Pacific Bonito

History of the Fishery

The Pacific bonito (*Sarda chiliensis*) is an economically important commercial species from Magdalena Bay in southern Baja California, Mexico to Point Conception, California, and in most years is ranked as one of the top 15 species sought by recreational fishermen in southern California.

As a result of the expansion of the commercial passenger fishing vessel (CPFV) industry after World War II, Pacific bonito catches by CPFVs increased from 36,500 in 1947 to over one million fish in 1960. Most of these fish were caught between Malibu Beach and the Coronado Islands. CPFV logbook landings of bonito remained high during the 1960s, with more than one million fish taken in 1964, 1968, and 1969. However, in the 1970s and 1980s, CPFV landings dropped and then stabilized with decadal averages for the 1970s and 1980s at 313,200 and 372,700 fish, respectively. In the 1990s, the number of fish taken by CPFVs dropped again. Logbook landings ranged between 2,880 and 263,000 fish with a decadal average of 101,700. The 1999 landings were the lowest annual catch on record and the decadal average the lowest since the 1940s.

During the 1980s, more then one-half of the bonito catch was made from private boats as this method of angling became increasingly popular. A similar trend was observed in the 1990s with private boats landing between 33 percent and 57 percent of the recreational catch. Private boat landings in the 1990s ranged between 1,200 and 128,400 fish with a decadal average of 49,600. This was significantly lower than the 1980s decadal average of 560,000 fish.

Recreational catches can be impacted by the availability of other desirable species. In the 1980s and 1990s, highly desirable species such as yellowfin tuna, bluefin tuna, and albacore occasionally were available in large numbers. The reductions in recreational landings of bonito can be attributed in part to a shift in targeted effort from bonito to these more desirable species.

Changes in regulations can also impact recreational catches. In 1982, a 24-inch size limit was imposed on bonito. Part of the reduction in sport landings after 1982 was probably due to this size restriction, but the impact of this regulation was probably limited because of a five fish tolerance for undersized bonito that was included with the size restriction.

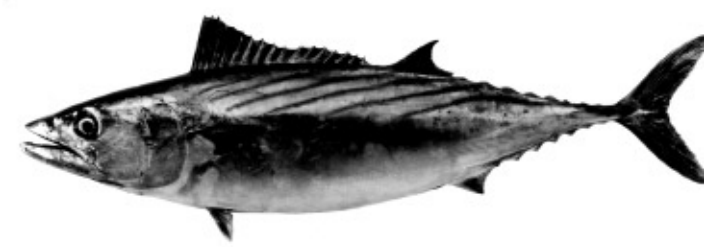
The bulk of the recreational catch consists of one-year bonito approximately 18 inches long. During fall and spring migrations, larger two-year fish become available to anglers. About five to 10 percent of the landings consist of fish larger then 24 inches.

Pacific bonito is well known for its fighting ability and quality as a food fish. Bonito can be caught recreationally with live anchovies and sardines or by casting or trolling with metal lures and feather jigs. Off California, recreational anglers typically catch bonito year round south of Point Conception with the highest catches in summer. North of Point Conception, recreational anglers usually take bonito during the fall months.

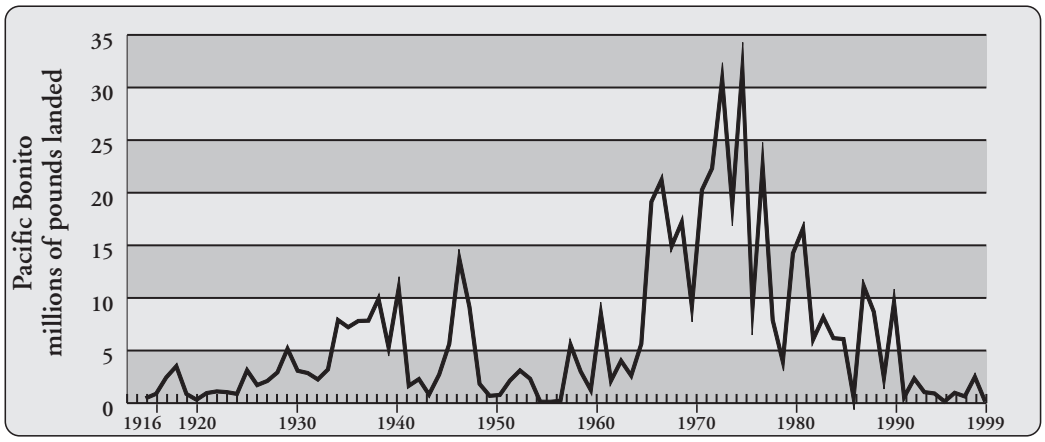
Bonito are taken commercially by troll gear, gillnets, and pole and line gear, but the landings of fish caught by these methods usually average less then two percent of the total catch. The primary commercial fishing gear for bonito is the purse seine. The purse seine fleet consists of two general groups: the local "wetfish" vessels with fish load capacities of 30 to 100 tons, and the larger tuna seiners capable of carrying 150 to 500 tons. Wetfish boats harvest mackerel and sardines, but seasonally target bonito, squid, and bluefin tuna. Nearly all of these wetfish seiners are based in San Pedro and fish in the Santa Barbara and San Pedro Channels. The large tuna seiners, now all but absent from California, operate primarily in the tropical waters off Mexico and Central and South America. Although the primary target for these seiners is yellowfin tuna, these vessels take bonito during their return trips to the United States to help compensate for small tuna catches.

Off California, commercial fishing for bonito occurs year round south of Point Conception with the largest catches in late summer and early fall. North of Point Conception, commercial fishing for bonito occurs primarily in the summer and fall.

Over the last 80 years, commercial landings of bonito have ranged between 127,600 pounds (1956) and 31.9 million pounds (1975). During the first half of the twentieth century, landings of bonito gradually increased from about 500,000 pounds in 1916 to around 10.9 million pounds in 1941. Landings briefly peaked again after World War II, but dropped during the 1950s and early 1960s. Landings then showed a major upward trend from the mid-1960s through the mid-1970s, increasing more than four-fold between 1965 and 1975. Starting in the late 1970s, this trend reversed with landings dropping in the 1980s to a decadal



Pacific Bonito, *Sarda chiliensis*
Credit: DFG



Commercial Landings 1916-1999, Pacific Bonito
Data Source: DFG Catch Bulletins and commercial landing receipts.

average of eight million pounds (compared to 9.7 million pounds for the 1960s and 17.7 million pounds for the 1970s). In the 1990s, landings for this fish ranged between 157,000 and 9.58 million pounds with a decadal average of 1.9 million pounds. This average was higher than that observed in the 1950s (1.8 million pounds) but lower than those from the previous three decades.

In the 1990s, bonito's ranking among the other commercial species also dropped. By total weight, bonito ranked among the top 20 species landed by California fisheries for most of the 1980s. In contrast, during the 1990s, this fish ranked among the top 20 species only in 1990 and 1998.

The amount of bonito landed is impacted by its availability, the availability of other desirable species, market demand, and price. Off of California, the availability of bonito can vary considerably between seasons and years. Some of this variation can be attributed to the migratory movements of these fish and some to oceanic changes. For instance, during El Niño events, more of the stock may move northward, becoming more available to California fisheries, while during La Niña events, fewer fish may move into California waters.

The availability of bonito also can be impacted by fishing restrictions. During the years from 1943 to 1958 and 1975 to 1978, at least 50 percent, and often more than 90 percent, of the landed bonito were taken off Baja California, Mexico. During the last two decades, Mexico has restricted access to foreign vessels fishing in its nearshore waters and California landings originating from Mexico have declined to less than 10 percent of the total landings.

In addition, the availability of bonito in California waters can be impacted by the amount of fish taken by the commercial fishery in Mexican waters. Mexican commercial landings of bonito over the last several decades show sharp periodic increases in the take of this fish. This pattern suggests that the Mexican commercial fishery for bonito is a pulse fishery. When bonito become more abundant, either from a gradual increase in the population or from the recruitment of a strong year class, then some of the commercial fishing effort in Mexican waters shifts to this species. The resource is harvested until the fish are no longer abundant. Effort then is redirected to other species until such time as the bonito resource becomes abundant again.

The availability of other desirable species can have a profound impact on the landings of bonito. Lower availability of other more desirable species due to environmental changes or management changes can increase the amount of bonito landed. For instance, bonito were targeted during seasonal yellowfin tuna closures in the 1970s because an incidental take of the more valuable yellowfin tuna was allowed while fishing for bonito. On the other hand, high availability of more desirable species can reduce the amount of bonito landed. This was likely the case in the 1980s and 1990s when a number of more desirable species including yellowfin tuna, skipjack tuna, albacore tuna, and bluefin tuna were at times quite abundant. In 1986, for example, high availability of bluefin tuna with a value of $1,550 per ton resulted in the wetfish seiners shifting their effort toward that species; as a result, bonito landings in 1986 dropped to a low of 533,000 pounds.

Market demand for bonito has been low over the last two decades. Commercial bonito landings are primarily purchased by canneries that process bonito for human consumption with the offal utilized for pet food or for reduction to fishmeal. Cannery orders for this fish in recent years have been limited. Higher demand exists for yellowfin tuna, skipjack tuna, albacore, and bluefin tuna for human consumption; for Pacific mackerel and jack mackerel as pet food; and for northern anchovy as fishmeal. Bonito also are sold fresh or frozen or are processed by curing or smoking. The market for this product

is currently small, but is growing due to the changes in California's demographics.

Prices for bonito have generally showed an upward trend over time. Between the 1960s and early 1980s, the price of bonito increased from $50 to $90 per ton to $550 per ton. The price then declined to $200 to $300 per ton in the mid-1980s but increased again in the 1990s to an average of $990 per ton. While the 1990s average price is the highest reported for bonito, it is still lower than that paid for desirable fish such as bluefin tuna which usually sells for four to five times the price of bonito.

Status of Biological Knowledge

Pacific bonito is a rapidly growing piscivorous fish. In one year this fish can reach roughly 20 inches in fork length, and weigh about four pounds. At two years of age, bonito average roughly 25 inches in fork length and weigh about eight pounds. Their growth slows in the latter half of life with the fish reaching 32 to 35 inches and 17 to 22 pounds at six years. The California angling record is a 22-pound fish caught off Malibu Beach in 1978, but larger fish are occasionally reported.

Swimming is continuous to maintain orientation and respiration, and is powered by richly oxygenated red muscle tissues near the tail. As the fish grow, the proportion of red muscle tissue increases; hence, larger fish become relatively more powerful swimmers. At a continuous-maintenance swimming speed, aquarium-held fish averaging 22 inches in length swim as much as 43 miles daily.

Bonito is a temperate epipelagic schooling fish with a discontinuous distribution in the eastern Pacific Ocean. It ranges from Chile to the Gulf of Alaska, but is absent from the central coast of Mexico south to Panama. The northern population typically is centered between southern California and central Baja California, but this distribution can shift northward during warm-water years. This species migrates approximately 600 miles along the United States - Mexico coastline, moving southward from southern California in the winter and northward from Baja California in the summer. This migration probably is a response to changing sea temperatures since these fish appear to be impacted by local variations in sea temperature. Individuals tagged and released within warm-water discharges from electrical generating stations have been recaptured near their release site up to three years later. These tagging studies suggest that some bonito do not move southward in the winter and instead overwinter in the Southern California Bight.

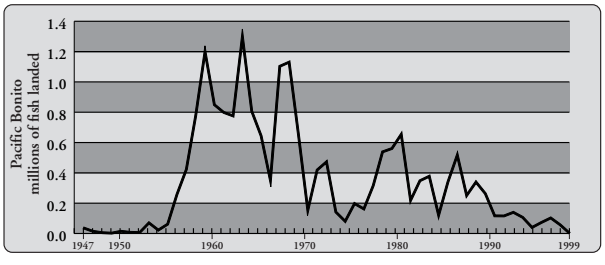
There is no external anatomical differences between the sexes. However, behavioral and visual cues can be used to distinguish males from females. During courtship of bonito observed in an aquarium, females swim with a wobble while males use color barring on their bodies to show their interest and aggressive nature. This aggressive vertical barring coloration in males has also been observed in aquarium-held bonito at feeding time. During courtship, males will follow directly behind the displaying female, jockeying for position. The successful male and female then pair and synchronize the release of gametes at the onset of a tight circle swim. Gametes are broadcast into the seawater where fertilization takes place.

Sexual maturity differs between males and females. Pacific bonito females begin to mature at two years of age and are fully mature at 24 inches. Males are more precocious. About 44 percent of the one-year males spawn, and all are mature at two years of age or 20 inches in length. Spawning begins in January and continues for a five-month period. Peak spawning occurs off central Baja California, but may take place in southern California late in the season or during El Niño episodes. Some localized spawning may also take place near warm-water discharges from electrical generating stations. Individuals may spawn more than once during a season. A 6.6-pound female releases an estimated 0.5 million eggs in one season.

Bonito consume prey equaling about six percent of their body weight per day. Northern anchovies are common prey, but market squid, highly vulnerable to predation while spawning, sometimes become a major part of the diet. Pacific sardines may also be a significant food source.

Status of the Population

Warm water conditions in the 1980s and 1990s may have provided good conditions for bonito survival, but large catches have been sporadic and the trends in both commercial and recreational landings continue downwards. This downward trend may be due in part to a shift in targeted effort from bonito to other more desirable species and to low market demand. It also may be due to changes in the distribution and migration of this northern population in response to oceanographic changes that have taken place over the last two decades. However,



Recreational Catch 1947-1999, Pacific Bonito

CPFV = commercial passenger fishing vessel (party boat); Recreational catch as reported by CPFV logbooks, logbooks not reported prior to 1947.

this downward trend may well be due to a decline in stock abundance. If this is the case, then current fishing practices may make it difficult for this stock to rebuild.

Management Considerations

See the Management Considerations Appendix A for further information.

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