,222.61 |
| 1991 | 868.59 | 19.45 | 0.00 | 0.00 | 1.64 | 0.63 | 821.83 | 1,712.15 |
| 1992 | 1,129.47 | 319.00 | 0.01 | 47.78 | 4.98 | 0.55 | 24.08 | 1,525.87 |
| 1993 | 1,533.64 | 276.96 | 0.00 | 132.04 | 0.93 | 5.73 | 0.21 | 1,949.52 |
| 1994 | 2,220.91 | 202.47 | 0.00 | 402.29 | 0.40 | 5.22 | 74.92 | 2,906.21 |
| 1995 | 1,697.06 | 149.06 | 0.00 | 0.07 | 1.76 | 28.76 | 0.21 | 1,876.93 |
| 1996 | 2,153.82 | 256.09 | 0.00 | 0.00 | 0.00 | 22.12 | 0.15 | 2,432.18 |
| 1997[a/] | 1,156.38 | 194.07 | 0.00 | 0.00 | 0.39 | 0.73 | 0.00 | 1,351.57 |

TABLE 2.1.2-1. Total Washington, Oregon, and California landings (mt) of northern anchovy, Pacific and jack mackerel, Pacific sardine, and market squid, by gear type, 1981-1997. Figures may differ from those in Table 2.1.1-1 because of differences between California and PacFIN databases. (Continued).

| Year | Round Haul | Trawl | Pot/Trap | Dipnet | Gill Net | Line | Other/Unkwn | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | **Pacific Sardine** | | | | |
| 1981 | 14.75 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 14.77 |
| 1982 | 1.82 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.82 |
| 1983 | 0.61 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.63 |
| 1984 | 0.49 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.64 | 1.18 |
| 1985 | 4.84 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.98 | 5.84 |
| 1986 | 321.18 | 0.00 | 0.00 | 3.96 | 1.00 | 0.00 | 62.34 | 388.48 |
| 1987 | 345.21 | 0.04 | 0.00 | 0.00 | 7.56 | 0.07 | 86.55 | 439.43 |
| 1988 | 1,094.22 | 0.00 | 0.00 | 0.00 | 0.91 | 0.00 | 93.30 | 1,188.42 |
| 1989 | 829.54 | 0.00 | 0.00 | 0.00 | 0.43 | 0.03 | 6.71 | 836.71 |
| 1990 | 1,444.04 | 0.00 | 0.00 | 157.83 | 1.19 | 0.13 | 61.05 | 1,664.24 |
| 1991 | 4,103.45 | 0.00 | 0.00 | 25.52 | 0.78 | 0.23 | 3,457.41 | 7,587.39 |
| 1992 | 15,289.44 | 3.89 | 0.00 | 1,926.83 | 0.13 | 1.07 | 732.24 | 17,953.59 |
| 1993 | 13,715.89 | 0.25 | 0.00 | 1,623.28 | 0.37 | 6.56 | 0.34 | 15,346.69 |
| 1994 | 10,291.49 | 0.02 | 0.00 | 1,165.11 | 0.06 | 1.03 | 186.07 | 11,643.79 |
| 1995 | 39,607.75 | 35.61 | 0.00 | 16.75 | 0.00 | 181.43 | 414.07 | 40,255.62 |
| 1996 | 32,512.65 | 0.00 | 0.00 | 30.76 | 0.00 | 10.00 | 0.00 | 32,553.42 |
| 1997[a/] | 42,652.14 | 0.06 | 0.00 | 2.79 | 0.03 | 17.75 | 143.43 | 42,816.20 |
| | | | | **Market Squid** | | | | |
| 1981 | 15,271.11 | 6.59 | 0.05 | 8,223.62 | 0.66 | 10.03 | 3.10 | 23,515.18 |
| 1982 | 12,491.30 | 6.66 | 51.42 | 3,623.89 | 11.51 | 52.14 | 124.67 | 16,361.60 |
| 1983 | 839.01 | 2.38 | 0.17 | 515.20 | 1.18 | 0.93 | 640.01 | 1,998.88 |
| 1984 | 536.88 | 3.24 | 0.32 | 70.91 | 0.02 | 0.88 | 394.18 | 1,006.42 |
| 1985 | 7,864.66 | 16.00 | 0.03 | 490.42 | 220.11 | 29.07 | 2,451.78 | 11,072.07 |
| 1986 | 16,690.39 | 6.22 | 2.92 | 63.03 | 36.96 | 0.64 | 4,494.33 | 21,294.48 |
| 1987 | 15,685.26 | 8.18 | 0.86 | 213.26 | 838.84 | 2.19 | 3,239.46 | 19,988.05 |
| 1988 | 31,157.77 | 5.06 | 0.12 | 137.34 | 456.68 | 0.30 | 5,476.52 | 37,233.80 |
| 1989 | 36,419.78 | 127.26 | 0.04 | 240.09 | 1.12 | 0.72 | 4,148.06 | 40,937.07 |
| 1990 | 25,791.74 | 2.35 | 1.40 | 45.88 | 0.33 | 50.24 | 2,555.29 | 28,447.23 |
| 1991 | 32,733.46 | 0.51 | 11.53 | 108.44 | 14.13 | 0.35 | 4,520.44 | 37,388.85 |
| 1992 | 12,443.08 | 16.79 | 0.86 | 408.33 | 0.09 | 1.70 | 246.18 | 13,117.04 |
| 1993 | 41,698.42 | 3.18 | 0.00 | 1,122.24 | 8.07 | 0.00 | 62.29 | 42,894.21 |
| 1994 | 54,862.54 | 21.40 | 58.69 | 346.02 | 0.00 | 51.12 | 662.11 | 56,001.89 |
| 1995 | 67,770.60 | 3.73 | 0.08 | 1,325.89 | 0.12 | 129.10 | 1,145.52 | 70,375.04 |
| 1996 | 79,668.59 | 2.94 | 0.00 | 757.25 | 0.04 | 0.09 | 0.00 | 80,428.90 |
| 1997[a/] | 70,604.48 | 41.83 | 0.01 | 151.42 | 0.00 | 18.68 | 226.04 | 71,042.47 |

a/ Preliminary.
Source: Washington, Oregon, and California fish ticket data converted to PacFIN format. Includes unspecified net gears as well as round haul gear.

TABLE 2.1.2-2. Number of California, Oregon, and Washington vessels landing CPS or squid, by principal gear[a/], 1981-1997.

| Principal Gear/Year | CPS>0, SQUID=0 | | | | CPS>0, SQUID>0 | | | | CPS=0, SQUID>0 | | | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CA | OR | WA | Sum | CA | OR | WA | Sum | CA | OR | WA | Sum | |
| **Round Haul[b/]** | | | | | | | | | | | | | |
| 1981 | 46 | 0 | 2 | 48 | 53 | 0 | 1 | 54 | 17 | 0 | 4 | 21 | 123 |
| 1982 | 54 | 1 | 1 | 56 | 54 | 0 | 0 | 54 | 12 | 0 | 3 | 15 | 125 |
| 1983 | 53 | 0 | 1 | 54 | 24 | 2 | 0 | 26 | 5 | 4 | 10 | 19 | 99 |
| 1984 | 55 | 0 | 2 | 57 | 11 | 2 | 0 | 13 | 1 | 8 | 3 | 12 | 82 |
| 1985 | 35 | 2 | 2 | 39 | 46 | 0 | 0 | 46 | 8 | 15 | 1 | 24 | 109 |
| 1986 | 20 | 0 | 2 | 22 | 45 | 0 | 0 | 45 | 9 | 2 | 1 | 12 | 79 |
| 1987 | 26 | 0 | 2 | 28 | 44 | 0 | 0 | 44 | 10 | 0 | 1 | 11 | 83 |
| 1988 | 18 | 1 | 3 | 22 | 46 | 0 | 0 | 46 | 25 | 0 | 0 | 25 | 93 |
| 1989 | 27 | 0 | 2 | 29 | 45 | 0 | 0 | 45 | 19 | 1 | 0 | 20 | 94 |
| 1990 | 20 | 0 | 2 | 22 | 49 | 0 | 0 | 49 | 14 | 0 | 0 | 14 | 85 |
| 1991 | 17 | 0 | 2 | 19 | 42 | 0 | 0 | 42 | 13 | 0 | 0 | 13 | 74 |
| 1992 | 30 | 0 | 3 | 33 | 29 | 0 | 0 | 29 | 19 | 0 | 2 | 21 | 83 |
| 1993 | 19 | 0 | 3 | 22 | 44 | 0 | 0 | 44 | 22 | 3 | 2 | 27 | 93 |
| 1994 | 27 | 0 | 2 | 29 | 42 | 0 | 1 | 43 | 26 | 5 | 4 | 35 | 107 |
| 1995 | 19 | 1 | 2 | 22 | 59 | 1 | 0 | 60 | 26 | 3 | 3 | 32 | 114 |
| 1996 | 20 | 0 | 2 | 22 | 76 | 0 | 0 | 76 | 41 | 3 | 3 | 47 | 145 |
| 1997 | 24 | 0 | 2 | 26 | 67 | 2 | 0 | 69 | 37 | 5 | 0 | 42 | 137 |
| **Trawl:** | | | | | | | | | | | | | |
| 1981 | 9 | 0 | 0 | 9 | 11 | 0 | 0 | 11 | 17 | 1 | 15 | 33 | 53 |
| 1982 | 14 | 0 | 0 | 14 | 6 | 0 | 0 | 6 | 20 | 4 | 12 | 36 | 56 |
| 1983 | 17 | 12 | 0 | 29 | 3 | 1 | 0 | 4 | 16 | 7 | 8 | 31 | 64 |
| 1984 | 10 | 1 | 0 | 11 | 6 | 0 | 0 | 6 | 13 | 3 | 9 | 25 | 42 |
| 1985 | 5 | 1 | 0 | 6 | 10 | 0 | 0 | 10 | 8 | 1 | 10 | 19 | 35 |
| 1986 | 3 | 0 | 0 | 3 | 3 | 0 | 0 | 3 | 11 | 4 | 19 | 34 | 40 |
| 1987 | 6 | 1 | 0 | 7 | 3 | 0 | 0 | 3 | 11 | 2 | 18 | 31 | 41 |
| 1988 | 6 | 2 | 0 | 8 | 1 | 0 | 0 | 1 | 7 | 1 | 13 | 21 | 30 |
| 1989 | 14 | 4 | 1 | 19 | 0 | 1 | 0 | 1 | 12 | 1 | 8 | 21 | 41 |
| 1990 | 8 | 4 | 1 | 13 | 2 | 0 | 0 | 2 | 12 | 0 | 3 | 15 | 30 |
| 1991 | 9 | 4 | 1 | 14 | 1 | 0 | 0 | 1 | 4 | 1 | 4 | 9 | 24 |
| 1992 | 13 | 9 | 2 | 24 | 0 | 10 | 1 | 11 | 5 | 6 | 3 | 14 | 49 |
| 1993 | 10 | 2 | 3 | 15 | 2 | 13 | 1 | 16 | 3 | 4 | 0 | 7 | 38 |
| 1994 | 12 | 14 | 3 | 29 | 1 | 14 | 6 | 21 | 6 | 5 | 3 | 14 | 64 |
| 1995 | 8 | 27 | 3 | 38 | 3 | 11 | 1 | 15 | 4 | 8 | 3 | 15 | 68 |
| 1996 | 17 | 23 | 11 | 51 | 2 | 15 | 1 | 18 | 1 | 6 | 2 | 9 | 78 |
| 1997 | 14 | 15 | 10 | 39 | 5 | 26 | 3 | 34 | 16 | 22 | 2 | 40 | 113 |
| **Pot/Trap:** | | | | | | | | | | | | | |
| 1981 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| 1982 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 3 | 3 | 0 | 6 | 7 |
| 1983 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 1 | 6 | 6 |
| 1984 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 6 |
| 1985 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 4 |
| 1986 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1987 | 4 | 0 | 0 | 4 | 2 | 0 | 0 | 2 | 8 | 0 | 0 | 8 | 14 |
| 1988 | 3 | 0 | 0 | 3 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 2 | 6 |
| 1989 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2 |
| 1990 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 2 |
| 1991 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 5 |
| 1992 | 6 | 0 | 0 | 6 | 1 | 0 | 0 | 1 | 4 | 0 | 0 | 4 | 11 |
| 1993 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 1994 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 1995 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 1996 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 |
| 1997 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 2 | 2 |

TABLE 2.1.2-2. Number of California, Oregon, and Washington vessels landing CPS or squid, by principal geara/, 1981-1997. (Continued).

| Principal Gear/Year | CPS>0, SQUID=0 | | | | CPS>0, SQUID>0 | | | | CPS=0, SQUID>0 | | | | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | CA | OR | WA | Sum | CA | OR | WA | Sum | CA | OR | WA | Sum | |
| **Dip Net:** | | | | | | | | | | | | | |
| 1981 | 0 | 0 | 1 | 1 | 9 | 0 | 0 | 9 | 42 | 0 | 2 | 44 | 54 |
| 1982 | 2 | 0 | 0 | 2 | 6 | 0 | 0 | 6 | 30 | 0 | 1 | 31 | 39 |
| 1983 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 25 | 1 | 11 | 37 | 39 |
| 1984 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 7 | 0 | 12 | 19 | 20 |
| 1985 | 1 | 0 | 0 | 1 | 4 | 0 | 0 | 4 | 24 | 0 | 1 | 25 | 30 |
| 1986 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 8 | 0 | 1 | 9 | 11 |
| 1987 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 4 | 0 | 0 | 4 | 5 |
| 1988 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 6 | 0 | 0 | 6 | 9 |
| 1989 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 5 | 0 | 0 | 5 | 8 |
| 1990 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1991 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 2 |
| 1992 | 3 | 0 | 0 | 3 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 2 | 6 |
| 1993 | 2 | 0 | 0 | 2 | 7 | 0 | 0 | 7 | 7 | 0 | 0 | 7 | 16 |
| 1994 | 2 | 0 | 0 | 2 | 7 | 0 | 0 | 7 | 10 | 0 | 1 | 11 | 20 |
| 1995 | 1 | 0 | 0 | 1 | 6 | 0 | 0 | 6 | 15 | 0 | 4 | 19 | 26 |
| 1996 | 1 | 0 | 0 | 1 | 7 | 0 | 0 | 7 | 16 | 0 | 1 | 17 | 25 |
| 1997 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 10 | 0 | 0 | 10 | 13 |
| **Gill Net:** | | | | | | | | | | | | | |
| 1981 | 70 | 0 | 0 | 70 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 2 | 73 |
| 1982 | 70 | 0 | 0 | 70 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 2 | 73 |
| 1983 | 58 | 0 | 0 | 58 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 59 |
| 1984 | 77 | 0 | 0 | 77 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 78 |
| 1985 | 120 | 0 | 0 | 120 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 123 |
| 1986 | 106 | 0 | 0 | 106 | 5 | 0 | 0 | 5 | 1 | 0 | 0 | 1 | 112 |
| 1987 | 111 | 0 | 0 | 111 | 4 | 0 | 0 | 4 | 4 | 0 | 0 | 4 | 119 |
| 1988 | 97 | 0 | 0 | 97 | 2 | 0 | 0 | 2 | 3 | 0 | 0 | 3 | 102 |
| 1989 | 84 | 1 | 0 | 85 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 87 |
| 1990 | 87 | 0 | 0 | 87 | 4 | 0 | 0 | 4 | 1 | 0 | 0 | 1 | 92 |
| 1991 | 66 | 0 | 0 | 66 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 67 |
| 1992 | 41 | 0 | 0 | 41 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 42 |
| 1993 | 49 | 0 | 0 | 49 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 51 |
| 1994 | 21 | 0 | 0 | 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 21 |
| 1995 | 19 | 0 | 0 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 19 |
| 1996 | 14 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 14 |
| 1997 | 21 | 0 | 4 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 25 |
| **Line:** | | | | | | | | | | | | | |
| 1981 | 180 | 5 | 0 | 185 | 2 | 0 | 0 | 2 | 1 | 0 | 2 | 3 | 190 |
| 1982 | 195 | 3 | 0 | 198 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 2 | 200 |
| 1983 | 92 | 49 | 0 | 141 | 1 | 0 | 0 | 1 | 4 | 0 | 1 | 5 | 147 |
| 1984 | 51 | 1 | 0 | 52 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 53 |
| 1985 | 74 | 1 | 0 | 75 | 2 | 0 | 0 | 2 | 1 | 0 | 0 | 1 | 78 |
| 1986 | 65 | 1 | 0 | 66 | 2 | 0 | 0 | 2 | 3 | 0 | 1 | 4 | 72 |
| 1987 | 108 | 91 | 0 | 199 | 2 | 0 | 0 | 2 | 3 | 0 | 1 | 4 | 205 |
| 1988 | 152 | 75 | 0 | 227 | 2 | 0 | 0 | 2 | 2 | 0 | 0 | 2 | 231 |
| 1989 | 161 | 146 | 0 | 307 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 308 |
| 1990 | 230 | 159 | 1 | 390 | 5 | 0 | 0 | 5 | 3 | 0 | 0 | 3 | 398 |
| 1991 | 102 | 35 | 1 | 138 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 3 | 141 |
| 1992 | 303 | 18 | 5 | 326 | 3 | 0 | 0 | 3 | 4 | 0 | 0 | 4 | 333 |
| 1993 | 151 | 10 | 3 | 164 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 164 |
| 1994 | 134 | 1 | 0 | 135 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 2 | 138 |
| 1995 | 106 | 2 | 1 | 109 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 112 |
| 1996 | 96 | 1 | 0 | 97 | 3 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 100 |
| 1997 | 107 | 6 | 0 | 113 | 2 | 0 | 0 | 2 | 2 | 2 | 1 | 5 | 120 |

TABLE 2.1.2-2. Number of California, Oregon, and Washington vessels landing CPS or squid, by principal geara/, 1981-1997. (Continued).

| Principal Gear/Year | CPS>0, SQUID=0 CA | OR | WA | Sum | CPS>0, SQUID>0 CA | OR | WA | Sum | CPS=0, SQUID>0 CA | OR | WA | Sum | Grand Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Other/Unknown:** | | | | | | | | | | | | | |
| 1981 | 13 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 3 | 16 |
| 1982 | 14 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 16 |
| 1983 | 139 | 0 | 0 | 139 | 14 | 0 | 0 | 14 | 12 | 0 | 0 | 12 | 165 |
| 1984 | 179 | 0 | 0 | 179 | 17 | 0 | 0 | 17 | 11 | 0 | 0 | 11 | 207 |
| 1985 | 103 | 0 | 0 | 103 | 16 | 0 | 0 | 16 | 15 | 0 | 0 | 15 | 134 |
| 1986 | 71 | 0 | 0 | 71 | 15 | 0 | 0 | 15 | 16 | 0 | 0 | 16 | 102 |
| 1987 | 34 | 0 | 0 | 34 | 7 | 0 | 0 | 7 | 11 | 0 | 0 | 11 | 52 |
| 1988 | 29 | 1 | 0 | 30 | 13 | 0 | 0 | 13 | 18 | 0 | 0 | 18 | 61 |
| 1989 | 32 | 0 | 0 | 32 | 7 | 0 | 0 | 7 | 11 | 0 | 0 | 11 | 50 |
| 1990 | 36 | 0 | 0 | 36 | 7 | 0 | 0 | 7 | 8 | 0 | 0 | 8 | 51 |
| 1991 | 28 | 0 | 0 | 28 | 13 | 0 | 0 | 13 | 4 | 0 | 0 | 4 | 45 |
| 1992 | 29 | 0 | 0 | 29 | 2 | 0 | 0 | 2 | 6 | 0 | 0 | 6 | 37 |
| 1993 | 9 | 0 | 0 | 9 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 2 | 12 |
| 1994 | 18 | 1 | 0 | 19 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 21 |
| 1995 | 11 | 0 | 0 | 11 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 12 |
| 1996 | 14 | 0 | 0 | 14 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 15 |
| 1997 | 12 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 13 |
| **ALL GEARS:** | | | | | | | | | | | | | |
| 1981 | 323 | 5 | 3 | 331 | 76 | 0 | 1 | 77 | 82 | 1 | 23 | 106 | 514 |
| 1982 | 350 | 4 | 1 | 355 | 67 | 0 | 0 | 67 | 70 | 7 | 17 | 94 | 516 |
| 1983 | 359 | 61 | 1 | 421 | 44 | 3 | 0 | 47 | 68 | 12 | 31 | 111 | 579 |
| 1984 | 373 | 2 | 2 | 377 | 36 | 2 | 0 | 38 | 38 | 11 | 24 | 73 | 488 |
| 1985 | 340 | 4 | 2 | 346 | 81 | 0 | 0 | 81 | 58 | 16 | 12 | 86 | 513 |
| 1986 | 267 | 1 | 2 | 270 | 71 | 0 | 0 | 71 | 48 | 6 | 22 | 76 | 417 |
| 1987 | 289 | 92 | 2 | 383 | 63 | 0 | 0 | 63 | 51 | 2 | 20 | 73 | 519 |
| 1988 | 305 | 79 | 3 | 387 | 68 | 0 | 0 | 68 | 63 | 1 | 13 | 77 | 532 |
| 1989 | 319 | 151 | 3 | 473 | 56 | 1 | 0 | 57 | 50 | 2 | 8 | 60 | 590 |
| 1990 | 382 | 163 | 4 | 549 | 67 | 0 | 0 | 67 | 39 | 0 | 3 | 42 | 658 |
| 1991 | 225 | 39 | 4 | 268 | 57 | 0 | 0 | 57 | 27 | 1 | 5 | 33 | 358 |
| 1992 | 425 | 27 | 10 | 462 | 36 | 10 | 1 | 47 | 41 | 6 | 5 | 52 | 561 |
| 1993 | 242 | 12 | 9 | 263 | 55 | 13 | 1 | 69 | 35 | 7 | 2 | 44 | 376 |
| 1994 | 216 | 16 | 5 | 237 | 52 | 14 | 7 | 73 | 45 | 10 | 8 | 63 | 373 |
| 1995 | 165 | 30 | 6 | 201 | 72 | 12 | 1 | 85 | 45 | 11 | 10 | 66 | 352 |
| 1996 | 164 | 24 | 13 | 201 | 89 | 15 | 1 | 105 | 58 | 9 | 6 | 73 | 379 |
| 1997 | 178 | 21 | 16 | 215 | 77 | 28 | 3 | 108 | 67 | 30 | 3 | 100 | 423 |

a/ Principal gear is the gear with which a vessel made most of its landings during the year.
b/ Includes vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries generated from Washington, Oregon, and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-3. Number of California, Oregon, and Washington vessels landing CPS or squid, by landing category, 1981-1997.

| | | | | | Round Haul Vessels[a/] | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Non-round Haulers | | | | CPS+SQUID<50 | | | | CPS=0, SQUID>=50[b/] | | | 0<CPS<50 CPS+SQUID>=50[b/] | | | CPS>=50 | | | | Grand |
| Year | CA | OR | WA | Sum | CA | OR | WA | Sum | CA | OR | Sum | CA | OR | Sum | CA | OR | WA | Sum | Total |
| 1981 | 365 | 6 | 20 | 391 | 37 | 0 | 7 | 44 | 5 | 0 | 5 | 16 | 0 | 16 | 58 | 0 | 0 | 58 | 514 |
| 1982 | 367 | 10 | 14 | 391 | 34 | 1 | 4 | 39 | 4 | 0 | 4 | 26 | 0 | 26 | 56 | 0 | 0 | 56 | 516 |
| 1983 | 389 | 70 | 21 | 480 | 27 | 5 | 11 | 43 | 1 | 0 | 1 | 2 | 1 | 3 | 52 | 0 | 0 | 52 | 579 |
| 1984 | 380 | 5 | 21 | 406 | 18 | 7 | 5 | 30 | 0 | 2 | 2 | 0 | 1 | 1 | 49 | 0 | 0 | 49 | 488 |
| 1985 | 390 | 3 | 11 | 404 | 29 | 13 | 3 | 45 | 2 | 4 | 6 | 13 | 0 | 13 | 45 | 0 | 0 | 45 | 513 |
| 1986 | 312 | 5 | 21 | 338 | 16 | 2 | 3 | 21 | 2 | 0 | 2 | 8 | 0 | 8 | 48 | 0 | 0 | 48 | 417 |
| 1987 | 323 | 94 | 19 | 436 | 22 | 0 | 2 | 24 | 4 | 0 | 4 | 8 | 0 | 8 | 46 | 0 | 1 | 47 | 519 |
| 1988 | 347 | 79 | 13 | 439 | 22 | 1 | 3 | 26 | 18 | 0 | 18 | 7 | 0 | 7 | 42 | 0 | 0 | 42 | 532 |
| 1989 | 334 | 153 | 9 | 496 | 25 | 1 | 2 | 28 | 14 | 0 | 14 | 6 | 0 | 6 | 46 | 0 | 0 | 46 | 590 |
| 1990 | 405 | 163 | 5 | 573 | 25 | 0 | 2 | 27 | 5 | 0 | 5 | 5 | 0 | 5 | 48 | 0 | 0 | 48 | 658 |
| 1991 | 237 | 40 | 7 | 284 | 24 | 0 | 1 | 25 | 4 | 0 | 4 | 9 | 0 | 9 | 35 | 0 | 1 | 36 | 358 |
| 1992 | 424 | 43 | 11 | 478 | 19 | 0 | 5 | 24 | 13 | 0 | 13 | 10 | 0 | 10 | 36 | 0 | 0 | 36 | 561 |
| 1993 | 247 | 29 | 7 | 283 | 26 | 3 | 5 | 34 | 14 | 0 | 14 | 10 | 0 | 10 | 35 | 0 | 0 | 35 | 376 |
| 1994 | 218 | 35 | 13 | 266 | 36 | 4 | 6 | 46 | 18 | 1 | 19 | 9 | 0 | 9 | 32 | 0 | 1 | 33 | 373 |
| 1995 | 178 | 48 | 12 | 238 | 32 | 4 | 4 | 40 | 17 | 1 | 18 | 15 | 0 | 15 | 40 | 0 | 1 | 41 | 352 |
| 1996 | 174 | 45 | 15 | 234 | 41 | 2 | 4 | 47 | 27 | 1 | 28 | 22 | 0 | 22 | 47 | 0 | 1 | 48 | 379 |
| 1997 | 194 | 72 | 20 | 286 | 37 | 6 | 1 | 44 | 24 | 0 | 24 | 13 | 0 | 13 | 54 | 1 | 1 | 56 | 423 |

a/ Includes vessels whose principal gear is round haul or an unspecified net gear.
b/ No Washington boats in this category in any year.

Source: Vessel summaries generated from Washington, Oregon, and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-4. Total number of vessels landing CPS or squid in Washington, Oregon, and California and percent distribution of vessels across landings categories, 1981-1997.

| | | | Round Haul Vessels[a/] | | | |
|---|---|---|---|---|---|---|
| | | | | CPS=0 | 0<CPS<50 | |
| Year | Total | Non-Round Haulers | CPS+Squid<50 | Squid>=50 | SQUID>=50 | CPS>=50 |
| 1981 | 514 | 76.1 | 8.6 | 1.0 | 3.1 | 11.3 |
| 1982 | 516 | 75.8 | 7.6 | 0.8 | 5.0 | 10.9 |
| 1983 | 579 | 82.9 | 7.4 | 0.2 | 0.5 | 9.0 |
| 1984 | 488 | 83.2 | 6.1 | 0.4 | 0.2 | 10.0 |
| 1985 | 513 | 78.8 | 8.8 | 1.2 | 2.5 | 8.8 |
| 1986 | 417 | 81.1 | 5.0 | 0.5 | 1.9 | 11.5 |
| 1987 | 519 | 84.0 | 4.6 | 0.8 | 1.5 | 9.1 |
| 1988 | 532 | 82.5 | 4.9 | 3.4 | 1.3 | 7.9 |
| 1989 | 590 | 84.1 | 4.7 | 2.4 | 1.0 | 7.8 |
| 1990 | 658 | 87.1 | 4.1 | 0.8 | 0.8 | 7.3 |
| 1991 | 358 | 79.3 | 7.0 | 1.1 | 2.5 | 10.1 |
| 1992 | 561 | 85.2 | 4.3 | 2.3 | 1.8 | 6.4 |
| 1993 | 376 | 75.3 | 9.0 | 3.7 | 2.7 | 9.3 |
| 1994 | 373 | 71.3 | 12.3 | 5.1 | 2.4 | 8.8 |
| 1995 | 352 | 67.6 | 11.4 | 5.1 | 4.3 | 11.6 |
| 1996 | 379 | 61.7 | 12.4 | 7.4 | 5.8 | 12.7 |
| 1997 | 423 | 67.6 | 10.4 | 5.7 | 3.1 | 13.2 |
| | | | CPS Landings | | | |
| 1981 | 105,490.0 | 0.2 | 0.2 | 0.0 | 0.1 | 99.5 |
| 1982 | 97,839.0 | 0.2 | 0.2 | 0.0 | 0.3 | 99.4 |
| 1983 | 55,738.7 | 18.8 | 0.6 | 0.0 | 0.1 | 80.5 |
| 1984 | 56,133.1 | 10.7 | 0.5 | 0.0 | 0.0 | 88.8 |
| 1985 | 46,291.4 | 2.3 | 0.5 | 0.0 | 0.3 | 96.9 |
| 1986 | 54,812.5 | 1.9 | 0.3 | 0.0 | 0.2 | 97.6 |
| 1987 | 56,652.0 | 4.2 | 0.3 | 0.0 | 0.2 | 95.4 |
| 1988 | 58,638.0 | 2.7 | 0.3 | 0.0 | 0.1 | 96.9 |
| 1989 | 61,806.1 | 3.6 | 0.6 | 0.0 | 0.1 | 95.7 |
| 1990 | 48,237.3 | 3.1 | 0.6 | 0.0 | 0.2 | 96.1 |
| 1991 | 45,386.4 | 47.2 | 0.5 | 0.0 | 0.3 | 52.0 |
| 1992 | 39,689.8 | 2.7 | 0.6 | 0.0 | 0.5 | 96.2 |
| 1993 | 31,428.0 | 7.9 | 0.6 | 0.0 | 0.5 | 91.0 |
| 1994 | 26,702.7 | 14.2 | 1.1 | 0.0 | 0.4 | 84.3 |
| 1995 | 52,971.1 | 0.9 | 0.3 | 0.0 | 0.4 | 98.4 |
| 1996 | 49,220.4 | 1.1 | 0.5 | 0.0 | 0.6 | 97.8 |
| 1997 | 70,085.3 | 3.3 | 0.2 | 0.0 | 0.2 | 96.4 |
| | | | Squid Landings | | | |
| 1981 | 23,515.2 | 31.5 | 0.8 | 5.9 | 28.4 | 33.5 |
| 1982 | 16,361.6 | 22.4 | 0.7 | 4.7 | 45.7 | 26.5 |
| 1983 | 1,998.9 | 52.1 | 7.7 | 7.6 | 6.2 | 26.3 |
| 1984 | 1,006.4 | 39.8 | 13.9 | 17.5 | 13.3 | 15.6 |
| 1985 | 11,072.1 | 17.6 | 2.6 | 8.0 | 16.1 | 55.8 |
| 1986 | 21,294.5 | 8.6 | 0.3 | 2.1 | 10.9 | 78.2 |
| 1987 | 19,988.0 | 15.1 | 0.6 | 7.6 | 14.0 | 62.6 |
| 1988 | 37,233.8 | 9.8 | 0.5 | 21.4 | 3.0 | 65.4 |
| 1989 | 40,937.1 | 5.9 | 0.4 | 30.7 | 6.4 | 56.6 |
| 1990 | 28,447.2 | 4.7 | 0.5 | 14.9 | 9.8 | 70.0 |
| 1991 | 37,388.9 | 12.4 | 0.7 | 9.9 | 14.7 | 62.4 |
| 1992 | 13,117.0 | 0.2 | 0.9 | 37.8 | 14.8 | 46.3 |
| 1993 | 42,894.2 | 0.6 | 0.4 | 29.7 | 10.3 | 58.9 |
| 1994 | 56,001.9 | 1.7 | 0.4 | 26.3 | 20.2 | 51.4 |
| 1995 | 70,375.0 | 1.8 | 0.5 | 19.2 | 25.5 | 53.0 |
| 1996 | 80,428.9 | 0.8 | 0.9 | 25.4 | 21.4 | 51.5 |
| 1997 | 71,042.5 | 0.3 | 0.6 | 28.8 | 13.0 | 57.3 |

a/ Includes vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries from Washington, Oregon and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-5. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal landing area, 1981-1997.

| Fishing Year and Principal Landing Area | CPS+SQUID<50 | CPS=0 SQUID>=50 | 0<CPS<50 SQUID>=50 | CPS>=50 | Total |
|---|---|---|---|---|---|
| **1981** | | | | | |
| San Diego | 1 | 0 | 0 | 0 | 1 |
| Orange/LA | 7 | 2 | 0 | 40 | 49 |
| Vent/Sbarb | 4 | 0 | 0 | 5 | 9 |
| SanLuisObispo | 1 | 0 | 0 | 0 | 1 |
| Monterey/StaCruz | 24 | 3 | 16 | 11 | 54 |
| SanFran Bay Area | 0 | 0 | 0 | 2 | 2 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 0 | 0 | 0 | 0 | 0 |
| Washington | 7 | 0 | 0 | 0 | 7 |
| Total | 44 | 5 | 16 | 58 | 123 |
| **1982** | | | | | |
| San Diego | 1 | 0 | 0 | 0 | 1 |
| Orange/LA | 9 | 0 | 0 | 42 | 51 |
| Vent/Sbarb | 2 | 1 | 0 | 6 | 9 |
| SanLuisObispo | 2 | 0 | 0 | 0 | 2 |
| Monterey/StaCruz | 17 | 3 | 26 | 7 | 53 |
| SanFran Bay Area | 3 | 0 | 0 | 1 | 4 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 1 | 0 | 0 | 0 | 1 |
| Washington | 4 | 0 | 0 | 0 | 4 |
| Total | 39 | 4 | 26 | 56 | 125 |
| **1983** | | | | | |
| San Diego | 1 | 0 | 0 | 0 | 1 |
| Orange/LA | 12 | 0 | 0 | 42 | 54 |
| Vent/Sbarb | 3 | 0 | 0 | 1 | 4 |
| SanLuisObispo | 0 | 0 | 0 | 0 | 0 |
| Monterey/StaCruz | 10 | 1 | 2 | 9 | 22 |
| SanFran Bay Area | 2 | 0 | 0 | 0 | 2 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 4 | 0 | 1 | 0 | 5 |
| Washington | 11 | 0 | 0 | 0 | 11 |
| Total | 43 | 1 | 3 | 52 | 99 |
| **1984** | | | | | |
| San Diego | 0 | 0 | 0 | 0 | 0 |
| Orange/LA | 9 | 0 | 0 | 39 | 48 |
| Vent/Sbarb | 5 | 0 | 0 | 1 | 6 |
| SanLuisObispo | 0 | 0 | 0 | 0 | 0 |
| Monterey/StaCruz | 4 | 0 | 0 | 9 | 13 |
| SanFran Bay Area | 0 | 0 | 0 | 0 | 0 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 7 | 2 | 1 | 0 | 10 |
| Washington | 5 | 0 | 0 | 0 | 5 |
| Total | 30 | 2 | 1 | 49 | 82 |

TABLE 2.1.2-5. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal landing area, 1981-1997. (Continued).

| Fishing Year and Principal Landing Area | CPS+SQUID<50 | CPS=0 SQUID>=50 | 0<CPS<50 SQUID>=50 | CPS>=50 | Total |
|---|---|---|---|---|---|
| **1985** | | | | | |
| San Diego | 0 | 0 | 0 | 0 | 0 |
| Orange/LA | 10 | 0 | 1 | 33 | 44 |
| Vent/Sbarb | 4 | 1 | 0 | 4 | 9 |
| SanLuisObispo | 2 | 0 | 0 | 0 | 2 |
| Monterey/StaCruz | 12 | 0 | 12 | 8 | 32 |
| SanFran Bay Area | 1 | 1 | 0 | 0 | 2 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 13 | 4 | 0 | 0 | 17 |
| Washington | 3 | 0 | 0 | 0 | 3 |
| Total | 45 | 6 | 13 | 45 | 109 |
| **1986** | | | | | |
| San Diego | 0 | 0 | 0 | 0 | 0 |
| Orange/LA | 5 | 0 | 1 | 32 | 38 |
| Vent/Sbarb | 4 | 1 | 0 | 8 | 13 |
| SanLuisObispo | 1 | 0 | 0 | 0 | 1 |
| Monterey/StaCruz | 6 | 1 | 6 | 8 | 21 |
| SanFran Bay Area | 0 | 0 | 1 | 0 | 1 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 2 | 0 | 0 | 0 | 2 |
| Washington | 3 | 0 | 0 | 0 | 3 |
| Total | 21 | 2 | 8 | 48 | 79 |
| **1987** | | | | | |
| San Diego | 1 | 0 | 0 | 0 | 1 |
| Orange/LA | 6 | 0 | 0 | 33 | 39 |
| Vent/Sbarb | 7 | 2 | 2 | 8 | 19 |
| SanLuisObispo | 0 | 0 | 0 | 0 | 0 |
| Monterey/StaCruz | 7 | 2 | 5 | 4 | 18 |
| SanFran Bay Area | 1 | 0 | 1 | 1 | 3 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 0 | 0 | 0 | 0 | 0 |
| Washington | 2 | 0 | 0 | 1 | 3 |
| Total | 24 | 4 | 8 | 47 | 83 |
| **1988** | | | | | |
| San Diego | 2 | 0 | 0 | 0 | 2 |
| Orange/LA | 12 | 2 | 0 | 30 | 44 |
| Vent/Sbarb | 3 | 9 | 2 | 8 | 22 |
| SanLuisObispo | 0 | 0 | 0 | 0 | 0 |
| Monterey/StaCruz | 4 | 6 | 5 | 3 | 18 |
| SanFran Bay Area | 2 | 1 | 0 | 1 | 4 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 0 | 0 | 0 | 0 | 0 |
| Washington | 3 | 0 | 0 | 0 | 3 |
| Total | 26 | 18 | 7 | 42 | 93 |

TABLE 2.1.2-5. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal landing area, 1981-1997. (Continued).

| Fishing Year and Principal Landing Area | CPS+SQUID<50 | CPS=0 SQUID>=50 | 0<CPS<50 SQUID>=50 | CPS>=50 | Total |
|---|---|---|---|---|---|
| **1989** | | | | | |
| San Diego | 2 | 0 | 0 | 0 | 2 |
| Orange/LA | 11 | 3 | 0 | 30 | 44 |
| Vent/Sbarb | 5 | 6 | 1 | 9 | 21 |
| SanLuisObispo | 0 | 0 | 0 | 0 | 0 |
| Monterey/StaCruz | 6 | 5 | 5 | 6 | 22 |
| SanFran Bay Area | 1 | 0 | 0 | 1 | 2 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 1 | 0 | 0 | 0 | 1 |
| Washington | 2 | 0 | 0 | 0 | 2 |
| Total | 28 | 14 | 6 | 46 | 94 |
| **1990** | | | | | |
| San Diego | 4 | 0 | 0 | 0 | 4 |
| Orange/LA | 10 | 0 | 0 | 30 | 40 |
| Vent/Sbarb | 3 | 1 | 2 | 6 | 12 |
| SanLuisObispo | 0 | 0 | 0 | 0 | 0 |
| Monterey/StaCruz | 8 | 4 | 3 | 11 | 26 |
| SanFran Bay Area | 0 | 0 | 0 | 1 | 1 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 0 | 0 | 0 | 0 | 0 |
| Washington | 2 | 0 | 0 | 0 | 2 |
| Total | 27 | 5 | 5 | 48 | 85 |
| **1991** | | | | | |
| San Diego | 3 | 0 | 0 | 2 | 5 |
| Orange/LA | 8 | 0 | 0 | 17 | 25 |
| Vent/Sbarb | 6 | 1 | 5 | 7 | 19 |
| SanLuisObispo | 0 | 0 | 0 | 0 | 0 |
| Monterey/StaCruz | 6 | 2 | 4 | 8 | 20 |
| SanFran Bay Area | 1 | 1 | 0 | 1 | 3 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 0 | 0 | 0 | 0 | 0 |
| Washington | 1 | 0 | 0 | 1 | 2 |
| Total | 25 | 4 | 9 | 36 | 74 |
| **1992** | | | | | |
| San Diego | 2 | 0 | 0 | 1 | 3 |
| Orange/LA | 7 | 0 | 0 | 29 | 36 |
| Vent/Sbarb | 4 | 4 | 0 | 0 | 8 |
| SanLuisObispo | 0 | 0 | 0 | 0 | 0 |
| Monterey/StaCruz | 3 | 7 | 10 | 5 | 25 |
| SanFran Bay Area | 3 | 2 | 0 | 1 | 6 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 0 | 0 | 0 | 0 | 0 |
| Washington | 5 | 0 | 0 | 0 | 5 |
| Total | 24 | 13 | 10 | 36 | 83 |

TABLE 2.1.2-5. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal landing area, 1981-1997. (Continued).

| Fishing Year and Principal Landing Area | CPS+SQUID<50 | CPS=0 SQUID>=50 | 0<CPS<50 SQUID>=50 | CPS>=50 | Total |
|---|---|---|---|---|---|
| **1993** | | | | | |
| San Diego | 1 | 0 | 0 | 0 | 1 |
| Orange/LA | 11 | 0 | 1 | 24 | 36 |
| Vent/Sbarb | 3 | 10 | 2 | 6 | 21 |
| SanLuisObispo | 2 | 0 | 0 | 0 | 2 |
| Monterey/StaCruz | 7 | 4 | 7 | 4 | 22 |
| SanFran Bay Area | 2 | 0 | 0 | 1 | 3 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 3 | 0 | 0 | 0 | 3 |
| Washington | 5 | 0 | 0 | 0 | 5 |
| Total | 34 | 14 | 10 | 35 | 93 |
| **1994** | | | | | |
| San Diego | 1 | 0 | 0 | 0 | 1 |
| Orange/LA | 14 | 0 | 1 | 19 | 34 |
| Vent/Sbarb | 8 | 9 | 6 | 4 | 27 |
| SanLuisObispo | 2 | 0 | 0 | 0 | 2 |
| Monterey/StaCruz | 11 | 9 | 2 | 6 | 28 |
| SanFran Bay Area | 0 | 0 | 0 | 3 | 3 |
| Northern California | 1 | 0 | 0 | 0 | 1 |
| Oregon | 4 | 1 | 0 | 0 | 5 |
| Washington | 5 | 0 | 0 | 1 | 6 |
| Total | 46 | 19 | 9 | 33 | 107 |
| **1995** | | | | | |
| San Diego | 1 | 0 | 0 | 0 | 1 |
| Orange/LA | 14 | 1 | 2 | 22 | 39 |
| Vent/Sbarb | 7 | 15 | 11 | 8 | 41 |
| SanLuisObispo | 0 | 0 | 0 | 0 | 0 |
| Monterey/StaCruz | 6 | 1 | 2 | 9 | 18 |
| SanFran Bay Area | 3 | 0 | 0 | 1 | 4 |
| Northern California | 1 | 0 | 0 | 0 | 1 |
| Oregon | 4 | 1 | 0 | 0 | 5 |
| Washington | 4 | 0 | 0 | 1 | 5 |
| Total | 40 | 18 | 15 | 41 | 114 |
| **1996** | | | | | |
| San Diego | 1 | 0 | 0 | 1 | 2 |
| Orange/LA | 12 | 1 | 6 | 23 | 42 |
| Vent/Sbarb | 17 | 23 | 15 | 12 | 67 |
| SanLuisObispo | 0 | 0 | 0 | 0 | 0 |
| Monterey/StaCruz | 10 | 3 | 1 | 10 | 24 |
| SanFran Bay Area | 0 | 0 | 0 | 1 | 1 |
| Northern California | 1 | 0 | 0 | 0 | 1 |
| Oregon | 2 | 1 | 0 | 0 | 3 |
| Washington | 4 | 0 | 0 | 1 | 5 |
| Total | 47 | 28 | 22 | 48 | 145 |

TABLE 2.1.2-5. Number of Washington, Oregon, and California round haul vessels[a/] landing any CPS or squid, by principal landing area, 1981-1997. (Continued).

| Fishing Year and Principal Landing Area | CPS+SQUID<50 | CPS=0 SQUID>=50 | 0<CPS<50 SQUID>=50 | CPS>=50 | Total |
|---|---|---|---|---|---|
| **1997** | | | | | |
| San Diego | 1 | 0 | 0 | 0 | 1 |
| Orange/LA | 19 | 0 | 2 | 28 | 49 |
| Vent/Sbarb | 5 | 20 | 10 | 12 | 47 |
| SanLuisObispo | 1 | 0 | 0 | 0 | 1 |
| Monterey/StaCruz | 8 | 4 | 1 | 14 | 27 |
| SanFran Bay Area | 3 | 0 | 0 | 1 | 4 |
| Northern California | 0 | 0 | 0 | 0 | 0 |
| Oregon | 6 | 0 | 0 | 0 | 6 |
| Washington | 1 | 0 | 0 | 1 | 2 |
| Total | 44 | 24 | 13 | 56 | 137 |

a/ Vessels whose principal gear is round haul or an unspecified net gear.

Principal landing area is the area in which the vessel made most of its landings during the year.
Source: Vessel summaries generated from Washington, Oregon, and California fish ticket data in PacFIN format.

TABLE 2.1.2-6. Average landings (mt) by Washington, Oregon, and California round haul vessels[a/] landing CPS or squid, by species, 1981-1997.

| Year | Anchovy | Mackerel | Sardine | Squid | Herring | Bonito | Tuna | All Else | Total |
|---|---|---|---|---|---|---|---|---|---|
| CPS+SQUID<50 mt: | | | | | | | | | |
| 1981 | 8.6 | 5.0 | 0.0 | 7.0 | 19.0 | 0.7 | 6.8 | 9.4 | 56.5 |
| 1982 | 8.0 | 4.4 | 0.1 | 6.4 | 8.9 | 1.4 | 8.6 | 3.3 | 41.0 |
| 1983 | 10.5 | 11.1 | 0.0 | 6.2 | 22.2 | 0.9 | 57.0 | 63.0 | 170.9 |
| 1984 | 20.1 | 10.4 | 0.1 | 10.8 | 19.8 | 1.0 | 3.0 | 35.3 | 100.4 |
| 1985 | 8.9 | 5.2 | 0.2 | 11.4 | 16.7 | 3.0 | 1.7 | 57.9 | 105.1 |
| 1986 | 18.5 | 6.5 | 0.4 | 5.4 | 15.1 | 0.7 | 20.1 | 11.5 | 78.2 |
| 1987 | 10.9 | 4.2 | 0.1 | 9.0 | 13.5 | 0.3 | 0.0 | 15.0 | 53.2 |
| 1988 | 8.5 | 5.9 | 1.9 | 14.6 | 25.0 | 0.1 | 6.8 | 10.5 | 73.4 |
| 1989 | 21.6 | 8.7 | 0.1 | 17.9 | 7.3 | 0.1 | 0.0 | 70.2 | 125.8 |
| 1990 | 22.5 | 6.9 | 0.8 | 10.7 | 19.9 | 0.7 | 0.1 | 2.5 | 64.1 |
| 1991 | 17.2 | 0.7 | 0.6 | 17.7 | 11.2 | 0.1 | 0.0 | 9.1 | 56.7 |
| 1992 | 16.0 | 10.9 | 4.6 | 15.2 | 19.3 | 0.1 | 25.1 | 78.7 | 170.0 |
| 1993 | 9.5 | 4.0 | 6.3 | 10.5 | 16.0 | 0.1 | 324.3 | 16.7 | 387.4 |
| 1994 | 4.9 | 6.0 | 6.3 | 9.9 | 7.6 | 3.1 | 37.0 | 55.3 | 130.2 |
| 1995 | 6.5 | 4.0 | 3.1 | 14.4 | 24.9 | 0.0 | 37.8 | 13.8 | 104.5 |
| 1996 | 12.5 | 4.1 | 4.9 | 23.2 | 17.1 | 0.1 | 18.8 | 10.4 | 91.0 |
| 1997 | 6.4 | 4.2 | 2.2 | 14.6 | 57.3 | 5.5 | 106.8 | 53.4 | 250.5 |
| | | | | | | | | | |
| 1981 | 0.0 | 0.0 | 0.0 | 275.6 | 16.3 | 0.0 | 40.9 | 6.1 | 338.8 |
| 1982 | 0.0 | 0.0 | 0.0 | 192.4 | 20.4 | 0.0 | 23.6 | 20.5 | 256.9 |
| 1983 | 0.0 | 0.0 | 0.0 | 151.9 | 0.0 | 0.0 | 1.8 | 2.7 | 156.4 |
| 1984 | 0.0 | 0.0 | 0.0 | 87.8 | 20.9 | 0.0 | 0.8 | 36.4 | 146.0 |
| 1985 | 0.0 | 0.0 | 0.0 | 147.1 | 25.1 | 0.0 | 7.9 | 115.6 | 295.7 |
| 1986 | 0.0 | 0.0 | 0.0 | 227.0 | 27.6 | 0.0 | 0.1 | 25.0 | 279.8 |
| 1987 | 0.0 | 0.0 | 0.0 | 381.6 | 43.9 | 21.5 | 0.0 | 18.0 | 465.1 |
| 1988 | 0.0 | 0.0 | 0.0 | 441.9 | 52.8 | 0.1 | 18.2 | 25.8 | 538.8 |
| 1989 | 0.0 | 0.0 | 0.0 | 898.0 | 65.2 | 0.0 | 25.8 | 22.4 | 1011.5 |
| 1990 | 0.0 | 0.0 | 0.0 | 848.4 | 36.0 | 0.0 | 0.0 | 3.0 | 887.4 |
| 1991 | 0.0 | 0.0 | 0.0 | 923.9 | 61.4 | 0.0 | 0.0 | 9.4 | 994.7 |
| 1992 | 0.0 | 0.0 | 0.0 | 381.7 | 52.5 | 0.0 | 1.0 | 16.2 | 451.5 |
| 1993 | 0.0 | 0.0 | 0.0 | 911.1 | 34.2 | 0.0 | 3.4 | 20.6 | 969.3 |
| 1994 | 0.0 | 0.0 | 0.0 | 774.6 | 32.4 | 1.7 | 0.0 | 16.8 | 825.5 |
| 1995 | 0.0 | 0.0 | 0.0 | 749.2 | 28.2 | 7.8 | 0.0 | 72.0 | 857.2 |
| 1996 | 0.0 | 0.0 | 0.0 | 729.5 | 37.5 | 26.3 | 0.2 | 8.8 | 802.4 |
| 1997 | 0.0 | 0.0 | 0.0 | 852.1 | 106.6 | 0.0 | 0.3 | 17.5 | 976.5 |
| | | | | | | | | | |
| 1981 | 1.4 | 8.1 | 0.0 | 416.9 | 29.4 | 0.0 | 25.1 | 5.8 | 486.7 |
| 1982 | 4.8 | 10.3 | 0.0 | 287.5 | 45.9 | 0.0 | 0.9 | 9.6 | 359.0 |
| 1983 | 9.2 | 15.9 | 0.0 | 41.5 | 74.1 | 0.1 | 0.9 | 16.4 | 158.2 |
| 1984 | 0.3 | 0.0 | 0.0 | 133.5 | 0.0 | 0.0 | 6.9 | 81.3 | 222.0 |
| 1985 | 13.0 | 6.7 | 0.0 | 136.8 | 41.7 | 0.0 | 1.5 | 5.3 | 204.9 |
| 1986 | 15.2 | 7.3 | 0.9 | 289.8 | 40.8 | 0.0 | 0.0 | 4.1 | 358.0 |
| 1987 | 0.0 | 10.9 | 1.3 | 350.0 | 54.6 | 0.5 | 0.0 | 19.4 | 436.6 |
| 1988 | 6.4 | 10.2 | 2.8 | 157.0 | 46.2 | 0.0 | 0.8 | 4.3 | 227.7 |
| 1989 | 19.9 | 10.1 | 0.0 | 439.9 | 48.5 | 0.1 | 2.9 | 6.8 | 528.2 |
| 1990 | 0.0 | 27.8 | 1.4 | 559.0 | 0.0 | 0.0 | 0.0 | 37.8 | 625.9 |
| 1991 | 8.5 | 7.2 | 8.9 | 612.8 | 41.3 | 0.0 | 247.5 | 248.2 | 1174.3 |
| 1992 | 18.3 | 11.9 | 8.7 | 194.2 | 61.8 | 0.0 | 0.0 | 0.7 | 295.5 |
| 1993 | 5.6 | 8.3 | 9.7 | 443.1 | 25.9 | 0.0 | 0.0 | 6.4 | 499.0 |
| 1994 | 0.0 | 7.3 | 10.7 | 1258.8 | 0.0 | 32.2 | 13.1 | 4.5 | 1326.6 |
| 1995 | 0.2 | 8.0 | 12.6 | 1197.4 | 45.2 | 1.6 | 0.0 | 0.8 | 1266.0 |
| 1996 | 17.2 | 5.8 | 11.5 | 780.8 | 0.0 | 7.7 | 0.7 | 10.7 | 834.4 |
| 1997 | 7.3 | 7.1 | 5.1 | 710.1 | 95.4 | 0.0 | 0.2 | 4.9 | 830.1 |

TABLE 2.1.2-6. Average landings (mt) by Washington, Oregon, and California round haul vessels[a/] landing CPS or squid, by species, 1981-1997. (Continued).

| Year | Anchovy | Mackerel | Sardine | Squid | Herring | Bonito | Tuna | All Else | Total |
|---|---|---|---|---|---|---|---|---|---|
| CPS>=50 mt: | | | | | | | | | |
| 1981 | 1135.3 | 959.5 | 1.0 | 291.9 | 52.1 | 133.1 | 89.3 | 3.2 | 2665.2 |
| 1982 | 1168.6 | 1040.7 | 0.5 | 206.8 | 105.4 | 65.0 | 68.7 | 5.3 | 2661.1 |
| 1983 | 74.6 | 847.1 | 0.3 | 32.9 | 70.0 | 81.9 | 82.3 | 6.6 | 1195.7 |
| 1984 | 172.7 | 995.1 | 0.2 | 17.4 | 28.3 | 78.9 | 170.6 | 101.3 | 1564.5 |
| 1985 | 117.4 | 992.8 | 1.3 | 237.7 | 41.8 | 105.2 | 71.9 | 5.2 | 1573.3 |
| 1986 | 93.3 | 1088.7 | 27.4 | 462.3 | 31.8 | 15.4 | 226.5 | 79.8 | 2025.2 |
| 1987 | 154.1 | 1165.6 | 26.1 | 431.5 | 42.2 | 131.3 | 116.7 | 10.2 | 2077.6 |
| 1988 | 145.1 | 1359.2 | 53.4 | 737.6 | 54.7 | 148.7 | 94.4 | 8.8 | 2601.9 |
| 1989 | 176.1 | 1222.0 | 37.6 | 643.1 | 52.6 | 38.5 | 57.8 | 176.4 | 2404.3 |
| 1990 | 165.1 | 887.7 | 44.8 | 510.7 | 48.7 | 156.5 | 127.4 | 162.5 | 2103.5 |
| 1991 | 174.7 | 598.0 | 152.1 | 842.6 | 46.7 | 10.3 | 27.8 | 3.6 | 1856.0 |
| 1992 | 87.6 | 592.8 | 521.4 | 319.4 | 17.4 | 69.0 | 104.2 | 3.2 | 1715.1 |
| 1993 | 124.8 | 372.0 | 466.5 | 870.6 | 39.9 | 25.3 | 140.1 | 6.0 | 2045.1 |
| 1994 | 98.9 | 408.4 | 337.0 | 1028.5 | 22.3 | 17.6 | 189.6 | 11.0 | 2113.2 |
| 1995 | 84.5 | 326.9 | 1001.8 | 1037.0 | 49.1 | 9.6 | 288.3 | 9.5 | 2806.6 |
| 1996 | 160.3 | 302.0 | 735.3 | 964.0 | 62.1 | 26.4 | 337.3 | 11.1 | 2598.4 |
| 1997 | 178.5 | 414.9 | 791.5 | 904.8 | 109.8 | 23.9 | 165.7 | 63.8 | 2652.8 |
| All Round Haul Vessels: | | | | | | | | | |
| 1981 | 917.7 | 582.4 | 1.0 | 214.9 | 32.8 | 109.2 | 68.1 | 6.2 | 1932.4 |
| 1982 | 878.2 | 544.4 | 0.4 | 184.1 | 47.2 | 58.8 | 57.0 | 6.1 | 1776.1 |
| 1983 | 42.4 | 583.3 | 0.3 | 21.3 | 40.2 | 62.0 | 67.8 | 38.2 | 855.5 |
| 1984 | 106.3 | 772.8 | 0.1 | 24.2 | 25.6 | 72.4 | 141.3 | 67.9 | 1210.6 |
| 1985 | 45.5 | 609.0 | 1.0 | 130.4 | 31.9 | 88.6 | 45.2 | 41.6 | 993.1 |
| 1986 | 57.2 | 844.4 | 18.5 | 341.6 | 29.4 | 13.4 | 193.6 | 45.4 | 1543.6 |
| 1987 | 78.3 | 796.9 | 18.4 | 308.5 | 39.6 | 102.0 | 104.4 | 13.5 | 1461.6 |
| 1988 | 59.5 | 939.7 | 43.5 | 473.0 | 47.9 | 128.9 | 73.2 | 12.3 | 1778.1 |
| 1989 | 92.8 | 894.7 | 34.4 | 592.7 | 48.5 | 34.7 | 51.3 | 105.6 | 1854.7 |
| 1990 | 117.6 | 686.9 | 40.5 | 430.3 | 42.1 | 130.6 | 114.7 | 93.4 | 1656.0 |
| 1991 | 103.7 | 385.9 | 125.0 | 601.0 | 46.6 | 7.4 | 96.4 | 43.6 | 1409.6 |
| 1992 | 47.4 | 437.8 | 371.4 | 261.9 | 40.9 | 60.9 | 89.7 | 21.5 | 1331.5 |
| 1993 | 66.7 | 238.1 | 331.1 | 600.3 | 29.5 | 22.2 | 163.2 | 13.5 | 1464.6 |
| 1994 | 53.1 | 215.4 | 194.0 | 705.9 | 22.5 | 14.8 | 156.2 | 32.6 | 1394.5 |
| 1995 | 57.6 | 197.0 | 628.9 | 751.2 | 38.3 | 6.4 | 254.9 | 23.2 | 1957.4 |
| 1996 | 112.6 | 166.2 | 478.7 | 648.4 | 35.3 | 20.0 | 211.3 | 10.3 | 1682.7 |
| 1997 | 137.6 | 282.3 | 586.5 | 638.0 | 98.1 | 19.0 | 130.9 | 49.3 | 1941.6 |

a/ Vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries generated from Washington, Oregon, and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-7. Average exvessel revenues ($1,000's; base year=1990) by Washington, Oregon, and California round haul vessels[a/] landing CPS or squid, by species, 1981-1997.

| Year | Anchovy | Mackerel | Sardine | Squid | Herring | Bonito | Tuna | All Else | Total |
|---|---|---|---|---|---|---|---|---|---|
| CPS+SQUID<50 mt: | | | | | | | | | |
| 1981 | 3.3 | 1.6 | 0.0 | 3.1 | 25.1 | 0.5 | 18.7 | 17.5 | 69.8 |
| 1982 | 4.0 | 1.3 | 0.1 | 2.5 | 13.2 | 0.7 | 22.4 | 8.0 | 52.3 |
| 1983 | 4.3 | 3.0 | 0.0 | 4.6 | 37.6 | 0.8 | 79.6 | 86.5 | 216.4 |
| 1984 | 7.9 | 2.2 | 0.1 | 6.6 | 13.5 | 0.6 | 5.2 | 44.0 | 80.1 |
| 1985 | 3.8 | 1.5 | 0.2 | 5.6 | 34.7 | 0.7 | 3.1 | 60.6 | 110.2 |
| 1986 | 7.9 | 0.9 | 0.1 | 1.5 | 10.3 | 0.4 | 28.4 | 31.0 | 80.4 |
| 1987 | 4.7 | 0.9 | 0.1 | 3.0 | 9.9 | 0.2 | 0.1 | 26.6 | 45.5 |
| 1988 | 4.5 | 1.2 | 0.5 | 3.4 | 18.7 | 0.1 | 9.8 | 17.1 | 55.3 |
| 1989 | 21.7 | 1.1 | 0.0 | 3.5 | 8.3 | 0.1 | 0.0 | 64.0 | 98.7 |
| 1990 | 13.5 | 1.0 | 0.1 | 1.8 | 21.9 | 0.6 | 0.3 | 5.6 | 44.7 |
| 1991 | 4.7 | 0.4 | 0.1 | 2.9 | 11.8 | 0.1 | 0.0 | 22.4 | 42.5 |
| 1992 | 5.1 | 2.5 | 0.4 | 2.9 | 28.7 | 0.1 | 54.7 | 95.5 | 189.9 |
| 1993 | 3.9 | 1.1 | 0.7 | 3.6 | 9.2 | 0.1 | 282.3 | 36.7 | 337.7 |
| 1994 | 1.7 | 1.6 | 0.6 | 2.9 | 7.3 | 1.2 | 57.0 | 66.2 | 138.5 |
| 1995 | 4.6 | 1.2 | 0.6 | 4.3 | 41.3 | 0.0 | 57.3 | 27.9 | 137.1 |
| 1996 | 5.1 | 0.9 | 0.3 | 6.8 | 46.3 | 0.1 | 29.0 | 26.0 | 114.5 |
| 1997 | 3.0 | 0.7 | 0.3 | 4.0 | 65.3 | 2.4 | 90.3 | 61.1 | 227.1 |
| CPS=0, SQUID>=50 mt: | | | | | | | | | |
| 1981 | 0.0 | 0.0 | 0.0 | 86.2 | 24.8 | 0.0 | 113.0 | 24.7 | 248.8 |
| 1982 | 0.0 | 0.0 | 0.0 | 53.4 | 38.5 | 0.0 | 48.7 | 11.3 | 151.9 |
| 1983 | 0.0 | 0.0 | 0.0 | 85.4 | 0.0 | 0.0 | 2.8 | 34.4 | 122.6 |
| 1984 | 0.0 | 0.0 | 0.0 | 48.1 | 14.2 | 0.0 | 1.0 | 70.1 | 133.4 |
| 1985 | 0.0 | 0.0 | 0.0 | 64.1 | 32.1 | 0.1 | 10.5 | 218.6 | 325.4 |
| 1986 | 0.0 | 0.0 | 0.0 | 61.8 | 27.6 | 0.0 | 0.3 | 26.3 | 116.0 |
| 1987 | 0.0 | 0.0 | 0.0 | 79.0 | 27.4 | 10.9 | 0.0 | 43.5 | 160.7 |
| 1988 | 0.0 | 0.0 | 0.0 | 104.2 | 21.5 | 0.1 | 36.7 | 56.0 | 218.4 |
| 1989 | 0.0 | 0.0 | 0.0 | 157.1 | 14.0 | 0.0 | 36.4 | 21.8 | 229.3 |
| 1990 | 0.0 | 0.0 | 0.0 | 229.8 | 23.9 | 0.0 | 0.0 | 5.5 | 259.1 |
| 1991 | 0.0 | 0.0 | 0.0 | 183.1 | 43.6 | 0.0 | 0.0 | 26.6 | 253.3 |
| 1992 | 0.0 | 0.0 | 0.0 | 69.9 | 49.0 | 0.0 | 2.3 | 45.0 | 166.2 |
| 1993 | 0.0 | 0.0 | 0.0 | 202.6 | 18.5 | 0.0 | 4.1 | 42.5 | 267.7 |
| 1994 | 0.0 | 0.0 | 0.0 | 230.3 | 24.3 | 0.3 | 0.0 | 106.1 | 360.9 |
| 1995 | 0.0 | 0.0 | 0.0 | 227.1 | 49.1 | 1.8 | 0.0 | 70.8 | 348.8 |
| 1996 | 0.0 | 0.0 | 0.0 | 259.2 | 77.5 | 6.1 | 0.3 | 29.2 | 372.4 |
| 1997 | 0.0 | 0.0 | 0.0 | 202.5 | 110.0 | 0.0 | 0.4 | 26.1 | 339.0 |
| 0<CPS<50, SQUID>=50 mt: | | | | | | | | | |
| 1981 | 0.1 | 1.8 | 0.0 | 178.6 | 31.0 | 0.0 | 68.8 | 3.4 | 283.7 |
| 1982 | 1.1 | 2.7 | 0.0 | 107.7 | 36.1 | 0.0 | 2.2 | 8.4 | 158.4 |
| 1983 | 2.0 | 5.9 | 0.0 | 26.1 | 111.4 | 0.1 | 1.4 | 35.1 | 182.0 |
| 1984 | 0.1 | 0.0 | 0.0 | 79.1 | 0.0 | 0.0 | 9.5 | 327.4 | 416.0 |
| 1985 | 3.3 | 1.5 | 0.0 | 77.7 | 46.4 | 0.0 | 1.7 | 8.4 | 138.9 |
| 1986 | 3.5 | 1.6 | 0.3 | 89.1 | 29.2 | 0.0 | 0.0 | 16.2 | 140.0 |
| 1987 | 0.0 | 2.0 | 0.3 | 83.9 | 35.1 | 0.4 | 0.0 | 46.6 | 168.3 |
| 1988 | 1.5 | 1.2 | 0.6 | 38.8 | 18.4 | 0.0 | 13.1 | 6.6 | 80.2 |
| 1989 | 3.4 | 1.7 | 0.0 | 91.1 | 20.8 | 0.1 | 4.3 | 18.9 | 140.2 |
| 1990 | 0.0 | 4.9 | 0.1 | 88.2 | 0.0 | 0.0 | 0.0 | 54.9 | 148.1 |
| 1991 | 1.3 | 1.6 | 1.0 | 99.0 | 29.9 | 0.0 | 199.3 | 278.1 | 610.2 |
| 1992 | 1.9 | 2.6 | 1.9 | 39.2 | 60.6 | 0.0 | 0.0 | 0.8 | 107.1 |
| 1993 | 1.3 | 1.9 | 0.8 | 102.2 | 13.3 | 0.0 | 0.0 | 2.0 | 121.5 |
| 1994 | 0.0 | 1.0 | 1.0 | 350.1 | 0.0 | 13.5 | 10.6 | 21.3 | 397.4 |
| 1995 | 0.2 | 1.7 | 1.0 | 319.0 | 62.9 | 0.3 | 0.0 | 2.8 | 387.8 |
| 1996 | 4.5 | 1.5 | 1.1 | 246.8 | 0.0 | 1.8 | 1.3 | 14.9 | 271.9 |
| 1997 | 3.3 | 0.6 | 1.8 | 173.9 | 109.1 | 0.0 | 0.4 | 6.6 | 295.4 |

TABLE 2.1.2-7. Average exvessel revenues ($1,000's; base year=1990) by Washington, Oregon, and California round haul vessels[a/] landing CPS or squid, by species, 1981-1997. (Continued).

| Year | Anchovy | Mackerel | Sardine | Squid | Herring | Bonito | Tuna | All Else | Total |
|---|---|---|---|---|---|---|---|---|---|
| CPS>=50 mt: | | | | | | | | | |
| 1981 | 100.2 | 279.2 | 0.3 | 102.4 | 30.0 | 113.3 | 181.1 | 4.1 | 810.6 |
| 1982 | 79.4 | 280.0 | 0.2 | 53.2 | 49.4 | 39.8 | 112.3 | 3.5 | 617.7 |
| 1983 | 14.5 | 210.8 | 0.1 | 16.7 | 95.4 | 41.3 | 118.1 | 3.1 | 500.1 |
| 1984 | 20.4 | 229.6 | 0.1 | 10.8 | 12.5 | 29.8 | 252.2 | 281.3 | 836.8 |
| 1985 | 11.7 | 209.1 | 0.3 | 80.1 | 33.5 | 26.4 | 76.9 | 9.0 | 447.1 |
| 1986 | 19.6 | 210.4 | 6.7 | 108.6 | 28.3 | 5.0 | 258.1 | 140.2 | 776.9 |
| 1987 | 34.8 | 189.4 | 4.3 | 93.7 | 29.8 | 69.5 | 237.5 | 13.7 | 672.6 |
| 1988 | 37.8 | 244.4 | 6.7 | 167.5 | 28.2 | 67.8 | 265.8 | 11.1 | 829.2 |
| 1989 | 63.0 | 190.7 | 8.8 | 111.6 | 23.5 | 17.3 | 76.5 | 174.1 | 665.5 |
| 1990 | 26.9 | 117.5 | 5.3 | 74.9 | 62.3 | 69.0 | 138.3 | 175.3 | 669.5 |
| 1991 | 25.9 | 108.8 | 18.7 | 130.9 | 60.6 | 4.2 | 25.7 | 4.4 | 379.2 |
| 1992 | 14.4 | 116.4 | 49.4 | 53.1 | 34.0 | 26.1 | 66.6 | 0.7 | 360.6 |
| 1993 | 26.5 | 42.8 | 42.0 | 183.5 | 22.3 | 7.9 | 94.7 | 2.3 | 421.9 |
| 1994 | 25.9 | 44.7 | 48.7 | 285.0 | 22.5 | 8.0 | 153.9 | 18.7 | 607.5 |
| 1995 | 14.2 | 35.9 | 79.6 | 289.2 | 69.7 | 4.2 | 187.8 | 27.9 | 708.5 |
| 1996 | 28.0 | 31.9 | 59.0 | 332.1 | 49.9 | 10.9 | 218.8 | 24.6 | 755.2 |
| 1997 | 20.6 | 52.1 | 62.3 | 247.0 | 113.8 | 10.9 | 135.5 | 60.1 | 702.2 |
| All Round Haul Vessels: | | | | | | | | | |
| 1981 | 81.5 | 169.4 | 0.3 | 81.8 | 28.7 | 93.0 | 141.7 | 9.9 | 606.3 |
| 1982 | 60.4 | 146.4 | 0.1 | 60.6 | 33.4 | 36.0 | 94.5 | 6.7 | 438.1 |
| 1983 | 9.2 | 145.3 | 0.1 | 12.2 | 60.2 | 31.4 | 96.7 | 51.2 | 406.2 |
| 1984 | 14.7 | 178.3 | 0.1 | 14.3 | 12.9 | 27.4 | 208.9 | 165.0 | 621.6 |
| 1985 | 6.4 | 128.4 | 0.3 | 51.7 | 37.8 | 22.3 | 48.7 | 53.8 | 349.4 |
| 1986 | 13.1 | 163.2 | 4.5 | 83.5 | 23.9 | 4.4 | 221.4 | 84.1 | 598.1 |
| 1987 | 18.9 | 129.6 | 3.0 | 68.1 | 26.8 | 54.0 | 212.5 | 24.1 | 537.0 |
| 1988 | 16.7 | 168.9 | 5.5 | 108.7 | 22.5 | 58.7 | 204.2 | 22.0 | 607.3 |
| 1989 | 39.3 | 139.6 | 8.0 | 104.5 | 18.4 | 15.6 | 68.1 | 103.9 | 497.5 |
| 1990 | 22.4 | 91.0 | 4.8 | 72.0 | 49.2 | 57.6 | 124.5 | 102.6 | 524.2 |
| 1991 | 16.1 | 70.3 | 15.4 | 96.9 | 49.4 | 3.0 | 79.3 | 54.5 | 384.8 |
| 1992 | 8.7 | 86.0 | 35.4 | 46.6 | 45.1 | 23.1 | 61.7 | 27.7 | 334.3 |
| 1993 | 14.9 | 27.7 | 29.8 | 130.2 | 16.1 | 6.9 | 120.9 | 25.2 | 371.8 |
| 1994 | 14.1 | 23.9 | 27.9 | 199.6 | 18.5 | 6.5 | 131.1 | 54.7 | 476.4 |
| 1995 | 10.8 | 21.9 | 50.0 | 210.7 | 57.2 | 2.5 | 170.4 | 34.3 | 557.9 |
| 1996 | 20.5 | 17.9 | 38.4 | 220.9 | 50.5 | 7.4 | 140.4 | 24.9 | 521.0 |
| 1997 | 16.4 | 35.4 | 46.4 | 165.3 | 104.3 | 8.6 | 108.0 | 52.5 | 536.9 |

a/ Vessels whose principal gear is round haul or an unspecified net gear.

Source: Vessel summaries generated from Washington, Oregon, and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-8. Mean exvessel price ($/mt; base year=1990) of fish caught by Washington, Oregon, and California round haul gear, 1981-1997.

| Year | Anchovy | Mackerel | Sardine | Squid | Bonito | Tuna | All Else |
|---|---|---|---|---|---|---|---|
| 1981 | $89 | $291 | $289 | $394 | $863 | $1,756 | $2,266 |
| 1982 | $69 | $269 | $393 | $331 | $614 | $1,489 | $3,077 |
| 1983 | $191 | $250 | $339 | $575 | $500 | $1,229 | $1,559 |
| 1984 | $135 | $232 | $821 | $570 | $382 | $1,220 | $2,973 |
| 1985 | $129 | $209 | $291 | $380 | $254 | $957 | $1,657 |
| 1986 | $231 | $191 | $244 | $239 | $318 | $964 | $3,028 |
| 1987 | $239 | $161 | $163 | $219 | $530 | $1,142 | $3,159 |
| 1988 | $309 | $179 | $125 | $227 | $454 | $1,455 | $3,874 |
| 1989 | $437 | $156 | $229 | $175 | $450 | $1,092 | $2,213 |
| 1990 | $187 | $133 | $123 | $167 | $441 | $995 | $2,971 |
| 1991 | $177 | $177 | $123 | $160 | $384 | $842 | $1,153 |
| 1992 | $186 | $206 | $96 | $177 | $379 | $829 | $1,731 |
| 1993 | $220 | $115 | $90 | $217 | $372 | $794 | $1,197 |
| 1994 | $264 | $113 | $143 | $283 | $448 | $862 | $2,086 |
| 1995 | $187 | $111 | $80 | $282 | $401 | $724 | $656 |
| 1996 | $182 | $107 | $80 | $341 | $382 | $719 | $913 |
| 1997 | $119 | $125 | $79 | $259 | $454 | $827 | $982 |

Round haul gear refers to unspecified net gears as well as round haul gear. Sardine prices apply to directed landings only. Mackerel prices apply to sardines landed in mixed loads with mackerel (which receive the same price as mackerel) as well as "pure" loads of mackerel.

Source: Washington, Oregon, and California fish ticket data converted to PacFIN format.

TABLE 2.1.2-9. Number of fish dealers[a/] who received any CPS or squid, by principal landing area, 1981-1997.

| | County | CPS>0, SQUID=0 | CPS>0, SQUID>0 | CPS=0, SQUID>0 | Total |
|---|---|---|---|---|---|
| **1981** | | | | | |
| | San Diego | 16 | 5 | 1 | 22 |
| | Orange/LA | 26 | 18 | 0 | 44 |
| | Vent/Sbarb | 8 | 6 | 1 | 15 |
| | SanLuisObispo | 5 | 6 | 0 | 11 |
| | Monterey/StaCruz | 8 | 12 | 9 | 29 |
| | SanFran Bay Area | 6 | 0 | 1 | 7 |
| | Northern California | 1 | 1 | 6 | 8 |
| | Oregon | 0 | 0 | 1 | 1 |
| | Washington | 2 | 1 | 11 | 14 |
| | Unknown | 1 | 0 | 0 | 1 |
| | Total | 73 | 49 | 30 | 152 |
| **1982** | | | | | |
| | San Diego | 16 | 1 | 0 | 17 |
| | Orange/LA | 29 | 13 | 1 | 43 |
| | Vent/Sbarb | 5 | 8 | 1 | 14 |
| | SanLuisObispo | 2 | 3 | 1 | 6 |
| | Monterey/StaCruz | 19 | 16 | 8 | 43 |
| | SanFran Bay Area | 12 | 0 | 2 | 14 |
| | Northern California | 1 | 3 | 2 | 6 |
| | Oregon | 4 | 0 | 5 | 9 |
| | Washington | 1 | 0 | 9 | 10 |
| | Unknown | 0 | 0 | 0 | 0 |
| | Total | 89 | 44 | 29 | 162 |
| **1983** | | | | | |
| | San Diego | 14 | 3 | 1 | 18 |
| | Orange/LA | 23 | 12 | 1 | 36 |
| | Vent/Sbarb | 6 | 10 | 2 | 18 |
| | SanLuisObispo | 3 | 2 | 1 | 6 |
| | Monterey/StaCruz | 15 | 11 | 1 | 27 |
| | SanFran Bay Area | 21 | 5 | 7 | 33 |
| | Northern California | 7 | 1 | 1 | 9 |
| | Oregon | 5 | 6 | 9 | 20 |
| | Washington | 1 | 0 | 23 | 24 |
| | Unknown | 0 | 0 | 0 | 0 |
| | Total | 95 | 50 | 46 | 191 |
| **1984** | | | | | |
| | San Diego | 19 | 1 | 0 | 20 |
| | Orange/LA | 23 | 6 | 0 | 29 |
| | Vent/Sbarb | 5 | 10 | 3 | 18 |
| | SanLuisObispo | 1 | 2 | 1 | 4 |
| | Monterey/StaCruz | 22 | 14 | 1 | 37 |
| | SanFran Bay Area | 27 | 3 | 3 | 33 |
| | Northern California | 3 | 0 | 1 | 4 |
| | Oregon | 2 | 2 | 5 | 9 |
| | Washington | 1 | 1 | 12 | 14 |
| | Unknown | 0 | 0 | 0 | 0 |
| | Total | 103 | 39 | 26 | 168 |
| **1985** | | | | | |
| | San Diego | 16 | 0 | 1 | 17 |
| | Orange/LA | 18 | 12 | 2 | 32 |
| | Vent/Sbarb | 7 | 13 | 1 | 21 |
| | SanLuisObispo | 5 | 2 | 0 | 7 |
| | Monterey/StaCruz | 13 | 18 | 5 | 36 |
| | SanFran Bay Area | 24 | 3 | 3 | 30 |
| | Northern California | 0 | 0 | 1 | 1 |
| | Oregon | 4 | 0 | 9 | 13 |
| | Washington | 2 | 0 | 6 | 8 |
| | Unknown | 0 | 0 | 0 | 0 |
| | Total | 89 | 48 | 28 | 165 |

TABLE 2.1.2-9. Number of fish dealers[a/] who received any CPS or squid, by principal landing area, 1981-1997. (Continued).

| | County | CPS>0, SQUID=0 | CPS>0, SQUID>0 | CPS=0, SQUID>0 | Total |
|---|---|---|---|---|---|
| **1986** | | | | | |
| | San Diego | 17 | 2 | 0 | 19 |
| | Orange/LA | 20 | 12 | 2 | 34 |
| | Vent/Sbarb | 3 | 10 | 9 | 22 |
| | SanLuisObispo | 5 | 2 | 1 | 8 |
| | Monterey/StaCruz | 16 | 15 | 4 | 35 |
| | SanFran Bay Area | 19 | 3 | 3 | 25 |
| | Northern California | 1 | 0 | 2 | 3 |
| | Oregon | 1 | 0 | 4 | 5 |
| | Washington | 2 | 0 | 11 | 13 |
| | Unknown | 0 | 0 | 0 | 0 |
| | Total | 84 | 44 | 36 | 164 |
| **1987** | | | | | |
| | San Diego | 14 | 5 | 1 | 20 |
| | Orange/LA | 23 | 10 | 2 | 35 |
| | Vent/Sbarb | 4 | 16 | 4 | 24 |
| | SanLuisObispo | 6 | 2 | 1 | 9 |
| | Monterey/StaCruz | 11 | 14 | 9 | 34 |
| | SanFran Bay Area | 20 | 6 | 1 | 27 |
| | Northern California | 3 | 0 | 1 | 4 |
| | Oregon | 8 | 0 | 2 | 10 |
| | Washington | 3 | 0 | 9 | 12 |
| | Unknown | 2 | 0 | 0 | 2 |
| | Total | 94 | 53 | 30 | 177 |
| **1988** | | | | | |
| | San Diego | 11 | 6 | 1 | 18 |
| | Orange/LA | 23 | 13 | 1 | 37 |
| | Vent/Sbarb | 10 | 11 | 6 | 27 |
| | SanLuisObispo | 3 | 2 | 1 | 6 |
| | Monterey/StaCruz | 7 | 10 | 5 | 22 |
| | SanFran Bay Area | 18 | 4 | 2 | 24 |
| | Northern California | 2 | 0 | 2 | 4 |
| | Oregon | 10 | 1 | 0 | 11 |
| | Washington | 3 | 0 | 6 | 9 |
| | Unknown | 1 | 0 | 0 | 1 |
| | Total | 88 | 47 | 24 | 159 |
| **1989** | | | | | |
| | San Diego | 17 | 3 | 0 | 20 |
| | Orange/LA | 27 | 16 | 1 | 44 |
| | Vent/Sbarb | 10 | 10 | 7 | 27 |
| | SanLuisObispo | 7 | 3 | 0 | 10 |
| | Monterey/StaCruz | 11 | 9 | 7 | 27 |
| | SanFran Bay Area | 20 | 1 | 2 | 23 |
| | Northern California | 3 | 0 | 2 | 5 |
| | Oregon | 12 | 3 | 0 | 15 |
| | Washington | 3 | 0 | 5 | 8 |
| | Unknown | 3 | 0 | 0 | 3 |
| | Total | 113 | 45 | 24 | 182 |
| **1990** | | | | | |
| | San Diego | 18 | 6 | 2 | 26 |
| | Orange/LA | 28 | 16 | 1 | 45 |
| | Vent/Sbarb | 10 | 8 | 3 | 21 |
| | SanLuisObispo | 2 | 4 | 0 | 6 |
| | Monterey/StaCruz | 12 | 12 | 5 | 29 |
| | SanFran Bay Area | 25 | 4 | 1 | 30 |
| | Northern California | 4 | 0 | 2 | 6 |
| | Oregon | 14 | 0 | 0 | 14 |
| | Washington | 6 | 0 | 2 | 8 |
| | Unknown | 2 | 0 | 0 | 2 |
| | Total | 121 | 50 | 16 | 187 |

TABLE 2.1.2-9. Number of fish dealers[a/] who received any CPS or squid, by principal landing area, 1981-1997. (Continued).

| | County | CPS>0, SQUID=0 | CPS>0, SQUID>0 | CPS=0, SQUID>0 | Total |
|---|---|---|---|---|---|
| **1991** | | | | | |
| | San Diego | 19 | 0 | 0 | 19 |
| | Orange/LA | 27 | 11 | 3 | 41 |
| | Vent/Sbarb | 7 | 7 | 3 | 17 |
| | SanLuisObispo | 3 | 1 | 1 | 5 |
| | Monterey/StaCruz | 19 | 7 | 1 | 27 |
| | SanFran Bay Area | 8 | 4 | 3 | 15 |
| | Northern California | 1 | 0 | 2 | 3 |
| | Oregon | 6 | 1 | 0 | 7 |
| | Washington | 3 | 0 | 4 | 7 |
| | Unknown | 1 | 0 | 0 | 1 |
| | Total | 94 | 31 | 17 | 142 |
| **1992** | | | | | |
| | San Diego | 21 | 0 | 0 | 21 |
| | Orange/LA | 30 | 7 | 0 | 37 |
| | Vent/Sbarb | 7 | 2 | 4 | 13 |
| | SanLuisObispo | 2 | 4 | 0 | 6 |
| | Monterey/StaCruz | 20 | 12 | 1 | 33 |
| | SanFran Bay Area | 20 | 10 | 4 | 34 |
| | Northern California | 4 | 0 | 2 | 6 |
| | Oregon | 9 | 4 | 1 | 14 |
| | Washington | 4 | 0 | 6 | 10 |
| | Unknown | 1 | 0 | 0 | 1 |
| | Total | 118 | 39 | 18 | 175 |
| **1993** | | | | | |
| | San Diego | 14 | 0 | 0 | 14 |
| | Orange/LA | 27 | 12 | 3 | 42 |
| | Vent/Sbarb | 12 | 6 | 3 | 21 |
| | SanLuisObispo | 2 | 4 | 2 | 8 |
| | Monterey/StaCruz | 15 | 6 | 1 | 22 |
| | SanFran Bay Area | 12 | 3 | 3 | 18 |
| | Northern California | 3 | 0 | 0 | 3 |
| | Oregon | 2 | 6 | 4 | 12 |
| | Washington | 6 | 0 | 4 | 10 |
| | Unknown | 1 | 0 | 0 | 1 |
| | Total | 94 | 37 | 20 | 151 |
| **1994** | | | | | |
| | San Diego | 16 | 3 | 1 | 20 |
| | Orange/LA | 26 | 15 | 0 | 41 |
| | Vent/Sbarb | 6 | 9 | 13 | 28 |
| | SanLuisObispo | 1 | 1 | 3 | 5 |
| | Monterey/StaCruz | 16 | 10 | 4 | 30 |
| | SanFran Bay Area | 13 | 2 | 3 | 18 |
| | Northern California | 6 | 1 | 1 | 8 |
| | Oregon | 3 | 9 | 2 | 14 |
| | Washington | 3 | 2 | 7 | 12 |
| | Unknown | 1 | 0 | 0 | 1 |
| | Total | 91 | 52 | 34 | 177 |
| **1995** | | | | | |
| | San Diego | 13 | 2 | 0 | 15 |
| | Orange/LA | 25 | 16 | 1 | 42 |
| | Vent/Sbarb | 13 | 15 | 13 | 41 |
| | SanLuisObispo | 0 | 1 | 1 | 2 |
| | Monterey/StaCruz | 10 | 4 | 1 | 15 |
| | SanFran Bay Area | 15 | 1 | 3 | 19 |
| | Northern California | 2 | 0 | 1 | 3 |
| | Oregon | 8 | 6 | 1 | 15 |
| | Washington | 4 | 1 | 11 | 16 |
| | Unknown | 0 | 0 | 0 | 0 |
| | Total | 90 | 46 | 32 | 168 |

TABLE 2.1.2-9. Number of fish dealers[a/] who received any CPS or squid, by principal landing area, 1981-1997. (Continued).

| | County | CPS>0, SQUID=0 | CPS>0, SQUID>0 | CPS=0, SQUID>0 | Total |
|---|---|---|---|---|---|
| **1996** | | | | | |
| | San Diego | 14 | 3 | 1 | 18 |
| | Orange/LA | 21 | 14 | 4 | 39 |
| | Vent/Sbarb | 11 | 15 | 7 | 33 |
| | SanLuisObispo | 0 | 0 | 0 | 0 |
| | Monterey/StaCruz | 8 | 6 | 0 | 14 |
| | SanFran Bay Area | 18 | 2 | 1 | 21 |
| | Northern California | 4 | 0 | 0 | 4 |
| | Oregon | 6 | 5 | 2 | 13 |
| | Washington | 5 | 1 | 6 | 12 |
| | Unknown | 0 | 0 | 0 | 0 |
| | Total | 87 | 46 | 21 | 154 |
| **1997** | | | | | |
| | San Diego | 12 | 3 | 0 | 15 |
| | Orange/LA | 22 | 13 | 4 | 39 |
| | Vent/Sbarb | 8 | 15 | 7 | 30 |
| | SanLuisObispo | 1 | 0 | 3 | 4 |
| | Monterey/StaCruz | 13 | 5 | 1 | 19 |
| | SanFran Bay Area | 25 | 3 | 1 | 29 |
| | Northern California | 1 | 4 | 4 | 9 |
| | Oregon | 6 | 8 | 3 | 17 |
| | Washington | 8 | 2 | 1 | 11 |
| | Unknown | 0 | 0 | 0 | 0 |
| | Total | 96 | 53 | 24 | 173 |

a/ Dealers include parent processing plants and associated buying stations.
Principal landing area is the area from which a dealer received the most landings.
Source: PacFIN summary data.

TABLE 2.1.2-10. Number of fish dealers[a/] who received any CPS or squid, by principal landing area, 1981-1997. Landings categories are in units of metric tons.

| | County | CPS+SQUID<500 | CPS=0 SQUID>=500 | 0<CPS<500 CPS+SQUID>=500 | CPS>=500 | Total |
|---|---|---|---|---|---|---|
| **1981** | | | | | | |
| | San Diego | 22 | 0 | 0 | 0 | 22 |
| | Orange/LA | 35 | 0 | 2 | 7 | 44 |
| | Vent/Sbarb | 14 | 0 | 0 | 1 | 15 |
| | SanLuisObispo | 11 | 0 | 0 | 0 | 11 |
| | Monterey/StaCruz | 20 | 2 | 5 | 2 | 29 |
| | SanFran Bay Area | 7 | 0 | 0 | 0 | 7 |
| | Northern California | 8 | 0 | 0 | 0 | 8 |
| | Oregon | 1 | 0 | 0 | 0 | 1 |
| | Washington | 14 | 0 | 0 | 0 | 14 |
| | Unknown | 1 | 0 | 0 | 0 | 1 |
| | Total | 133 | 2 | 7 | 10 | 152 |
| **1982** | | | | | | |
| | San Diego | 17 | 0 | 0 | 0 | 17 |
| | Orange/LA | 35 | 0 | 0 | 8 | 43 |
| | Vent/Sbarb | 12 | 0 | 0 | 2 | 14 |
| | SanLuisObispo | 6 | 0 | 0 | 0 | 6 |
| | Monterey/StaCruz | 34 | 1 | 6 | 2 | 43 |
| | SanFran Bay Area | 14 | 0 | 0 | 0 | 14 |
| | Northern California | 6 | 0 | 0 | 0 | 6 |
| | Oregon | 9 | 0 | 0 | 0 | 9 |
| | Washington | 10 | 0 | 0 | 0 | 10 |
| | Unknown | 0 | 0 | 0 | 0 | 0 |
| | Total | 143 | 1 | 6 | 12 | 162 |
| **1983** | | | | | | |
| | San Diego | 18 | 0 | 0 | 0 | 18 |
| | Orange/LA | 28 | 0 | 0 | 8 | 36 |
| | Vent/Sbarb | 16 | 0 | 0 | 2 | 18 |
| | SanLuisObispo | 6 | 0 | 0 | 0 | 6 |
| | Monterey/StaCruz | 24 | 0 | 0 | 3 | 27 |
| | SanFran Bay Area | 33 | 0 | 0 | 0 | 33 |
| | Northern California | 9 | 0 | 0 | 0 | 9 |
| | Oregon | 20 | 0 | 0 | 0 | 20 |
| | Washington | 24 | 0 | 0 | 0 | 24 |
| | Unknown | 0 | 0 | 0 | 0 | 0 |
| | Total | 178 | 0 | 0 | 13 | 191 |
| **1984** | | | | | | |
| | San Diego | 20 | 0 | 0 | 0 | 20 |
| | Orange/LA | 22 | 0 | 0 | 7 | 29 |
| | Vent/Sbarb | 17 | 0 | 0 | 1 | 18 |
| | SanLuisObispo | 4 | 0 | 0 | 0 | 4 |
| | Monterey/StaCruz | 32 | 0 | 0 | 5 | 37 |
| | SanFran Bay Area | 32 | 0 | 0 | 1 | 33 |
| | Northern California | 4 | 0 | 0 | 0 | 4 |
| | Oregon | 9 | 0 | 0 | 0 | 9 |
| | Washington | 14 | 0 | 0 | 0 | 14 |
| | Unknown | 0 | 0 | 0 | 0 | 0 |
| | Total | 154 | 0 | 0 | 14 | 168 |

TABLE 2.1.2-10. Number of fish dealers[a/] who received any CPS or squid, by principal landing area, 1981-1997. Landings categories are in units of metric tons. (Continued).

| | County | CPS+SQUID<500 | CPS=0 SQUID>=500 | 0<CPS<500 CPS+SQUID>=500 | CPS>=500 | Total |
|---|---|---|---|---|---|---|
| **1985** | | | | | | |
| | San Diego | 17 | 0 | 0 | 0 | 17 |
| | Orange/LA | 25 | 0 | 0 | 7 | 32 |
| | Vent/Sbarb | 19 | 0 | 0 | 2 | 21 |
| | SanLuisObispo | 7 | 0 | 0 | 0 | 7 |
| | Monterey/StaCruz | 31 | 0 | 2 | 3 | 36 |
| | SanFran Bay Area | 30 | 0 | 0 | 0 | 30 |
| | Northern California | 1 | 0 | 0 | 0 | 1 |
| | Oregon | 13 | 0 | 0 | 0 | 13 |
| | Washington | 8 | 0 | 0 | 0 | 8 |
| | Unknown | 0 | 0 | 0 | 0 | 0 |
| | Total | 151 | 0 | 2 | 12 | 165 |
| **1986** | | | | | | |
| | San Diego | 19 | 0 | 0 | 0 | 19 |
| | Orange/LA | 26 | 0 | 2 | 6 | 34 |
| | Vent/Sbarb | 18 | 1 | 0 | 3 | 22 |
| | SanLuisObispo | 8 | 0 | 0 | 0 | 8 |
| | Monterey/StaCruz | 31 | 0 | 2 | 2 | 35 |
| | SanFran Bay Area | 24 | 1 | 0 | 0 | 25 |
| | Northern California | 3 | 0 | 0 | 0 | 3 |
| | Oregon | 5 | 0 | 0 | 0 | 5 |
| | Washington | 13 | 0 | 0 | 0 | 13 |
| | Unknown | 0 | 0 | 0 | 0 | 0 |
| | Total | 147 | 2 | 4 | 11 | 164 |
| **1987** | | | | | | |
| | San Diego | 20 | 0 | 0 | 0 | 20 |
| | Orange/LA | 24 | 0 | 1 | 10 | 35 |
| | Vent/Sbarb | 20 | 0 | 0 | 4 | 24 |
| | SanLuisObispo | 9 | 0 | 0 | 0 | 9 |
| | Monterey/StaCruz | 28 | 3 | 2 | 1 | 34 |
| | SanFran Bay Area | 27 | 0 | 0 | 0 | 27 |
| | Northern California | 4 | 0 | 0 | 0 | 4 |
| | Oregon | 10 | 0 | 0 | 0 | 10 |
| | Washington | 12 | 0 | 0 | 0 | 12 |
| | Unknown | 2 | 0 | 0 | 0 | 2 |
| | Total | 156 | 3 | 3 | 15 | 177 |
| **1988** | | | | | | |
| | San Diego | 18 | 0 | 0 | 0 | 18 |
| | Orange/LA | 25 | 0 | 1 | 11 | 37 |
| | Vent/Sbarb | 22 | 2 | 0 | 3 | 27 |
| | SanLuisObispo | 6 | 0 | 0 | 0 | 6 |
| | Monterey/StaCruz | 20 | 1 | 0 | 1 | 22 |
| | SanFran Bay Area | 24 | 0 | 0 | 0 | 24 |
| | Northern California | 4 | 0 | 0 | 0 | 4 |
| | Oregon | 11 | 0 | 0 | 0 | 11 |
| | Washington | 9 | 0 | 0 | 0 | 9 |
| | Unknown | 1 | 0 | 0 | 0 | 1 |
| | Total | 140 | 3 | 1 | 15 | 159 |

TABLE 2.1.2-10. Number of fish dealers[a/] who received any CPS or squid, by principal landing area, 1981-1997. Landings categories are in units of metric tons. (Continued).

| | County | CPS+SQUID<500 | CPS=0 SQUID>=500 | 0<CPS<500 CPS+SQUID>=500 | CPS>=500 | Total |
|---|---|---|---|---|---|---|
| **1989** | | | | | | |
| | San Diego | 20 | 0 | 0 | 0 | 20 |
| | Orange/LA | 32 | 0 | 2 | 10 | 44 |
| | Vent/Sbarb | 22 | 2 | 1 | 2 | 27 |
| | SanLuisObispo | 10 | 0 | 0 | 0 | 10 |
| | Monterey/StaCruz | 23 | 1 | 2 | 1 | 27 |
| | SanFran Bay Area | 22 | 0 | 0 | 1 | 23 |
| | Northern California | 5 | 0 | 0 | 0 | 5 |
| | Oregon | 15 | 0 | 0 | 0 | 15 |
| | Washington | 8 | 0 | 0 | 0 | 8 |
| | Unknown | 3 | 0 | 0 | 0 | 3 |
| | Total | 160 | 3 | 5 | 14 | 182 |
| **1990** | | | | | | |
| | San Diego | 26 | 0 | 0 | 0 | 26 |
| | Orange/LA | 36 | 0 | 1 | 8 | 45 |
| | Vent/Sbarb | 18 | 0 | 2 | 1 | 21 |
| | SanLuisObispo | 6 | 0 | 0 | 0 | 6 |
| | Monterey/StaCruz | 23 | 1 | 3 | 2 | 29 |
| | SanFran Bay Area | 29 | 0 | 0 | 1 | 30 |
| | Northern California | 6 | 0 | 0 | 0 | 6 |
| | Oregon | 14 | 0 | 0 | 0 | 14 |
| | Washington | 8 | 0 | 0 | 0 | 8 |
| | Unknown | 2 | 0 | 0 | 0 | 2 |
| | Total | 168 | 1 | 6 | 12 | 187 |
| **1991** | | | | | | |
| | San Diego | 19 | 0 | 0 | 0 | 19 |
| | Orange/LA | 34 | 0 | 0 | 7 | 41 |
| | Vent/Sbarb | 12 | 1 | 2 | 2 | 17 |
| | SanLuisObispo | 5 | 0 | 0 | 0 | 5 |
| | Monterey/StaCruz | 24 | 0 | 2 | 1 | 27 |
| | SanFran Bay Area | 14 | 1 | 0 | 0 | 15 |
| | Northern California | 3 | 0 | 0 | 0 | 3 |
| | Oregon | 7 | 0 | 0 | 0 | 7 |
| | Washington | 7 | 0 | 0 | 0 | 7 |
| | Unknown | 1 | 0 | 0 | 0 | 1 |
| | Total | 126 | 2 | 4 | 10 | 142 |
| **1992** | | | | | | |
| | San Diego | 21 | 0 | 0 | 0 | 21 |
| | Orange/LA | 29 | 0 | 0 | 8 | 37 |
| | Vent/Sbarb | 12 | 1 | 0 | 0 | 13 |
| | SanLuisObispo | 6 | 0 | 0 | 0 | 6 |
| | Monterey/StaCruz | 28 | 0 | 3 | 2 | 33 |
| | SanFran Bay Area | 32 | 0 | 2 | 0 | 34 |
| | Northern California | 6 | 0 | 0 | 0 | 6 |
| | Oregon | 14 | 0 | 0 | 0 | 14 |
| | Washington | 10 | 0 | 0 | 0 | 10 |
| | Unknown | 1 | 0 | 0 | 0 | 1 |
| | Total | 159 | 1 | 5 | 10 | 175 |

TABLE 2.1.2-10. Number of fish dealers[a/] who received any CPS or squid, by principal landing area, 1981-1997. Landings categories are in units of metric tons. (Continued).

| | County | CPS+SQUID<500 | CPS=0 SQUID>=500 | 0<CPS<500 CPS+SQUID>=500 | CPS>=500 | Total |
|---|---|---|---|---|---|---|
| **1993** | | | | | | |
| | San Diego | 14 | 0 | 0 | 0 | 14 |
| | Orange/LA | 34 | 0 | 0 | 8 | 42 |
| | Vent/Sbarb | 16 | 2 | 2 | 1 | 21 |
| | SanLuisObispo | 8 | 0 | 0 | 0 | 8 |
| | Monterey/StaCruz | 18 | 1 | 2 | 1 | 22 |
| | SanFran Bay Area | 18 | 0 | 0 | 0 | 18 |
| | Northern California | 3 | 0 | 0 | 0 | 3 |
| | Oregon | 12 | 0 | 0 | 0 | 12 |
| | Washington | 10 | 0 | 0 | 0 | 10 |
| | Unknown | 1 | 0 | 0 | 0 | 1 |
| | Total | 134 | 3 | 4 | 10 | 151 |
| **1994** | | | | | | |
| | San Diego | 20 | 0 | 0 | 0 | 20 |
| | Orange/LA | 33 | 0 | 1 | 7 | 41 |
| | Vent/Sbarb | 19 | 4 | 5 | 0 | 28 |
| | SanLuisObispo | 5 | 0 | 0 | 0 | 5 |
| | Monterey/StaCruz | 26 | 1 | 2 | 1 | 30 |
| | SanFran Bay Area | 18 | 0 | 0 | 0 | 18 |
| | Northern California | 8 | 0 | 0 | 0 | 8 |
| | Oregon | 14 | 0 | 0 | 0 | 14 |
| | Washington | 12 | 0 | 0 | 0 | 12 |
| | Unknown | 1 | 0 | 0 | 0 | 1 |
| | Total | 156 | 5 | 8 | 8 | 177 |
| **1995** | | | | | | |
| | San Diego | 15 | 0 | 0 | 0 | 15 |
| | Orange/LA | 34 | 0 | 1 | 7 | 42 |
| | Vent/Sbarb | 32 | 2 | 5 | 2 | 41 |
| | SanLuisObispo | 2 | 0 | 0 | 0 | 2 |
| | Monterey/StaCruz | 15 | 0 | 0 | 0 | 15 |
| | SanFran Bay Area | 19 | 0 | 0 | 0 | 19 |
| | Northern California | 3 | 0 | 0 | 0 | 3 |
| | Oregon | 15 | 0 | 0 | 0 | 15 |
| | Washington | 16 | 0 | 0 | 0 | 16 |
| | Unknown | 0 | 0 | 0 | 0 | 0 |
| | Total | 151 | 2 | 6 | 9 | 168 |
| **1996** | | | | | | |
| | San Diego | 18 | 0 | 0 | 0 | 18 |
| | Orange/LA | 31 | 0 | 0 | 8 | 39 |
| | Vent/Sbarb | 22 | 3 | 5 | 3 | 33 |
| | SanLuisObispo | 0 | 0 | 0 | 0 | 0 |
| | Monterey/StaCruz | 11 | 0 | 1 | 2 | 14 |
| | SanFran Bay Area | 21 | 0 | 0 | 0 | 21 |
| | Northern California | 4 | 0 | 0 | 0 | 4 |
| | Oregon | 13 | 0 | 0 | 0 | 13 |
| | Washington | 12 | 0 | 0 | 0 | 12 |
| | Unknown | 0 | 0 | 0 | 0 | 0 |
| | Total | 132 | 3 | 6 | 13 | 154 |

TABLE 2.1.2-10. Number of fish dealers who received any CPS or squid, by principal landing area, 1981-1997. Landings categories are in units of metric tons. (Continued).

| County | CPS+SQUID<500 | CPS=0 SQUID>=500 | 0<CPS<500 CPS+SQUID>=500 | CPS>=500 | Total |
|---|---|---|---|---|---|
| **1997** | | | | | |
| San Diego | 15 | 0 | 0 | 0 | 15 |
| Orange/LA | 31 | 0 | 0 | 8 | 39 |
| Vent/Sbarb | 20 | 3 | 5 | 2 | 30 |
| SanLuisObispo | 4 | 0 | 0 | 0 | 4 |
| Monterey/StaCruz | 13 | 0 | 2 | 4 | 19 |
| SanFran Bay Area | 29 | 0 | 0 | 0 | 29 |
| Northern California | 9 | 0 | 0 | 0 | 9 |
| Oregon | 16 | 0 | 0 | 1 | 17 |
| Washington | 11 | 0 | 0 | 0 | 11 |
| Unknown | 0 | 0 | 0 | 0 | 0 |
| Total | 148 | 3 | 7 | 15 | 173 |

a/ Dealers include parent processing plants and associated buying stations.
Principal landing area is the area from which a dealer received the most landings.
Source: PacFIN summary data.

TABLE 2.1.2-11. Mean annual landings received by California CPS/squid processors[a/] and percentage of landings consisting of CPS and squid, by purchase category, 1986-1997.

| | Category I CPS+Squid<500 | | | | Category II CPS=0, Squid>=500 | | |
|---|---|---|---|---|---|---|---|
| Year | mt | %CPS | %Squid | Year | mt | %CPS | %Squid |
| 1986 | 329.0 | 4.0 | 6.2 | 1986 | --- | --- | --- |
| 1987 | 237.4 | 5.0 | 4.9 | 1987 | --- | --- | --- |
| 1988 | 313.2 | 3.9 | 5.0 | 1988 | 1,760.3 | 0.0 | 72.4 |
| 1989 | 270.1 | 2.8 | 4.0 | 1989 | 1,064.8 | 0.0 | 82.7 |
| 1990 | 235.1 | 5.6 | 1.7 | 1990 | --- | --- | --- |
| 1991 | 191.1 | 10.9 | 1.8 | 1991 | --- | --- | --- |
| 1992 | 195.6 | 4.2 | 3.4 | 1992 | --- | --- | --- |
| 1993 | 191.8 | 5.0 | 2.5 | 1993 | --- | --- | --- |
| 1994 | 291.9 | 4.0 | 3.2 | 1994 | --- | --- | --- |
| 1995 | 198.4 | 4.6 | 3.6 | 1995 | --- | --- | --- |
| 1996 | 250.5 | 4.1 | 1.5 | 1996 | --- | --- | --- |
| 1997 | 202.9 | 3.8 | 1.5 | 1997 | --- | --- | --- |
| Avg. | 242.2 | 4.8 | 3.3 | Avg. | 1,412.6 | 0.0 | 77.6 |

| | Category III 0<CPS<500, CPS+Squid>=500 | | | | Weighted Average of II and III | | |
|---|---|---|---|---|---|---|---|
| Year | mt | %CPS | %Squid | Year | mt | %CPS | %Squid |
| 1986 | 1,570.5 | 7.8 | 64.3 | 1986 | 1,570.5 | 7.8 | 64.3 |
| 1987 | --- | --- | --- | 1987 | 1,679.4 | 8.6 | 51.2 |
| 1988 | --- | --- | --- | 1988 | 2,178.8 | 5.3 | 75.7 |
| 1989 | 1,545.5 | 2.9 | 79.8 | 1989 | 1,339.5 | 1.9 | 80.8 |
| 1990 | 2,367.2 | 8.3 | 52.4 | 1990 | 2,266.8 | 7.4 | 57.4 |
| 1991 | 2,462.5 | 5.9 | 76.5 | 1991 | 2,430.8 | 5.0 | 80.2 |
| 1992 | 2,022.7 | 1.0 | 71.4 | 1992 | 2,022.7 | 1.0 | 71.4 |
| 1993 | 4,843.1 | 2.5 | 77.1 | 1993 | 4,042.5 | 2.3 | 79.4 |
| 1994 | 4,920.3 | 1.6 | 75.0 | 1994 | 4,920.3 | 1.6 | 75.0 |
| 1995 | 5,061.0 | 3.3 | 73.8 | 1995 | 5,061.0 | 3.3 | 73.8 |
| 1996 | 4,831.7 | 2.5 | 92.0 | 1996 | 4,408.1 | 2.3 | 91.3 |
| 1997 | 3,010.0 | 3.9 | 96.2 | 1997 | 2,512.9 | 3.1 | 91.1 |
| Avg. | 3,263.4 | 4.0 | 75.8 | Avg. | 2,869.4 | 4.1 | 74.3 |

| | Category IV CPS>=500 | | |
|---|---|---|---|
| Year | mt | %CPS | %Squid |
| 1986 | 10,410.0 | 56.2 | 14.1 |
| 1987 | 7,962.8 | 53.0 | 14.9 |
| 1988 | 11,900.7 | 47.9 | 24.5 |
| 1989 | 9,964.6 | 50.8 | 27.0 |
| 1990 | 7,997.9 | 57.0 | 23.6 |
| 1991 | 8,587.3 | 55.3 | 32.9 |
| 1992 | 5,933.4 | 70.9 | 12.3 |
| 1993 | 6,975.1 | 42.3 | 42.4 |
| 1994 | 7,102.7 | 43.0 | 51.3 |
| 1995 | 11,859.5 | 43.0 | 46.1 |
| 1996 | 12,379.6 | 38.2 | 45.1 |
| 1997 | 10,294.0 | 54.0 | 46.1 |
| Avg. | 9,280.6 | 51.0 | 31.7 |

--- Fewer than three processors fell into category ii and iii in some years. In order to maintain confidentiality, statistics for categories ii and iii are not reported separately in this table for those three years but instead as weighted averages, with the weights being the respective number of processors in the two categories.
a/ Processors include parent companies only.
Source: PacFIN summary data.

TABLE 2.1.2-12. Percentage of total California CPS/squid processors[a/] and percentage of landings of CPS and squid accounted for by dealers in each of four purchase categories, 1986-1997.

| | Category I CPS+Squid<500 | | |
|---|---|---|---|
| Year | %Dealers | %CPS | %Squid |
| 1986 | 86.0 | 2.2 | 8.8 |
| 1987 | 85.1 | 2.0 | 5.6 |
| 1988 | 87.3 | 2.0 | 4.1 |
| 1989 | 84.2 | 1.3 | 2.7 |
| 1990 | 86.3 | 2.9 | 1.5 |
| 1991 | 85.3 | 4.0 | 0.8 |
| 1992 | 89.5 | 2.3 | 5.7 |
| 1993 | 87.0 | 2.9 | 1.0 |
| 1994 | 86.6 | 4.3 | 1.6 |
| 1995 | 86.4 | 1.6 | 0.9 |
| 1996 | 83.7 | 1.7 | 0.4 |
| 1997 | 83.6 | 1.0 | 0.4 |
| Avg. | 85.9 | 2.4 | 2.8 |

| | Category II CPS=0, Squid>=500 | | |
|---|---|---|---|
| Year | %Dealers | %CPS | %Squid |
| 1986 | --- | --- | --- |
| 1987 | --- | --- | --- |
| 1988 | 2.7 | 0.0 | 10.3 |
| 1989 | 2.5 | 0.0 | 6.5 |
| 1990 | --- | --- | --- |
| 1991 | --- | --- | --- |
| 1992 | --- | --- | --- |
| 1993 | --- | --- | --- |
| 1994 | --- | --- | --- |
| 1995 | --- | --- | --- |
| 1996 | --- | --- | --- |
| 1997 | --- | --- | --- |
| Avg. | 2.6 | 0.0 | 8.4 |

| | Category III 0<CPS<500, CPS+Squid>=500 | | |
|---|---|---|---|
| Year | %Dealers | %CPS | %Squid |
| 1986 | 5.6 | 1.3 | 28.6 |
| 1987 | --- | --- | --- |
| 1988 | --- | --- | --- |
| 1989 | 3.3 | 0.3 | 12.1 |
| 1990 | 4.8 | 2.4 | 26.1 |
| 1991 | 4.9 | 1.6 | 25.2 |
| 1992 | 3.2 | 0.2 | 44.0 |
| 1993 | 2.8 | 1.2 | 26.1 |
| 1994 | 6.3 | 2.2 | 46.2 |
| 1995 | 3.9 | 1.3 | 21.3 |
| 1996 | 5.1 | 1.3 | 27.7 |
| 1997 | 3.6 | 0.7 | 16.3 |
| Avg. | 4.4 | 1.2 | 27.4 |

| | Weighted Average of Categories II & III | | |
|---|---|---|---|
| Year | %Dealers | %CPS | %Squid |
| 1986 | 5.6 | 1.3 | 28.6 |
| 1987 | 3.5 | 1.0 | 17.2 |
| 1988 | 3.6 | 0.8 | 17.7 |
| 1989 | 5.8 | 0.3 | 18.5 |
| 1990 | 5.6 | 2.4 | 32.0 |
| 1991 | 5.9 | 1.6 | 31.3 |
| 1992 | 3.2 | 0.2 | 44.0 |
| 1993 | 3.7 | 1.2 | 30.0 |
| 1994 | 6.3 | 2.2 | 46.2 |
| 1995 | 3.9 | 1.3 | 21.3 |
| 1996 | 6.1 | 1.3 | 30.1 |
| 1997 | 5.5 | 0.7 | 19.4 |
| Avg. | 4.9 | 1.2 | 28.0 |

| | Category IV CPS>=500 | | |
|---|---|---|---|
| Year | %Dealers | %CPS | %Squid |
| 1986 | 8.4 | 96.4 | 62.6 |
| 1987 | 11.4 | 97.0 | 77.1 |
| 1988 | 9.1 | 97.2 | 78.2 |
| 1989 | 10.0 | 98.5 | 78.8 |
| 1990 | 8.1 | 94.6 | 66.5 |
| 1991 | 8.8 | 94.4 | 67.9 |
| 1992 | 7.3 | 97.4 | 50.3 |
| 1993 | 9.3 | 95.9 | 69.0 |
| 1994 | 7.1 | 93.5 | 52.2 |
| 1995 | 9.7 | 97.2 | 77.8 |
| 1996 | 10.2 | 97.0 | 69.6 |
| 1997 | 10.9 | 98.3 | 80.2 |
| Avg. | 9.2 | 96.4 | 69.2 |

--- Fewer than three processors fell into category ii and iii in some years. In order to maintain confidentiality, statistics for categories ii and iii are not reported separately in this table for those three years but instead as weighted averages, with the weights being the respective number of processors in the two categories.
a/ Processors include parent companies only.
Source: PacFIN summary data.

TABLE 2.1.3-1. Estimated number of recreational fishing trips by various modes in California (thousands of trips), 1980-1997.

| Year | Shore | CPFV[a] | Private Boat | Total |
|---|---|---|---|---|
| 1980 | 6,807 | 2,152 | 3,532 | 12,490 |
| 1981 | 3,745 | 1,422 | 2,765 | 7,933 |
| 1982 | 3,482 | 2,252 | 2,544 | 8,277 |
| 1983 | 3,613 | 1,629 | 2,893 | 8,135 |
| 1984 | 3,741 | 1,348 | 3,198 | 8,286 |
| 1985 | 3,434 | 1,377 | 2,989 | 7,800 |
| 1986 | 3,539 | 1,537 | 3,798 | 8,874 |
| 1987 | 2,836 | 1,073 | 3,692 | 7,601 |
| 1988 | 7,178 | 833 | 1,925 | 9,936 |
| 1989 | 3,220 | 1,350 | 2,481 | 7,051 |
| 1990 | | No survey | | |
| 1991 | | No survey | | |
| 1992 | | No survey | | |
| 1993 | 2,335 | 1,174 | 2,681 | 6,189 |
| 1994 | 2,575 | 1,201 | 2,939 | 6,714 |
| 1995 | 2,706 | 1,131 | 2,780 | 6,617 |
| 1996 | 2,361 | 1,080 | 1,935 | 5,375 |
| 1997[b] | 1,896 | 795 | 1,526 | 4,217 |

a/ Commercial passenger fishing vessels (CPFV's) transport passengers to and from the fishing grounds and provide bait, food, beverage service, gear rental and fish cleaning.

b/ Preliminary.

Source: RecFIN database.

TABLE 2.1.3-2. Proportion of recreational fishing trips in southern California for which anchovy is used as live or dead bait during 1989.

| | Fishing Mode | | | |
|---|---|---|---|---|
| Bait Status | Beach | Pier | CPFV[a] | Private Boat |
| Live | 3% | 12% | 77% | 44% |
| Dead | 33% | 60% | 13% | 34% |
| Live or Dead[b] | 35% | 66% | 84% | 71% |

a/ CPFV's transport passengers to and from the fishing grounds and provide bait, food and beverage service, gear rental and fish cleaning.

b/ "Live" + "Dead" do not necessarily sum to "Live or Dead" since some anglers use both live and dead bait on a single trip.

Source: Thomson and Crooke 1991.

TABLE 2.1.4-1. Mexican landings of sardine and Pacific (chub) mackerel (mt) in Ensenada, Baja California, 1961-1997, as available.

| Year | Pacific Sardine | Pacific (chub) mackerel |
|---|---|---|
| 1961 | 0 | N/A |
| 1962 | 4,580 | N/A |
| 1963 | 4,269 | N/A |
| 1964 | 4,907 | N/A |
| 1965 | 4,286 | N/A |
| 1966 | 2,575 | N/A |
| 1967 | 5,846 | N/A |
| 1968 | 5,135 | N/A |
| 1969 | N/A | N/A |
| 1970 | N/A | N/A |
| 1971 | N/A | N/A |
| 1972 | N/A | N/A |
| 1973 | 3,258 | 103 |
| 1974 | 6,284 | 82 |
| | Data Not Available | |
| 1978 | 0 | 0 |
| 1979 | 0 | 0 |
| 1980 | 0 | 0 |
| 1981 | 0 | 0 |
| 1982 | 0 | 0 |
| 1983 | 274 | 135 |
| 1984 | 0 | 128 |
| 1985 | 3,722 | 2,582 |
| 1986 | 243 | 4,883 |
| 1987 | 2,432 | 2,082 |
| 1988 | 2,035 | 4,884 |
| 1989 | 6,224 | 13,387 |
| 1990 | 11,375 | 35,767 |
| 1991 | 31,391 | 17,450 |
| 1992 | 34,568 | 24,345 |
| 1993 | 32,045 | 7,741 |
| 1994 | 20,877 | 13,319 |
| 1995 | 35,396 | 4,821 |
| 1996 | 39,064 | 5,603 |
| 1997 | 68,439 | 12,477 |

Sources: 1961-1974 data from Osuna, et al. 1976.
1978-1997 data from Garcia and Sanchez 1998.

## 3.0 SOCIOECONOMICS OF THE COASTAL PELAGIC FISHERY

The primary sources of socioeconomic information in this report are (1) the U.S. Bureau of the Census (1977, 1982, 1987-1990, 1997); (2) U.S. Bureau of Economic Analysis (1998); (3) the California Department of Finance (1998); and, (4) Kearney/Centaur (1987a 1987b). Socioeconomic information in this report is generally at the county level, but community-level information is included where available. Dollar amounts are adjusted for inflation using 1989 as the base year. Boats are assigned to a gear type or location by "plurality of landings." For example, a boat that used round haul gear to land 40% of its landings, gillnets to land 30%, and hook-and-line to land 30%, would be defined as a round haul boat.

In this report, demographic data are used to demonstrate changes in the racial and ethnic makeup of coastal counties. Racial groups discussed in this report are white, black, American Indian, Eskimo or Aleutian Islander, and Asian or Pacific Islander. Racial and ethnic groupings may overlap; a group of people with Hispanic ethnicity, for example, might have various racial backgrounds. Ethnic groups discussed in this report distinguish people with Hispanic ancestry from people without Hispanic ancestry.

### 3.1 Commercial Fleet

Northern anchovy, jack mackerel, Pacific sardine, Pacific (chub) mackerel, and squid are the coastal pelagic species (CPS) included in the CPS fishery management plan. Socioeconomic information is presented in this chapter for Los Angeles, Ventura, and Monterey counties, because they are the most important areas in the CPS fishery and likely to be affected by management of the CPS fishery. Most CPS landings (45% of 546,237 mt) during 1993 through 1997 occurred in Los Angeles and Orange counties where the largest number of CPS vessels and trips also occurred (Table 3.1-1). Ventura County was next with 38% of total CPS landings for the period, followed by Monterey County with 15%. Ventura County accounted for most of the CPS exvessel revenues from 1993 through 1997 (108.8 million in 1989 dollars), 54%, followed by Los Angeles County, 30%, and Monterey County, 14%. Other areas accounted for less than two percent of total landings and less than three percent of total revenues. Finfish comprised 70% of the Los Angeles County and Orange County landings for the period, while squid accounted for over 95% of the Ventura County landings for the period. Monterey had a better balance between finfish and squid landings for the period, 57% finfish, 43% squid (Table 3.1-1).

The most important counties along the West Coast in the context of CPS revenues and landings (Table 3.1-1) are Los Angeles/Orange (45% of CPS landings 1993 through 1997 and 30% of real revenues), Santa Barbara/Ventura (38% of landings and 53% or revenues), and Monterey (15% of landings and 14% of revenues). Socioeconomic information are presented in this chapter for Los Angeles and Monterey counties, because data were readily available.

Vessels using round haul gear (purse seines and lampara nets) are responsible for 99% of CPS total landings and revenues in any given year. The southern California round haul fleet, known locally as the "wetfish fleet", is the most important sector of the CPS fishery in terms of landings (Jacobson and Thomson 1992; Thomson et al. 1994). The wetfish fleet is based primarily in Los Angeles harbor, with small segments in the Monterey and Ventura areas. It harvests Pacific bonito, market squid, bluefin tuna, and other tunas, as well as CPS. During 1993, the fleet consisted of 37 active purse seiners (Thomson et al. 1994) averaging 20 meters in length (Thomson et al. 1991). Approximately one-third of the fleet were steel-hulled boats built during the last 20 years. The rest were wooden-hulled and built in the heyday of the Pacific sardine fleet from 1930 to 1949 (Murphy 1966).

### 3.2 Setnet Fleet

California setnet (gillnet and trammel net) fishers land small amounts of CPS, primarily for fresh fish markets. Setnet fishers expressed interest in converting to round haul gear and catching CPS after the California Marine Resources Protection Act displaced them from state waters.

Bramel and Kronman (1991) found it technically feasible to convert small gillnet vessels to run with lampara nets for catching CPS. The average fixed cost of conversion (including gear, vessel, and machinery modifications) was estimated to be $16,400 without sonar and $31,400 with sonar. By harvesting wetfish, a converted gillnet boat might earn gross weekly revenues of $1,500 to $2,000, if markets were available.

In 1980, between 100 and 120 Vietnamese fishers and boat owners used setnets to fish from about 40 converted pleasure boats of the 20-foot to 30-foot range in the Monterey Bay area (Orbach and Beckwith 1980). The active Vietnamese fleet, however, comprised 40 fishers to 60 fishers (in a single day as few as three to 15) who worked about 15 boats (in a single day as few as one). The Vietnamese fleet used setnets to target white croaker (kingfish) and halibut, but small amounts of CPS were also taken.

In 1984, 586 setnet fishers (95% of the total) held permits to operate from Pt. Sal to Pt. Reyes; 67% of these were traditional (nonVietnamese), and 33% were Vietnamese (Ueber 1988). The traditional fleet was estimated to include 266 fishers who independently operated 133 vessels, about half of which used setnets. The traditional setnet fleet fished predominantly for Pacific halibut, rockfish, white croaker, shark, lingcod, and sablefish.

## 3.3 Economic Impact of Commercial Fishery

Growth or decline in fishing affects production, trade, and employment throughout the California economy as fishers make purchases and as the fish are processed, distributed, and marketed. Revenues from these expenditures filter through local, state, and regional economies. Economic multipliers can be used to calculate change in income and employment resulting from a change in the level or the success of fishing (Radtke and Jensen 1987). Economic multipliers have been used to estimate indirect benefits of wetfish fishing (ICF et al. 1988), but the estimates are probably not reliable.

## 3.4 Sources of Income for California Commercial Fishers

Based on a survey of commercial fishers (ICF 1988), in 1984, 15% of California commercial fishers who operated trawl vessels and troll vessels earned all their income from fishing (ICF 1988). Another 66% earned more than half of their incomes from other occupations. Approximately one-third of trawlers and trollers held full-time shore-based jobs, and 30% held part-time shore-based jobs or pooled their incomes with working spouses who held shore-based jobs. Commerical fishers who were retired from other occupations represented about 20% of those sampled; 17% survived on investment incomes; and an unreported percentage were part-time or full-time students.

## 3.5 Recreational Fishery

Total participation in southern California sportfishing declined during 1980 to 1989 from 2,408,000 anglers to 1,390,000 anglers (Table 3.5-1). Coastal residents made up 70% to 80% of total anglers; out-of-state residents made up 18% to 25%; and noncoastal southern California residents made up only one to four percent.

### 3.5.1 Effort

Estimates of recreational fishing effort (number of trips) during 1980, 1985, and 1989 are provided in Table 3.5.1-1. Coastal residents made 89% to 90% of all trips in all years; out-of-state anglers made seven percent to nine percent of all trips; and noncoastal residents made one percent to two percent. In 1980 pier fishing was most popular; 33% of sportfishing was done from man-made structures (Table 3.5.1-1). In 1985, private and rental boat fishing dominated (37%), and in 1989 bank (shore) fishing dominated (40%), although the 1989 data are hard to interpret, because pier fishing may have been included in the figures for shore fishing. Thomson and Crooke (1991) reported that 40% of recreational fishing in 1989 was done from private and rental boats.

### 3.5.2 Expenditures

Table 3.5.2-1 lists 1989 recreational fishing expenditures by county of residence. The recreational fishery generated significant revenues through boat-related expenditures (moorage fees, insurance, etc.), expenditures on licenses and fishing gear, and trip-related expenditures. In 1989 $536 million was spent by local and visiting anglers in southern California, making recreational fishing an important contributor to local economies.

### 3.5.3 Demographics

Table 3.5.3-1 lists demographic characteristics for "key" anglers (the angler who made the most trips in a household) in southern California sportfishing households during 1989. The key anglers were predominantly nonHispanic white (85%) and male (91%) with median ages of 25 years to 45 years. Hispanics made up seven percent of total key anglers.

74% of anglers were employed for more than 35 hours per week; 11% were retired. A large proportion (41%) had some college education.

The highest percentage of recreational fishing households had annual incomes in the range of $30,000 to $40,000 (18%), with sizable fractions in the $40,000 to $50,000 range (15%), and the $20,000 to $30,000 range (13%).

### 3.5.4 Motivation to Fish

Sixty-two percent to 74% of anglers among all four modes (beach, pier, commercial party fishing vessel (CPFV), and private/rental boat) went fishing to relax and "get away from it all" (Table 3.5.4-1). Other motivations were "fishing as a means to do something with family or friends," "fishing to please someone else," "fishing to put food on the table," "the availability of bait," and "the availability of target species."

## 3.6 Resource Use Conflicts

In the early 1980s controversy arose about how to allocate northern anchovy between recreational and commercial fisheries (Huppert 1981; PMFC 1983). There was conflict over whether anchovy should be a commercial resource for reduction to fishmeal and oil or forage and bait for sportfish.

Hook-and-line fishers operating from Santa Barbara and Morro Bay have expressed concern about the effects of oil exploration in the Santa Barbara Channel. Sound waves from geophysical survey devices used in oil exploration may startle marine fish (Malme et al. 1986; Pearson et al. 1987), affecting search time and catch per unit of effort in adjacent fisheries and decreasing efficiency. Experiments revealed that rockfish catch was substantially reduced during periods of sound transmission such as that used during oil exploration (Kearney/Centaur 1987a, b).

Fishers and seismic boats in the Santa Barbara Channel now maintain sufficient distance to avoid conflict. A National Marine Fisheries Service (NMFS) source stated that seismic activity associated with oil exploration now has an insignificant effect on catch. But hook-and-line fishers from Santa Barbara and Morro Bay continue to encourage NMFS to study the effects of oil exploration.

## 3.7 Profile - Los Angeles County, California

Most CPS economic activity takes place in Los Angeles County (Table 3.1-1). Harvesting, processing, and support industries are located in San Pedro, Wilmington-Harbor City, and Long Beach.

### 3.7.1 Population and Housing

Between 1980 and 1990, the population of Los Angeles County increased from 7,477,000 to 8,897,000 (Table 3.7.1-1), from 1,800 persons per square mile to 2,200 persons per square mile. The number of housing units grew at about half the rate of population growth.

### 3.7.2 Demographics

Between 1980 and 1990 the number of whites in Los Angeles County declined from 68.7% to 56.8% of the total population, and blacks from 12.6% to 11.2%. People of Hispanic ethnic origin increased from 27.6% of the population to 37.8%. The numbers of Asians or Pacific Islanders grew at an average rate of 13.3% annually, from 5.5% in 1980 to 10.8% in 1990 (Table 3.7.1-1).

In 1980, 27.2% of the population was younger than 18 years; 62.9% was between 18 years and 64 years; and 9.9% was older than 64 years. In 1990, the age structure remained virtually the same. The median age was 29.8 years in 1980 and 30.7 years in 1990 (Table 3.7.1-1).

### 3.7.3 General Economy

The number of employees in Los Angeles County was 3,185,000 in 1980, 3,701,000 in 1991 and 4,053,000 in 1996, about 50% of the population in each year. Unemployment was 6.6% in 1980, 5.8% in 1990 and 8.2% in 1996. Income per employee (in 1989 dollars) was $25,000 in 1991 and rose 12% to $28,383 in 1995. The 1996 per capita income (in 1989 dollars) was $20,413, 15th out of 58 counties in the state, and was 98% of the state average, $20,759.

Payrolls in the county grew for most major industrial sectors from 1980 through 1991. Total payroll grew at an average annual rate of 2.3%, from $73 billion to $92 billion. Agriculture, forestry, and fishing ranked third among major industries with four percent average annual payroll growth; but agriculture, forestry, and fishing contributed a very small portion (0.3%) to total 1991 payrolls. The total county payroll (in 1989 dollars) was $87.1 billion in 1993, increasing to $87.6 billion in 1995. Los Angeles' agriculture, forestry, and fishing sector had a $254.8 million payroll in 1993, 0.3% of the county's total payroll. In 1995, the County's agriculture, forestry, and fishing sector payroll was $242.9 million, a 4.6% decrease from 1993, and was slightly less than 0.3% of the county's total payroll in 1995.

The number of persons employed in Los Angeles County grew 1.3% annually, from 1980 to 1991. Agriculture, forestry, and fishing grew second fastest (3.1% annually), from 10,622 employees in 1980 to 16,059 (0.3% of total employees) in 1991. Employment in agriculture, forestry, and fishing was 16,066, 1.3% of overall employment in 1993, and 15,278 in 1995, 0.4% of total employment.

### 3.7.4 Earnings

Average 1991 earnings (payroll in 1989 dollars divided by number of employees) were relatively low at $17,000 in the agriculture, forestry, and fishing sector. Average earnings for employees in agriculture, forestry, and fishing were $16,000 per employee in 1993, a 5.9% decrease from 1991, and further decreased 6.3% to $15,000 in 1995.

## 3.8 Community Profile - San Pedro, California

San Pedro is the single most important port for CPS in Los Angeles County and along the West Coast. It is located in southwest Los Angeles on the southeastern slope of the Palos Verdes Peninsula. San Pedro was incorporated as an independent city in 1909, but annexed in 1988 by the City of Los Angeles. The community's roots developed over a century of participation in fishing and related industries and are described in the San Pedro Community Plan (Environmental Perspectives 1989). The community is small, with a hometown feeling, enhanced by the fact that many residents are employed locally.

The Fisherman's Fiesta has been the most visible community activity associated with fishing. Since its beginning in 1945, the fiesta has celebrated fisher's role in the historical development of the San Pedro area. In October 1991 the fiesta was sponsored by 20 local organizations and drew thousands of people to Fishermen's Wharf to enjoy ethnic foods and entertainment. Sponsors included the Italian American Club, the Apostolic Church of San Pedro and Harbor City, and the Los Angeles Police Department Explorers. The fiesta acknowledges the importance of religious ceremony to fishing with the blessing of the fleet.

### 3.8.1 Population and Housing

Population in the San Pedro area grew from 62,336 in 1980 to 69,526 in 1990, and density increased from 9.6 persons per acre in 1980 to 11.4 in 1989. Total housing units in San Pedro increased from 25,053 in 1980 to 27,904 in 1990.

### 3.8.2 Demographics

San Pedro's population is mostly white and nonHispanic (59.7% of the total population in 1980 and 55.0% in 1990) although the proportion of nonwhites (mainly Hispanics) has increased in recent years. Hispanics made up 30.8% of the population in 1980 and 34% in 1990; blacks made up 4.4% of the population in 1980 and five percent in 1990.

### 3.8.3 Income, Employment, and Poverty

San Pedro's mean household income during 1980 was $29,829. Income earned from wages and salaries averaged $22,362; self-employed income averaged $1,884; income from interest and dividends averaged $1,945; social security, $1,544; and public assistance, $472.

The civilian labor force in 1980 consisted of 27,303 people (43.8% of the total population). Of the total jobs, 35.5% were manufacturing or service, 18.8% clerical, 10.9% professional, 9.6% sales, 9.1% management and administrative, 6.4% labor, 2.3% technical, and 7.3% other.

In 1980, 8,500 people, or 13.6% of the total population in San Pedro, were below the poverty line. Most of the impoverished people were younger than 55.

### 3.8.4 History

The San Pedro wetfish industry began in the early 1890s with the *F/V Alpha*, a 22-ton sloop-rigged vessel skippered by Captain Young (Scofield 1951). Captain Young supplied sardines and mackerel to the area's first cannery, the California Fish Company, later renamed the Southern California Fish Company. The *F/V Alpha* operated with a seven-man crew, making the first recorded California seine gear harvests in 1894. In addition to CPS, the *F/V Alpha* landed yellowtail, barracuda, and white sea bass, and generally supplied them to canneries rather than fresh fish markets.

The wetfish seine fleet grew as San Pedro shipbuilders added three new vessels from 1895 to 1914. The fleet remained small for nearly 20 years, until success at harvesting bluefin tuna led to a dramatic expansion of the fleet to 125 purse seine vessels by 1920. Some of the additional boats were built locally; others moved into the area from the northeast Pacific. By 1922 the operating fleet dwindled to 65, as many boats returned to the northeast Pacific or remained in port, because of the poor post-World War I economy and reduced prices.

Southern California canneries grew at a rate parallel to that of the fishing fleet. The processing sector expanded first in San Pedro, after early experimentation with fish canning. Albacore tuna was first canned in 1911, and 16 tuna canneries had been established from San Pedro to San Diego by 1916. The capacity of the processing plants grew in response to the success of canned tuna, which also led to the processing of large amounts of mackerel and sardines.

The wetfish industry suffered from the sharp decline in sardine abundance from the mid 1940s through the 1960s. This was compounded in the 1970s by rising operating costs (primarily fuel) and static fish prices. Perrin and Noetzel (1970) found expansion or construction of new wetfish seiners economically infeasible, even with construction subsidies, because of catch rates and fish prices.

During the 1980s, the commercial fishing industry in Los Angeles continued to decline, directly affecting the local economies of San Pedro and Wilmington. One reason cited for the decline was price-cutting competition from foreign fisheries, which allegedly operated with lower labor costs and government subsidies. State and local taxes and high insurance costs were blamed as additional burdens on the struggling industry. By 1986, only one fish packing plant remained of the 14 that constituted the industry in 1960. The business community, dependent on San Pedro's revenue base, was severely affected by job losses in the local fishery and related industries. The Terminal Island Star-Kist facility closure in October 1984 reportedly caused the loss of 1,200 jobs (California Legislature Senate Committee on Governmental Organization 1986). Two additional major canneries closed in the early 1990s.

#### 3.8.5 Residential Distribution of Crew Members

Zip codes on file with the American Federation of Labor - Congress of Industrial Organizations (AFL-CIO) office in San Pedro are probably representative of crew residence, although some fishers may keep post office boxes near their work. According to Ms. Terry Hoinsky, Fisherman's Union representative, in 1991 the AFL-CIO represented 184 crewmen, or about 30% of the crew members who worked on vessels out of San Pedro.

Crew members resided primarily (89.0%) in the San Pedro area. Some (5.4%) lived in the surrounding communities of Wilmington, Lomita, Palos Verdes Peninsula, and South Gate; others (3.2%) commuted from Carson, Van Nuys, and Torrance.

#### 3.8.6 Crew Demography

Ethnicity and demographic data are available for commercial fishers employed on six vessels that operated in the wetfish fishery during 1977, 1980, 1985, and 1990 (Table 3.8.6-1). These vessels employed between 98 crewman and 70 crewmen annually for the years specified. It was not possible to determine the ages for six crew members, but ethnicity data were available for all.

Italian crew members were the dominant ethnic group throughout the entire period and ranged from 54% to 63% of the total (Table 3.8.6-1). Yugoslavians ranged from 14% to 34% of the total crew and were the second most numerous group until 1990 when they were displaced by Hispanics. All six boats were owned by Italians, who may have employed Italian crew members, because of cultural and familial ties.

The crew became younger over the first period, averaging 47 years in 1977 and 40 years in 1980 (Table 3.8.6-1). Average age increased during the remaining periods (45 years in 1985 and 49 years in 1990). Hispanic crew over the entire period were comparatively younger (30 years to 42 years) than crew members from other ethnic groups, except for a single 27-year-old Portuguese in 1990. Ages for Italian crew ranged from 40 years to 51 years and were equal to or greater than the median in all years.

Jacobson and Thomson (1992) indicate that changes in the ethnicity of crew members are due to different "opportunity costs" among traditional Italian and Yugoslavian crew members and more recent participants who were mostly Hispanic. Declining economic opportunities in the fishery may have contributed to the overall decline in crew members.

### 3.9 Profile - Ventura County, California

Ventura represented the most important region in terms of revenues and the second most important region in terms of landings by the CPS fishery for the 1993 through 1997 period, because of squid. Port Hueneme is the center of CPS fishing activity in Ventura County.

### 3.9.1 Population and Housing

Total population in Ventura County was 529,174 in 1980 and grew on average by 2.6% annually to 669,016 in 1990. The estimated population in 1997 was 725,968, an 8.5% increase since 1990. Population density also increased by 2.6% annually, from 286 persons per square mile in 1980 to 362 in 1990 and to 393 in 1997. Between 1980 and 1990, available housing units grew at 2.5% average annually, from 183,384 to 228,478.

### 3.9.2 Demographics

From 1980 to 1990, the white population of Ventura County grew at an average annual rate of 1.4%. Hispanics increased at an average annual rate of 5.4%, from 21.6% of the population in 1980 to 26.6% in 1990. Although the number of Asians and Pacific Islanders increased at an average annual rate of 10.9%, they still represented only small segments of the population: 3.0% in 1980 and 4.9% in 1990. Even though the black population grew at 1.9% annual rate, their proportion of the total population remained virtually unchanged from 2.1% in 1980 to 2.2% in 1990. American Indians, Eskimos, and Aleutian Islanders constituted 0.7% of the total population (3,805) in 1980 and 0.5% (3,440) in 1990, a decline of 1.0% average annually.

In 1980, 31.2% (166,095) of Ventura County's population was younger than 18; 61.2% was between the ages of 18 and 65; and 7.6% was older than 65. By 1990 the population had aged slightly: 27.6% was less than 18; 64% was between the ages of 18 and 65; and, 8.7% was greater than 65. The median age in the county was 27.8 in 1980 and 30.5 in 1990.

### 3.9.3 General Economy

The civilian labor force in Ventura County was 249,037 persons in 1980, 353,613 in 1990, and 381,800 in 1996. The unemployment rate dropped from 9.1% in 1980 to 8.8% in 1990 and to 7.1% in 1996. Per capita income (in 1989 dollars) was $13,276 in 1979, $17,861 in 1989, and $20,647 in 1995. The 1996 per capita income increased to $21,144, 13th out of 58 counties in California, and was 102% of the state average, $20,759.

The total county payroll (in 1989 dollars) was $3.7 billion in 1993, increasing to $4.3 billion in 1995. Ventura's agriculture, forestry, and fishing sector had a $47.6 million payroll in 1993, 1.3% of the county's total payroll. In 1995, Ventura's agriculture, forestry, and fishing sector payroll was $45.3 million, a 4.8% decrease from 1993, and was 1.1% of the county's total payroll.

The total number of employees in Ventura's agriculture, forestry, and fishing sector grew from 15,922 in 1980 to 17,892 in 1990, an average of 1.2% annually. The overall civilian labor force increased 41.9% between 1980 and 1990, a 4.2% annual average. Employment in the agriculture, forestry, and fishing sector was 6.4% of overall employment in 1980, 5.1% in 1990, 5.6% in 1993 and 4.9% in 1995.

### 3.9.4 Earnings

Ventura County earnings (in 1989 dollars) averaged $21,176 per worker in 1993 and increased slightly to $21,517 in 1995. Among major industrial sectors, agriculture, forestry, and fishing paid $13,760 per employee in 1993 and increased 2.7% to $14,129 per employee in 1995.

## 3.10 Profile - Monterey County, California

Monterey represents the third most important region in terms of landings and revenues by the CPS fishery.

### 3.10.1 Population and Housing

Total population in Monterey County was 290,444 in 1980 and grew on average by 2.2% annually to 355,660 in 1990 (Table 3.9.1-1). Population density also increased by 2.2% annually, from 88 persons per square mile in 1980 to 107 in 1990. Available housing units grew at 1.7% average annually, from 103,557 in 1980 to 121,224 in 1990. The estimated population in 1997 was 361,907, up 1.8% from 1990, with a density of 109 persons per square mile.

### 3.10.2 Demographics

From 1980 to 1990, the white population of Monterey County grew at an average annual rate of 1.3% (Table 3.9.1-1). This rate was less than the county average. Hispanics increased at an average annual rate of 5.9%, from 25.9% of the population in 1980 to 33.6% in 1990. Although the number of Asians and Pacific Islanders increased at an average annual rate of 3.9%, they still represented only small segments of the population, 6.9% in 1980 and 7.8% in 1990. Although the black population grew at 1.9% average annually, their proportion of the total population declined from 6.6% in 1980 to 6.4% in 1990. American Indians, Eskimos, and Aleutian Islanders constituted 1.2% of the total population (3,550) in 1980 and 0.8% (3,017) in 1990, a decline of 1.5% average annually.

In 1980, 28.3% (82,295) of Monterey County's population was younger than 18; 62.4% was between the ages of 18 and 64; and 9.2% were older than 64 (Table 3.9.1-1). By 1990, there had been no significant change. The median age in the county was 27.8 in 1980 and 29.6 in 1990.

### 3.10.3 General Economy

The civilian labor force in Monterey County was 64,801 persons in 1980, 85,875 in 1991, and increased 108.8% to 179,300 in 1996. The unemployment rate dropped from 9.1% in 1980 to 8.8% in 1990, and rose to 11.0% in 1996. Income per capita (in 1989 dollars) was $19,000 in 1991 and 20,500 in 1996, a 7.9% increase.

The total county payroll (in 1989 dollars) was $1.6 billion in 1988 (Table 3.10.3-1). Among Monterey's major industrial sectors, agriculture, forestry, and fishing was second in payroll growth (6.1% average annually), rising from $24 million in 1980 to $41 million in 1991. Although this sector's growth was strong, it contributed only a small percentage (2.5% in 1991) to the total payroll. The Monterey county payroll was $1.7 billion in 1993, increasing to $1.9 billion in 1995. Monterey County's agriculture, forestry, and fishing sector had a $38.6 million payroll in 1993, 2.3% of the county's total payroll. In 1995, the County's agriculture, forestry, and fishing sector payroll was $89.7 million, a 132.4% increase from 1993, and represented 4.7% of the county's total payroll in 1995.

The total number of employees in Monterey County grew 2.2% average annually, from 65,000 to 86,000. Agriculture, forestry, and fishing grew at 3.3% average annually, the fourth fastest rate. Agriculture, forestry, and fishing maintained 2.2% of the total employees in 1991. Employment in agriculture, forestry, and fishing was 1,787, 2.0% of overall employment in 1993, and increased to 3,315, 3.5% of total employment in 1995.

### 3.10.4 Earnings

Monterey County earnings (payroll in 1989 dollars divided by number of employees) in 1988 averaged $19,000. Among major industrial sectors, agriculture, forestry, and fishing paid sixth highest, $21,000 per employee. Average earnings for employees in the agriculture, forestry, and fishing sector were $22,000 in 1993 up 4.8% from 1988, and rose another 22.7% to $27,000 in 1995.

### 3.10.5 History

The history of the sardine fishery in the Monterey area is described by Reinstedt (1978).

### 3.10.6 Residential Distribution of Crew Members

The residential distribution of 128 crew members in the AFL-CIO Fisherman's Union who lived in Monterey County is described in Table 3.9.8-1: 79.7% (102) lived in the Monterey city area, and 11.7% in the Seaside area. Some came from Pacific Grove, Marina, King City, and Carmel.

TABLE 3.1-1. Total commercial landings and revenues (1997 dollars) for species in the PacFIN "WETF" (wetfish) complex (includes Pacific [chub] mackerel, jack mackerel, market squid, northern anchovy, Pacific bonito, Pacific sardine, and unspecified mackerel) by county in Washington, Oregon, and California during 1993 through 1997. Counties are listed from south to north.

| County | Landings (mt) | % Total Landings | Revenues ($1997) | % Total Revenues |
|---|---|---|---|---|
| San Diego | 522 | 0% | $285,184 | 0% |
| Los Angeles/Orange | 246,204 | 0% | 41,268,508 | 0% |
| Santa Barbara/Ventura | 209,401 | 38% | $73,148,255 | 53% |
| San Luis Obisbo | 3,804 | 1% | $1,625,244 | 1% |
| Monterey | 80,999 | 15% | $18,669,794 | 14% |
| Santa Cruz | 424 | 0% | $134,053 | 0% |
| San Mateo | 4,789 | 1% | $1,521,630 | 1% |
| San Francisco | 638 | 0% | $233,455 | 0% |
| Alameda | 0 | 0% | $97 | 0% |
| Sonoma/Marin | 10 | 0% | 4,606 | 0% |
| Mendocino | 1 | 0% | $1,448 | 0% |
| Humboldt | 117 | 0% | $30,084 | 0% |
| Del Norte | 10 | 0% | $4,395 | 0% |
| Other or Unknown California | 40 | 0% | $17,706 | 0% |
| Curry | 0 | 0% | $4 | 0% |
| Coos | 19 | 0% | $2,959 | 0% |
| Douglas | 1 | 0% | $214 | 0% |
| Lincoln | 2,554 | 0% | $28,650 | 0% |
| Tillamook | 0 | 0% | $5 | 0% |
| Clatsop | 1,080 | 0% | $17,533 | 0% |
| Pacific | 257 | 0% | $108,056 | 0% |
| Grays Harbor | 395 | 0% | $189,595 | 0% |
| Snohomish | 0 | 0% | $2 | 0% |
| Jefferson | 0 | 0% | $4 | 0% |
| Whatcom | 4 | 0% | $562 | 0% |
| Clallam | 0 | 0% | $8 | 0% |
| Skagit | 28 | 0% | $16,526 | 0% |
| Total | 551,297 | 100% | $137,308,578 | 100% |

TABLE 3.5-1. Estimated number of marine recreational fishers (thousands) in southern California.[a/]

| Residence of Participant | 1980 | | 1985 | | 1989 | |
|---|---|---|---|---|---|---|
| | Number | Percent | Number | Percent | Number | Percent |
| Coastal[b/] | 1,710 | 71.00 | 994 | 71.60 | 1,119 | 80.50 |
| Noncoastal | 91 | 3.80 | 50 | 3.60 | 20 | 1.40 |
| Out of state | 607 | 25.20 | 344 | 24.80 | 250 | 18.10 |
| Total | 2,408 | 100.00 | 1,388 | 100.00 | 1,390 | 100.00 |

a/ Los Angeles, Orange, San Diego, San Luis Obispo, Santa Barbara, and Ventura counties.
b/ Within 25 miles of the coast.

Sources: Department of Commerce, NOAA, NMFS, Marine Recreational Fishing Statistical Survey (MRFSS). Report Numbers 8321 and 8328 and 1989 tables (Washington, D.C.: 1984, 1986, and 1989).

TABLE 3.5.1-1. Estimated number of marine recreational fishing trips (thousands) in southern California[a/] during 1980, 1985, and 1989 by mode and residence.

| Mode | Coastal[b/] | Percent | Noncoastal | Percent | Out-of-state | Percent | Total | Percent |
|---|---|---|---|---|---|---|---|---|
| | | | | **1980** | | | | |
| Pier[c/] | 2,700 | 30.2 | 59 | 0.7 | 203 | 2.3 | 2,962 | 33.1 |
| Bank[d/] | 1,540 | 17.2 | 45 | 0.5 | 160 | 1.8 | 1,745 | 19.5 |
| CPFV[e/] | 1,392 | 15.6 | 33 | 0.4 | 274 | 3.1 | 1,699 | 19.0 |
| Private[f/] | 2,371 | 26.5 | 53 | 0.6 | 116 | 1.3 | 2,540 | 28.4 |
| Total | 8,003 | 89.5 | 190 | 2.2 | 753 | 8.5 | 8,946 | 100.0 |
| | | | | **1985** | | | | |
| Pier | 1,284 | 24.3 | 27 | 0.5 | 104 | 2.0 | 1,415 | 26.8 |
| Bank | 654 | 12.4 | 21 | 0.4 | 68 | 1.3 | 743 | 14.1 |
| CPFV | 947 | 17.9 | 19 | 0.4 | 186 | 3.5 | 1,152 | 21.8 |
| Private | 1,826 | 34.6 | 43 | 0.8 | 98 | 1.9 | 1,967 | 37.3 |
| Total | 4,711 | 89.2 | 110 | 2.1 | 456 | 8.7 | 5,277 | 100.0 |
| | | | | **1989** | | | | |
| Pier | | | | | | | | |
| Bank | 1,744 | 37.5 | 19 | 0.4 | 89 | 1.9 | 1,852 | 39.9 |
| CPFV | 937 | 20.2 | 16 | 0.3 | 180 | 3.9 | 1,133 | 24.4 |
| Private | 1,590 | 34.2 | 20 | 0.4 | 50 | 1.1 | 1,660 | 35.7 |
| Total | 4,271 | 91.9 | 55 | 1.2 | 319 | 6.9 | 4,645 | 100.0 |

a/ Los Angeles, Orange, San Diego, San Luis Obispo, Santa Barbara, and Ventura Counties.
b/ Within 25 miles of the coast.
c/ Structures such as piers, docks, jetties, breakwaters, breachways, bridges, and causeways.
d/ Beaches and banks.
e/ Party and charter boats.
f/ Private and rental boats.

Sources: Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, MRFSS, Report Numbers 8321, 8328, (Washington, D.C.: 1984 and 1986) and 1989 data tables.

TABLE 3.5.2-1. Total annual expenditures for saltwater fishing ($1,000s), by expenditure category and county of residence during 1989.

| | | | Trip-Related Expenditures | | | | | |
|---|---|---|---|---|---|---|---|---|
| County of Residence | Licenses and Gear | Boat-Related Expenditures | Beach | Pier | CPFV | Private Boat | Total | Grand Total |
| Los Angeles | 35,765.60 | 27,106.10 | 3,275.20 | 10,240.00 | 80,960.10 | 40,709.00 | 135,184.40 | 198,056.10 |
| Orange | 14,914.90 | 39,551.80 | 1,888.70 | 2,576.60 | 31,296.00 | 27,963.00 | 63,724.30 | 118,191.00 |
| Riverside | 2,660.50 | 2,203.10 | 281.40 | 1,309.20 | 8,526.80 | 4,752.70 | 14,870.10 | 19,733.70 |
| San Bernardino | 3,077.60 | 4,010.90 | 46.60 | 1,915.60 | 6,016.30 | 5,191.60 | 13,170.00 | 20,258.50 |
| San Diego | 13,101.20 | 19,490.70 | 4,614.80 | 3,801.20 | 15,959.00 | 19,095.20 | 43,470.30 | 76,062.20 |
| San Luis Obispo | 1,156.90 | 1,037.40 | 492.40 | 462.1 | 2,454.30 | 1,953.10 | 5,361.90 | 7,556.20 |
| Santa Barbara | 1,719.10 | 2,473.40 | 1,256.60 | 894.6 | 1,210.90 | 3,893.00 | 7,255.10 | 11,447.60 |
| Ventura | 3,018.50 | 5,544.70 | 908.60 | 1,340.30 | 6,817.00 | 5,267.40 | 14,333.30 | 22,896.50 |
| Noncoastal | 12,678.30 | 18,967.10 | 3,532.30 | 5,163.30 | 14,752.30 | 6,965.50 | 30,413.40 | 62,058.80 |
| Total | 88,092.70 | 120,385.20 | 16,296.60 | 27,703.00 | 167,992.70 | 115,790.60 | 327,782.80 | 536,260.60 |

Source: Thomson and Crooke 1991.

TABLE 3.5.3-1. Demographics of southern California anglers by county of residence during 1989.

| | LA (%) | Orange (%) | River (%) | San Bern (%) | San D (%) | San L Ob (%) | San B (%) | Vent (%) | Other (%) | Average (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Age** | | | | | | | | | | |
| 1-12 | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.0 | 0.1 |
| 13-16 | 0.2 | 2.0 | 2.3 | 1.0 | 1.0 | 2.8 | 2.0 | 1.8 | 2.4 | 1.8 |
| 17-24 | 10.4 | 9.0 | 9.7 | 8.2 | 14.9 | 8.8 | 11.4 | 7.7 | 12.9 | 10.3 |
| 25-34 | 31.8 | 31.3 | 27.3 | 28.2 | 30.8 | 28.9 | 22.9 | 28.1 | 18.8 | 27.6 |
| 35-44 | 23.7 | 26.4 | 36.4 | 32.8 | 22.9 | 24.5 | 33.8 | 26.7 | 21.2 | 27.6 |
| 45-54 | 16.8 | 15.9 | 13.6 | 15.9 | 14.9 | 14.9 | 13.4 | 19.5 | 25.9 | 16.8 |
| 55-64 | 9.2 | 10.4 | 5.7 | 8.7 | 9.0 | 8.4 | 7.0 | 10.0 | 10.6 | 8.8 |
| >64 | 5.0 | 5.1 | 5.1 | 6.5 | 11.6 | 9.0 | 6.3 | 6.3 | 8.2 | 7.0 |
| Male | 91.3 | 92.1 | 90.4 | 90.8 | 88.6 | 88.4 | 92.1 | 92.3 | 90.6 | 90.7 |
| **Ethnicity** | | | | | | | | | | |
| Asian/Pac | 5.1 | 3.9 | 2.2 | 2.0 | 5.4 | 1.6 | 3.9 | 3.1 | 0.0 | 3.0 |
| Black | 6.3 | 0.0 | 1.7 | 3.5 | 1.5 | 0.4 | 1.0 | 1.3 | 1.2 | 1.9 |
| Hispanic | 10.8 | 7.8 | 4.5 | 7.5 | 3.5 | 6.5 | 8.8 | 7.6 | 5.9 | 7.0 |
| Non-Hispanic (White) | 77.3 | 86.3 | 88.2 | 82.4 | 86.1 | 89.5 | 83.9 | 85.7 | 89.4 | 85.4 |
| Other | 0.6 | 2.0 | 3.4 | 4.5 | 3.5 | 2.0 | 2.4 | 2.2 | 3.5 | 2.7 |
| **Employment Status** | | | | | | | | | | |
| <35 h/wk | 75.1 | 77.8 | 79.1 | 73.5 | 74.4 | 66.5 | 68.0 | 75.0 | 76.7 | 74.0 |
| >35 h/wk | 4.5 | 4.3 | 4.0 | 7.5 | 6.4 | 7.5 | 4.9 | 4.5 | 1.2 | 5.0 |
| Retired | 10.2 | 6.3 | 7.9 | 9.0 | 9.9 | 15.0 | 12.1 | 11.6 | 15.1 | 10.8 |
| Student | 5.6 | 4.3 | 3.4 | 3.5 | 3.9 | 6.3 | 8.7 | 1.8 | 3.5 | 4.6 |
| Homemaker | 1.1 | 2.4 | 1.7 | 0.5 | 1.5 | 1.2 | 1.0 | 0.4 | 2.3 | 1.3 |
| Unemployed | 0.0 | 0.0 | 1.1 | 2.0 | 1.0 | 0.8 | 2.4 | 1.8 | 0.0 | 1.0 |
| Other | 3.4 | 4.8 | 2.8 | 4.0 | 3.0 | 2.8 | 2.9 | 4.9 | 1.2 | 3.3 |
| Education | | | | | | | | | | |
| Less than 8th grade | 1.7 | 0.5 | 1.7 | 1.5 | 0.0 | 0.8 | 0.5 | 0.0 | 0.0 | 0.7 |
| 8th grade graduate | 2.8 | 0.5 | 0.0 | 0.0 | 1.0 | 0.4 | 0.5 | 1.3 | 2.3 | 1.0 |
| Some high school | 5.1 | 4.3 | 9.0 | 4.5 | 3.4 | 6.7 | 6.3 | 3.1 | 7.0 | 5.5 |
| High school graduate | 17.0 | 11.1 | 5.7 | 5.6 | 10.8 | 13.8 | 16.5 | 12.1 | 17.4 | 14.4 |
| Some trade school | 7.4 | 3.4 | 2.8 | 4.5 | 3.9 | 1.6 | 4.9 | 4.9 | 8.1 | 4.6 |
| Trade/technical school graduate | 5.7 | 4.8 | 4.5 | 9.0 | 5.9 | 7.5 | 6.8 | 7.2 | 4.7 | 6.2 |
| Some college | 34.1 | 40.6 | 3.8 | 2.7 | 44.8 | 41.7 | 37.9 | 43.0 | 38.4 | 40.8 |
| BA | 15.3 | 15.9 | 1.2 | 0.1 | 18.2 | 14.6 | 15.5 | 14.8 | 11.6 | 14.1 |
| Postgraduate | 10.8 | 18.8 | 1.2 | 2.1 | 11.8 | 13.0 | 11.2 | 13.5 | 10.5 | 12.5 |
| **Annual Household Income** | | | | | | | | | | |
| <10k | 2.5 | 1.0 | 2.9 | 2.7 | 3.2 | 5.8 | 7.3 | 1.4 | 2.3 | 3.3 |
| 10-20k | 11.9 | 4.1 | 5.8 | 9.6 | 9.5 | 14.5 | 9.3 | 2.4 | 12.3 | 8.8 |
| 20-30k | 13.1 | 9.8 | 13.5 | 11.8 | 15.8 | 17.4 | 14.5 | 11.4 | 13.6 | 13.4 |
| 30-40k | 13.1 | 17.4 | 12.9 | 16.6 | 16.8 | 22.0 | 18.7 | 18.6 | 24.7 | 17.9 |
| 40-50k | 15.6 | 14.9 | 21.1 | 17.1 | 13.7 | 15.8 | 11.4 | 17.1 | 12.3 | 15.4 |
| 50-60k | 2.5 | 9.8 | 12.3 | 14.4 | 10.5 | 10.0 | 13.5 | 13.3 | 11.1 | 11.9 |
| 60-70k | 7.5 | 13.9 | 9.4 | 8.0 | 10.5 | 4.1 | 8.3 | 10.0 | 7.4 | 8.8 |
| 70-80k | 4.4 | 6.7 | 9.9 | 7.5 | 7.9 | 2.9 | 6.7 | 6.7 | 8.6 | 6.8 |
| 80-90k | 5.0 | 6.7 | 3.5 | 3.7 | 2.6 | 2.9 | 2.6 | 6.7 | 3.7 | 4.2 |
| 90-100k | 2.5 | 2.1 | 2.3 | 2.1 | 1.6 | 0.4 | 1.6 | 2.9 | 0.0 | 1.7 |
| 100-110k | 3.1 | 2.6 | 2.3 | 2.7 | 2.1 | 0.4 | 1.6 | 3.3 | 1.2 | 2.1 |
| 110-120k | 1.3 | 2.6 | 1.2 | 1.6 | 0.5 | 1.2 | 0.5 | 1.4 | 0.0 | 1.1 |
| 120-130k | 1.9 | 3.1 | 0.0 | 0.0 | 3.2 | 0.0 | 1.0 | 1.0 | 1.2 | 1.3 |
| 130-140k | 0.6 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.5 | 0.0 | 0.1 |
| >140k | 5.0 | 5.2 | 2.9 | 2.1 | 2.1 | 2.5 | 3.1 | 3.3 | 1.2 | 3.0 |
| Sample | 160 | 194 | 171 | 187 | 190 | 241 | 193 | 210 | 81 | 181 |
| Total | | | | | | 100.00 | | | | |

Source: Thomson and Crooke 1991.

TABLE 3.5.4-1. Motivation for fishing for southern California anglers in 1989, by mode, on a scale of one (not at all important) to seven (very important).

| Scale | Food | Challenge | Fish | Bait | Relax | Social | Pleasure |
|---|---|---|---|---|---|---|---|
| | | | | **Beach** | | | |
| 1 | 51.70 | 2.00 | 34.50 | 60.60 | 0.70 | 5.50 | 81.40 |
| 2 | 8.30 | 0.70 | 8.30 | 9.90 | 1.30 | 4.10 | 4.80 |
| 3 | 13.80 | 2.70 | 9.00 | 7.00 | 2.00 | 2.10 | 2.80 |
| 4 | 13.80 | 12.20 | 17.20 | 8.50 | 1.30 | 10.30 | 5.50 |
| 5 | 6.20 | 8.20 | 9.00 | 4.90 | 6.00 | 11.00 | 1.40 |
| 6 | 1.40 | 17.70 | 11.70 | 2.10 | 14.80 | 13.10 | 0.70 |
| 7 | 4.80 | 56.50 | 10.30 | 7.00 | 73.80 | 53.80 | 3.40 |
| | | | | **Pier** | | | |
| 1 | 70.30 | 4.20 | 51.90 | 64.30 | 0.90 | 3.80 | 67.50 |
| 2 | 9.00 | 0.00 | 9.00 | 8.90 | 0.90 | 1.90 | 6.70 |
| 3 | 7.10 | 3.30 | 9.40 | 8.00 | 2.30 | 1.90 | 3.80 |
| 4 | 7.10 | 14.00 | 11.80 | 7.00 | 7.00 | 7.50 | 4.80 |
| 5 | 0.90 | 19.20 | 8.00 | 3.30 | 10.30 | 9.90 | 4.30 |
| 6 | 1.40 | 14.50 | 2.80 | 2.80 | 16.80 | 19.20 | 2.90 |
| 7 | 4.20 | 44.90 | 7.10 | 5.60 | 61.70 | 55.90 | 10.00 |
| | | | | **CPFV** | | | |
| 1 | 49.80 | 2.00 | 24.90 | 47.50 | 2.10 | 2.10 | 73.50 |
| 2 | 14.80 | 1.70 | 7.10 | 13.70 | 1.10 | 0.90 | 7.00 |
| 3 | 11.80 | 2.50 | 9.20 | 9.90 | 2.10 | 3.40 | 4.10 |
| 4 | 12.10 | 10.70 | 14.90 | 9.70 | 6.50 | 10.10 | 5.10 |
| 5 | 4.70 | 16.10 | 13.70 | 6.00 | 10.90 | 14.10 | 2.80 |
| 6 | 2.70 | 13.50 | 9.80 | 3.60 | 15.10 | 22.10 | 3.20 |
| 7 | 4.10 | 53.60 | 20.40 | 9.60 | 62.20 | 47.20 | 4.50 |
| | | | | **Private Boat** | | | |
| 1 | 49.00 | 3.10 | 25.20 | 52.00 | 1.10 | 1.40 | 73.30 |
| 2 | 11.10 | 0.50 | 5.60 | 8.50 | 0.70 | 1.10 | 6.50 |
| 3 | 12.30 | 3.60 | 10.40 | 8.70 | 2.00 | 2.90 | 5.20 |
| 4 | 14.60 | 9.00 | 15.70 | 13.30 | 6.40 | 7.70 | 6.70 |
| 5 | 7.70 | 17.00 | 13.90 | 6.00 | 9.60 | 13.20 | 2.70 |
| 6 | 1.80 | 15.40 | 7.40 | 2.80 | 14.30 | 17.60 | 3.10 |
| 7 | 3.50 | 51.30 | 21.80 | 8.70 | 66.00 | 56.10 | 2.50 |

Food=Fishing gives me the opportunity to put food on the table.
Challenge=I enjoy the challenge of catching fish.
Fish=A species that I particularly like to fish for was available at this time.
Bait=A bait that I like to fish with was available at this time.
Relax=Fishing gives me the opportunity to relax and "get away from it all."
Social=Fishing gives me the opportunity to do something with family and/or friends.
Please=I went fishing to please someone else.
Source: Thomson and Crooke, 1991.

TABLE 3.8.6-1. Ethnicity, median birth year, median age during fishing year, and number of crew members on six wetfish boats based in San Pedro during four years.[a/]

| Fishing Year | | Ethnicity | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Unknown/Other | Hispanic | Italian | Asian | Port. | Yugo. | All |
| **1977** | Birth Year | 1951 | 1945 | 1930 | NA | 1920 | 1927 | 1930 |
| | Age | 26 | 32 | 47 | 57 | 50 | 47 | 47 |
| | Number | 5 | 6 | 53 | 1 | 0 | 33 | 98 |
| | Proportion (%) | 5 | 6 | 54 | 1 | 0 | 34 | 100 |
| **1980** | Birth Year | 1959 | 1950 | 1940 | NA | 1931 | 1922 | 1940 |
| | Age | 21 | 30 | 40 | 49 | 58 | 40 | 40 |
| | Number | 3 | 4 | 49 | 2 | 0 | 22 | 80 |
| | Proportion (%) | 4 | 5 | 61 | 3 | 0 | 28 | 100 |
| **1985** | Birth Year | 1960 | 1952 | 1939 | NA | 1931 | 1935 | 1940 |
| | Age | 25 | 33 | 46 | 54 | 50 | 45 | 45 |
| | Number | 6 | 6 | 44 | 4 | 0 | 10 | 70 |
| | Proportion (%) | 9 | 9 | 63 | 6 | 0 | 14 | 100 |
| **1990** | Birth Year | 1955 | 1948 | 1939 | 1943 | 1963 | 1938 | 1941 |
| | Age | 35 | 42 | 51 | 47 | 27 | 52 | 49 |
| | Number | 3 | 15 | 46 | 2 | 1 | 7 | 74 |
| | Proportion (%) | 4 | 20 | 62 | 3 | 1 | 9 | 100 |

a/ In 1985, for example, there were six Hispanic crew members whose median birth year was 1952 and median age was 33 years. Data are for boats affiliated with the Fishermen's Cooperative Association in San Pedro, California, from 1977 to 1990 that had crew members belonging to the Fisherman and Allied Workers Union in San Pedro. Data were obtained from personnel records. Ethnicity of each crew member was determined by surname and checked by someone familiar with the fishery and the crew members. Birth dates were not available for six crew members (<2 of the total sample), who are not included in the table.

Source: Jacobson and Thomson (1992).

TABLE 3.9.8-1. Residence of fishers belonging to AFL-CIO Fisherman's Union, the San Pedro area, Los Angeles County, California.

| County/Number | Percentage | Zip Code | Area |
|---|---|---|---|
| **Los Angeles County** | | | |
| 136 | 74 | 97031 | Terminal Island Fort MacArthur |
| 14 | 8 | 90011 | Washington Station, Los Angeles |
| 12 | 7 | 90732 | Fidelity Federal Bldg. 29000 Western Ave. |
| 4 | 2 | 90745 | Carson |
| 3 | 2 | 90744 | Wilmington |
| 3 | 2 | 90717 | Lomita |
| 2 | 1 | 90733 | San Pedro |
| 2 | 1 | 90274 | Palos Verdes Peninsula |
| 2 | 1 | 90280 | South Gate |
| 1 | <1 | 91401 | Van Nuys |
| 1 | <1 | 90501 | Torrance |
| 1 | <1 | 90007 | Adams Blvd., Los Angeles |
| 1 | <1 | 90810 | Cabrillo, Long Beach |
| 1 | <1 | 95456 | Northern Cal |
| 1 | <1 | Unknown | Unknown |
| 184 | 100 | | Total Los Angeles County |
| **San Diego County** | | | |
| 4 | 100 | 92139 | San Diego |
| **Monterey County** | | | |
| 102 | 80 | 93940 | Monterey |
| 15 | 12 | 93955 | Seaside |
| 5 | 4 | 93950 | Pacific Grove |
| 4 | 3 | 93933 | Marina |
| 1 | <1 | 93930 | King City |
| 1 | <1 | 93923 | Carmel |
| 128 | 100 | | Total Monterey County |

## ADDITIONAL REFERENCES


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