Pacific Mackerel

History of the Fishery

Pacific mackerel (*Scomber japonicus)*, also called chub mackerel or blue mackerel, are harvested by three separate fisheries – the California commercial fishery, a sport fishery based primarily in southern California, and the Mexican commercial fishery. In the commercial fisheries, Pacific mackerel are landed by the same boats that catch jack mackerel, Pacific sardine, and market squid.

Pacific mackerel supported one of California's major fisheries during the 1930s and 1940s and again in the 1980s. The canning of Pacific mackerel began in the late 1920s and increased as greater processing capacities and more marketable packs were developed. Landings decreased in the early 1930s, due to the economic depression and a decline in demand, and then rose to a peak of 73,214 tons in 1935. During this period, Pacific mackerel was second only to Pacific sardine in annual landings. The mackerel fishery then experienced a long, fluctuating decline. A moratorium was placed on the fishery in 1970 after the stock had collapsed.

In 1972, legislation was enacted which imposed a landing quota based on the age one-plus biomass. A series of successful year classes in the late 1970s initiated a recovery, and the fishery was reopened under a quota system in 1977. During the recovery period from 1977 to 1985, various adjustments were made to quotas for directed take of Pacific mackerel and to incidental catch limits. These measures were intended to lessen the impact of the recovering population on the jack mackerel fishery, and to accommodate the development of the Pacific mackerel fishery as the population increased. From 1990 through 1999, Pacific mackerel accounted for 87 percent of total mackerel landings in California. Pacific mackerel ranked third in volume of California finfish landings throughout the 1990s.

Before 1928, when canning began, Pacific mackerel were landed incidentally in the sardine fishery and used primarily as fresh fish. For many years, demand for canned mackerel was steady and exceeded supply. Following the recovery, the market for canned mackerel has fluctuated due to availability and economic conditions. At present, most Pacific mackerel is used for human consumption, canned, or used for pet food, with a small but increasing amount sold as fresh fish. Minor amounts of Pacific mackerel are used by anglers for live and dead bait. Mackerel prices increased from $45 per ton in 1956 to $315 in 1981, but have declined to $120 per ton in 1999. Domestic demand for canned Pacific mackerel appears to have decreased in recent years. During the early fishery, Pacific mackerel were taken by lampara boats, which were replaced in the 1930s by the same purse seine fleet that fished for sardines. The purse seiners fished for Pacific mackerel until the moratorium in 1970, and were able to fish for jack mackerel, northern anchovy, and other species until the fishery reopened in 1977. Fishing originally occurred near port, but by the late 1930s it extended along the entire coast from San Diego to Santa Barbara, and included the Channel Islands. Beginning in the 1952-1953 season, fishing extended to Tanner and Cortez Banks.

Until the mid-1950s, there was a seasonal pattern to the fishery. Pacific mackerel were mostly unavailable from January through May, then increased in availability until late fall. Most of the catch was taken by purse seiners until September, when the sardine fishery began. During the declining years of the fishery, catches became more sporadic, with no apparent seasonal patterns.

At present the purse seine fleet fishes the Southern California Bight, including the Channel Islands and offshore banks. A small portion of the catch (approximately 10 percent in recent years) is taken in the Monterey Bay area. The purse seine fleet fishes year-round. Landings are typically slow during April and May, increase beginning in June, peak during the third quarter of the year, and decrease after September. As of June 2000, 63 purse seiners hold permits to participate in the NMFS limited entry fishery for coastal pelagic species, which is in effect south of 39° N. latitude (Pt. Arena, California). North of this area, there is open access to the fishery. These vessels participate not only in the Pacific mackerel fishery, but also take jack mackerel, Pacific sardine, northern anchovy, and market squid. Other types of gear take Pacific mackerel incidentally.

Pacific mackerel fisheries in California were managed by the state through 1999, and a fishery management plan (FMP) for coastal pelagic species, including Pacific mackerel, was implemented by the Pacific Fishery Management Council (PFMC) in January 2000. State regulations, enacted in 1985, had imposed a moratorium on directed fishing when the total biomass was less than 20,000 tons, and limited the incidental catch of Pacific mackerel to 18 percent during a moratorium. The fishing

Pacific Mackerel, *Scomber japonicus*
Credit: DFG

season for Pacific mackerel was set to extend from July 1 to June 30 of the following year. A seasonal quota, equal to 30 percent of the total biomass in excess of 20,000 tons had been allowed when the biomass was between 20,000 and 150,000 tons, and there was no quota when the total biomass was 150,000 tons or greater. From 1985 to 1991, the biomass exceeded 150,000 tons and no quota restrictions were in effect. The quotas from the period 1992 through 2000 averaged 24,445 tons, with a high at 47,200 tons set by the PFMC for the 1999-2000 fishing season.

Pacific mackerel have ranked among the top 11 most important sportfish caught in southern California waters, primarily because they are abundant rather than desirable. The recreational catch of Pacific mackerel averaged 1,500 tons per year from 1977 through 1991, and 700 tons per year from 1993 through 1999. During the commercial fishing moratorium, the sport fishery became the largest exploiter of Pacific mackerel in California. The recreational catch increased during the late 1970s and early 1980s, with more than one million fish per year caught from 1979 through 1981. Recent estimates of annual recreational catches indicate a steady decline since 1981 to about 200 tons of Pacific mackerel in southern California in 1999. The catches from commercial passenger fishing vessels (CPFVs) have declined from a peak in 1980 of over 1.31 million Pacific mackerel, and an average of over 700,000 fish per year during the 1980s, to an average of slightly over 330,000 fish per year through the 1990s. The reported CPFV catch in 1998 totaled only 136,614 fish.

Demand for Pacific mackerel in Baja California, Mexico increased after World War II. Mexican landings remained stable for several years, rose to 8,000 tons in 1963, then declined to a low of 100 tons in 1968. Catches remained insignificant until the mid-1970s. During the period 1990 to 1999, annual landings of Pacific mackerel in Ensenada peaked twice, first in 1990 at 39,426 tons, and again in 1998 at 55,916 tons. The average for Baja California annual landings during the 1990s was 20,108 tons per year. Mexican landings of Pacific and jack mackerels, Pacific sardines, northern anchovy, and round herrings, are primarily used for reduction into fishmeal, and approximately 20 percent used for human consumption.

Status of Biological Knowledge

Pacific mackerel occur worldwide in temperate and subtropical coastal waters. In the eastern Pacific, they range from Chile to the Gulf of Alaska, including the Gulf of California. They are common from Monterey Bay, California to Cape San Lucas, Baja California, but are most abundant south of Point Conception, California. Pacific mackerel usually occur within 20 miles of shore, but have been taken as far offshore as 250 miles.

Adults are found in water temperatures ranging from 50.0° to 72.0° F and larvae in 57.2° to 70.0° F. Adults occur from the surface to 1,000 feet deep. Sub-adult and adult Pacific mackerel in the northeastern Pacific move northward along the coast during the summer. The most northerly records occur during El Niño events. There is an inshore-offshore migration off California, with increased abundance inshore from July to November and increased abundance offshore from March to May. Pacific mackerel are typically found near shallow banks, and juveniles are commonly found off sandy beaches, around kelp beds, and in open bays.

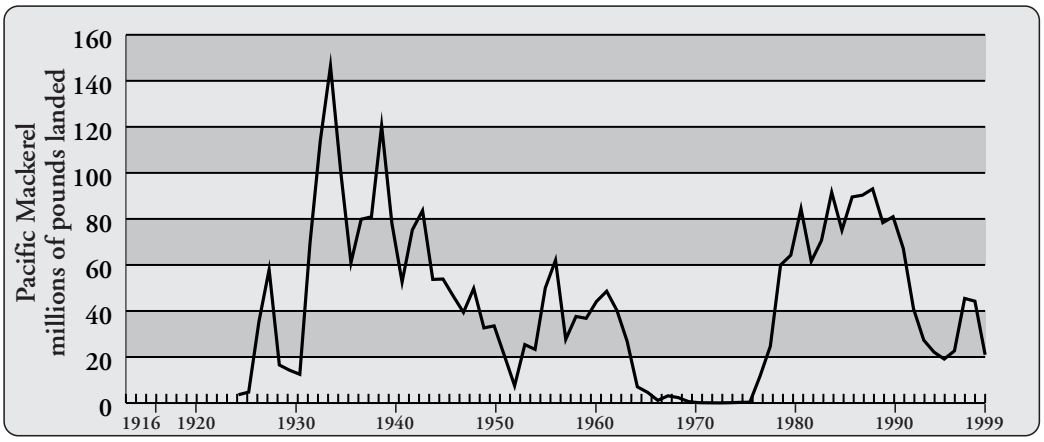
The largest recorded Pacific mackerel was 24.8 inches and weighed 6.4 pounds, although commercially harvested Pacific mackerel seldom exceed 16 inches and two pounds. Growth is believed to be density-dependent, as fish reach much higher weights-at-age when the population size is small. The oldest recorded age, determined by otolith reading, was 12 years, but most Pacific mackerel in the commercial catch are less than four years old. Some Pacific mackerel mature as one-year olds, although most are not sexually mature until age two or three. Pacific mackerel become available to the commercial fishery in their first year of life and are not fully recruited to the fishery until age four. However, substantial numbers of younger fish are taken by the commercial fishery and make up the bulk of the catch.

Recruitment of Pacific mackerel is variable and loosely linked to the size of the spawning biomass. Reproductive success is somewhat cyclical, with periods of roughly three to seven years. The annual rate of natural mortality is thought to be approximately 40 percent in the absence of fishing.

There are three spawning stocks in the northeastern Pacific – one in the Gulf of California, one near Cape San Lucas, and one along the Pacific coast north of Punta Abreojos, Baja California. Spawning occurs from Eureka, California to Cape San Lucas, two to 200 miles offshore, and in the Gulf of California.

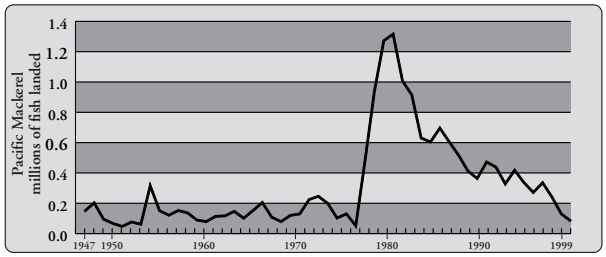
Off California, spawning occurs from late April to July at depths to 300 feet. Individual fish may spawn eight times or more per year and release at least 68,000 eggs per spawning. Off Baja California, spawning occurs from June through October.

Pacific mackerel larvae eat copepods and each other. Larvae normally begin to feed within 50 hours of hatching. Juvenile and adult Pacific mackerel feed primarily on small fishes, fish larvae, squid, and pelagic crustaceans such as euphausiids.



Commercial Landings 1916-1999, Pacific Mackerel
Data Source: DFG Catch Bulletins and commercial landing receipts. Pacific mackerel were aggregated as unclassified mackerel prior to 1926.

Pacific mackerel larvae are subject to predation from a number of invertebrate and vertebrate planktivores. Juvenile and adults are eaten by larger fishes, marine mammals, and seabirds. Pacific mackerel school as a defense against predation, often with other pelagic species, including jack mackerel and Pacific sardine. Principal predators include porpoises, California sea lions, brown pelicans, striped marlin, black marlin, sailfish, bluefin tuna, white seabass, yellowtail, giant sea bass, and various sharks.



Recreational Catch 1947-1999, Pacific Mackerel
Data source: DFG commercial passenger fishing vessel (CPFV) logbooks

Status of the Population

Historical estimates of Pacific mackerel biomass along the Pacific Coast indicate a decline in total biomass from 1932 until 1952. After a brief resurgence, the population reached a peak in 1962, then declined to less than 10,000 tons by 1966, and remained low until the late 1970s.

A series of successful year classes beginning in 1976 brought about a resurgence, and the age one-plus biomass peaked in 1982, at over one million tons. Since then, it has precipitously declined. Recent stock assessments indicate that biomass in the late 1990s was approximately 120,000 tons. Information derived from deposits of Pacific mackerel scales on the sea floor indicates that the prolonged period of high biomass during the late 1970s and 1980s was an unusual event that might be expected to occur about once every 60 years.

It is estimated that the maximum long-term yield of Pacific mackerel might be 29,000 to 32,000 tons under management systems similar to that in current use. It is difficult to assess the effects on the catch of recent warm temperatures, possible changes in availability of young fish, and the deteriorating markets. However, it is unlikely that the recent high harvest levels can be sustained.

Eddy S. Konno and **Patricia Wolf**
California Department of Fish and Game

Revised by:
Darrin R. Bergen
California Department of Fish and Game

References

Fitch, J.E. 1952. The decline of the Pacific mackerel fishery. Calif. Fish and Game. 38:381-389.

Hill, K.T., M. Yaremko, and L.D. Jacobson. 1999. Status of the pacific mackerel resource and fishery in 1998. Calif. Dept. Fish and Game Marine Region Admin. Rep. 99-3. 57p.

Hill, K.T. and D. R. Bergen. 2000. Stock assessment and management recommendations for Pacific mackerel (*Scomber japonicus*) in 2000. Calif. Dept. Fish. Game Marine Region Admin. Rept. 00-XX. In prep.

Klingbeil, R.A. 1983. Pacific mackerel: a resurgent resource and fishery of the California Current. Calif. Coop. Oceanic Fish. Invest. Rep. 24:35-45.

MacCall. A.D., R.A. Klingbeil, and R.D. Methot. 1985. Recent increased abundance and potential productivity of Pacific mackerel (*Scomber japonicus*). Calif. Coop. Oceanic Fish. Invest. Rep. 26:119-129.

Parrish, R.H. and A.D. MacCall. 1978. Climate variation and exploitation in the Pacific mackerel fishery. Calif. Dept. Fish Game, Fish Bull. 167. 110 p.