

## 9 Pacific Bonito, *Sarda chiliensis*



Pacific bonito, *Sarda chiliensis lineolata*. Photo credit: Daniel W. Gotshall.

### History of the Fishery

Pacific bonito, *Sarda chiliensis lineolata*, is a component of the commercial purse seine fishery as well as a popular recreational species in southern California. Commercial landings of Pacific bonito have declined steadily since the mid 1980s, but have increased moderately in recent years, from 320 short tons (291 metric tons) in 1997 to 885 short tons (803 metric tons) in 2008 (Figure 9-1). There was a significant increase in landings in 2006 when 2740 short tons (2486 metric tons) were caught by the commercial fishery, but that was an anomaly and not part of the overall trend of recent years. After over 2 decades of low landings, the size of the fleet has decreased from 72 vessels to 59. This smaller fleet is landing fewer loads that are considerably bigger. In 2003, 19 vessels made 38 landings with a CPUE of 0.07 short tons per trip (0.06 metric tons per trip) (Figure 9-1). By 2008, the number of vessels increased to 69 and made 153 landings with a CPUE of 5.8 short tons per trip (5.3 metric tons per trip). The average of the 6 preceding years (1997-2002) was 51 vessels with a CPUE of 1.6 short tons per trip (1.4 metric tons per trip).

The trend over the last 15 years seems to be low landings for most years interspersed with high yield years. Competition with higher valued fisheries was likely part of the decline in landings during the 1980s and 1990s. Increased regulations, decreased stocks and market demand likely contributed to the decline. In 1982, Mexico began restricting foreign vessel access to its nearshore fisheries. Prior to this closure, 50-90 percent of Pacific bonito landed in the United States was caught off the coast of Baja California, Mexico. Now less than 10 percent originates in Mexican waters. Other causes of the fluctuations in landings likely include long term environmental variations in seasonal and local water temperatures, changes in ocean currents and water masses from year to year, strength of recruiting year classes of both predator and prey populations, local availability of prey, effects of pollution on spawning and variable fishing pressure throughout the species' range.

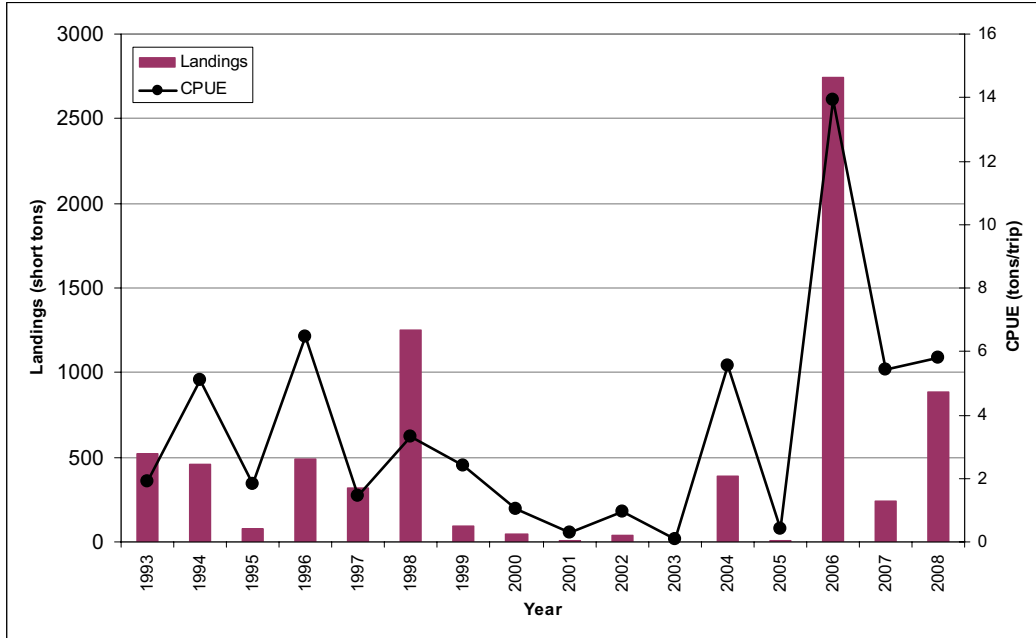


Figure 9-1. Pacific bonito commercial landings and catch-per-unit-effort (CPUE), 1993-2008. Data source: CFIS data, all gear types combined.

Regardless of the reason, lower densities of Pacific bonito in southern California mean that the purse seine fleet will target this species only when large schools are found near the coastline. As a result, the number of vessels landing Pacific bonito can vary dramatically from year to year. The general trend has been a decline from a high of 131 vessels in 1998 to 13 vessels in 2005. The average over the last 15 years is 46 vessels landing Pacific bonito annually. Most of these vessels are not targeting Pacific bonito, but are catching bonito incidental to the target species. In the last three years, 90 percent of the commercial landings have been incidental to other fisheries, and fewer than 10 percent of the vessels active in the fishery each year land over 95 percent of the annual landings.

Pacific bonito is a popular recreational species in southern California, when available. Pacific bonito is a favorite among anglers because they are usually found within 15-20 miles (24-32 kilometers) of the coastline, they fight hard when hooked and are an excellent food fish.

In 1947, the commercial passenger fishing vessel (CPFV) fleet landed only 36,500 fish. After World War II the CPFV industry expanded and the annual landings of Pacific bonito increased to 2.1 million fish in 1961 and reached a peak of 4.6 million fish in 1966. In 1971, CPFV landings dropped to less than 200,000 fish from 1.1 million in 1969. Landings remained low during the 1970s, yielding 100,000 to 650,000 fish annually. The 1980s and 1990s saw another decline with a low of 3300 fish in 1999 (Figure 9-2). Along with reduced catches in the 1990s, the number of anglers and CPUE also declined (Figure 9-3).

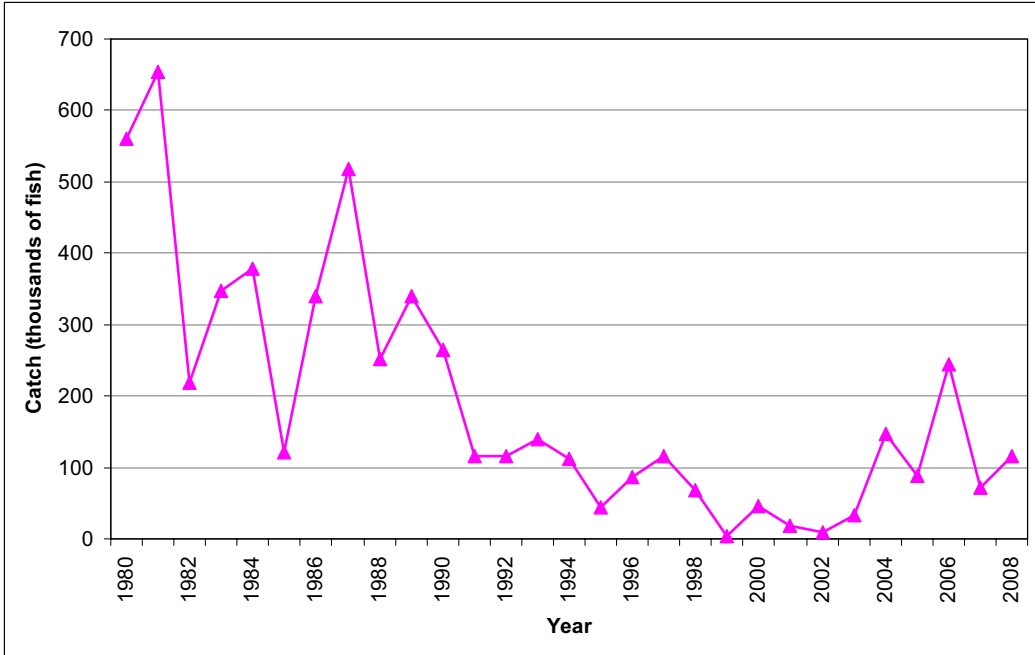


Figure 9-2. Pacific bonito commercial passenger fishing vessel (CPFV) catch, 1980-2008. Data source: CPFV logbook data.

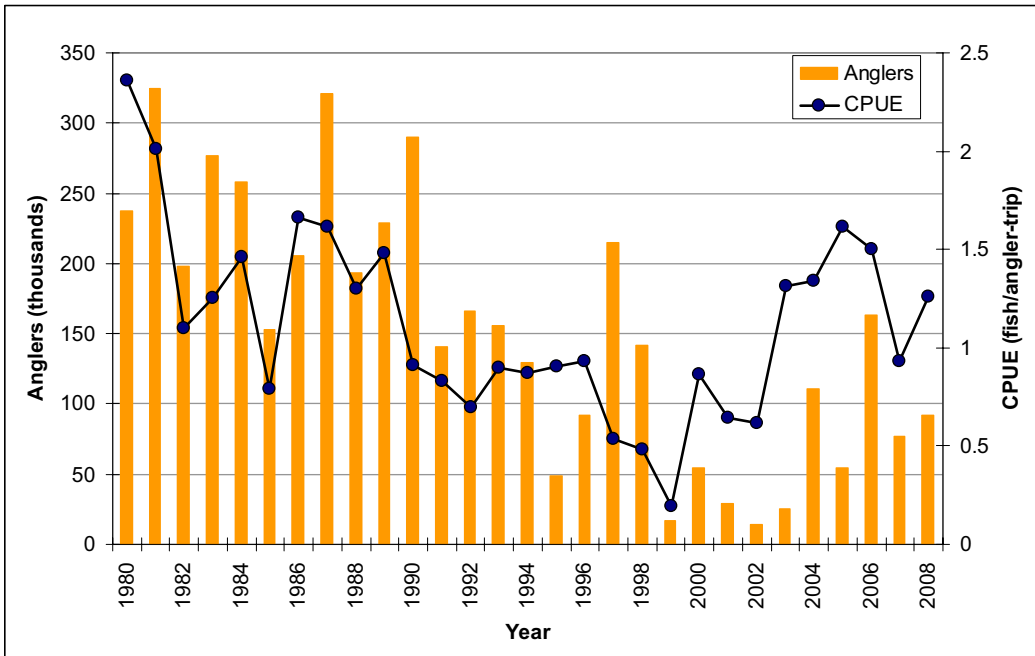


Figure 9-3. Pacific bonito recreational commercial passenger fishing vessel (CPFV) catch-per-unit-effort (CPUE), 1980-2008. Data Source: CPFV logbook data.

There are two different recreational sampling programs: the Marine Recreational Fisheries Statistical Survey (MRFSS) which sampled from 1980 to 2003 and the California Recreational Fisheries Survey (CRFS) which was initiated by the California Department of Fish and Game in 2004. Due to changes in the sampling protocol and how the data are used to estimate catch these two surveys are not comparable.

Recreational catch of Pacific bonito was much higher in the 1980s compared to the 1990s (Figure 9-4) and is likely due to lack of abundance in local waters rather than a reduction in recreational anglers. This trend has continued through 2008 (Figure 9-5). Both MRFSS and CRFS data indicate that Pacific bonito are taken primarily by boat modes (Figures 9-4 and 9-5), with occasional catches from the shore modes, primarily piers and jetties.

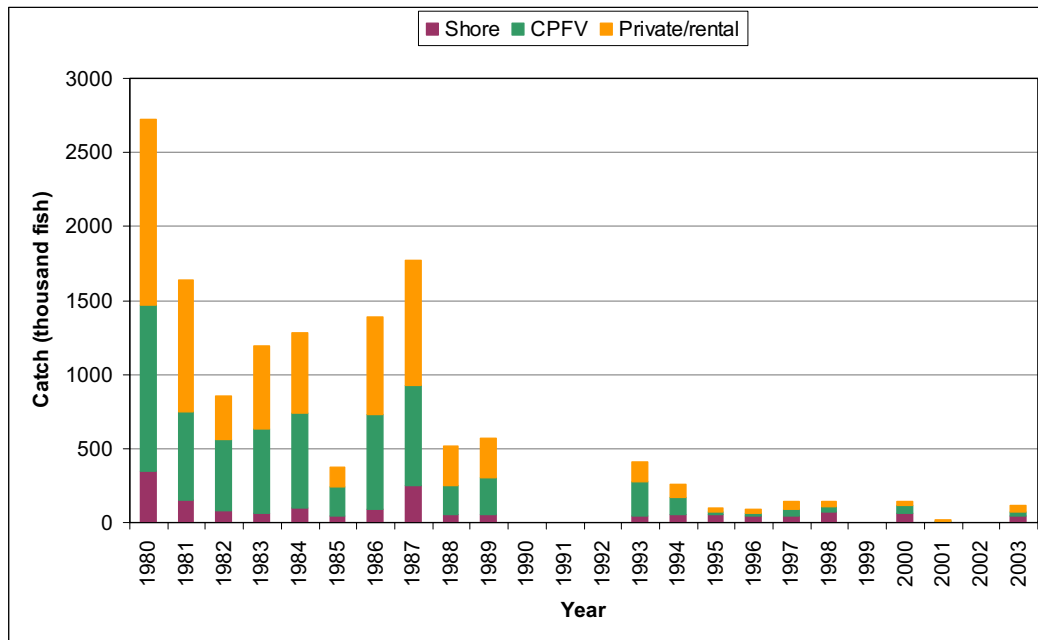


Figure 9-4. Pacific bonito recreational catch by fishing mode, 1980-2003. Data source: MRFSS data, all gear types combined. Data for 1990-1992 is not available. CPFV data not available for central and northern California for 1993-1995.

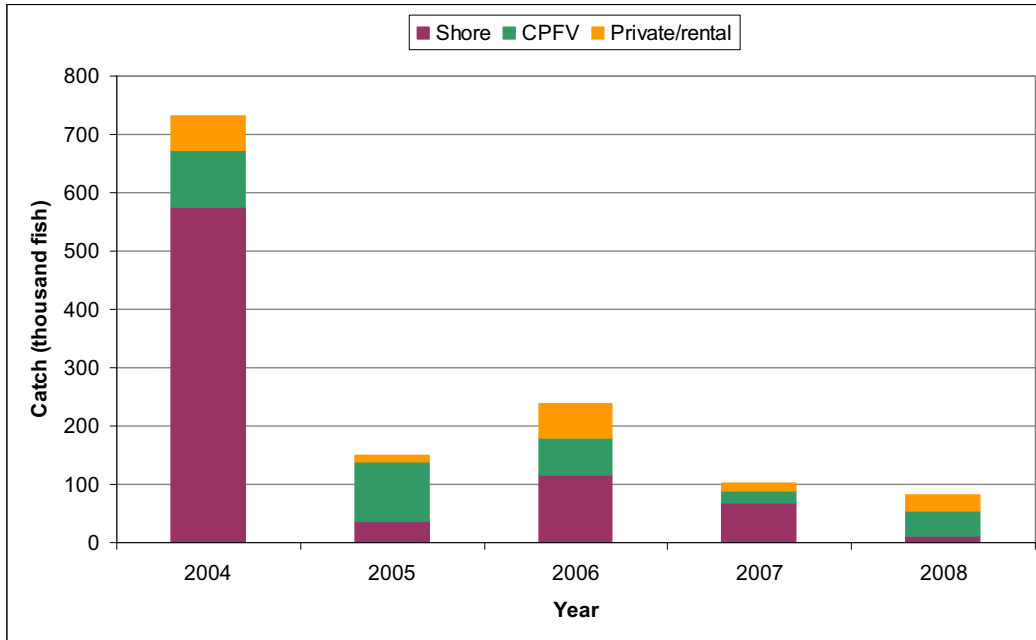


Figure 9-5. Pacific bonito recreational catch by mode, 2004-2008. Data source: CRFS data, all gear types combined.

### Status of Biological Knowledge

Pacific bonito are found in the eastern Pacific and are divided into two geographically distinct populations. The California fishery targets the northern sub-species, *Sarda chiliensis lineolata*, which ranges from the Gulf of Alaska to Revillagigedo Island, Mexico [located 240 miles (386 kilometers) southwest of the southern tip of Baja California, Mexico]. This population is centered between southern California and central Baja California, Mexico and moves farther north in warm water years. The southern sub-species, *Sarda chiliensis chiliensis* (Peruvian), is found off the western coast of South America from Colombia to Chile. A different species of bonito is found from the central coast of Mexico to Panama. The separate *S. chiliensis* populations are not different sub-species, but they do have significant physical differences and they are not known to interbreed.

Pacific bonito are a temperate epipelagic schooling fish. They can migrate up to 600 miles (966 kilometers) along the west coast of North America over the continental shelf (to a depth of 120 feet; 37 meters), moving south in the winter and north in the summer. Individuals tagged off Baja California, Mexico have been caught in Santa Barbara. They are most abundant within 15 miles (24 kilometers) of the coast, but can be found several hundred miles out to sea. They are usually caught by California fishers within 50 miles (80 kilometers) of shore in association with kelp beds, around islands and the mainland.

Pacific bonito populations fluctuate on a decadal scale in a similar manner as northern anchovy. These fluctuations are usually associated with warm and cold water

periods of the Pacific Decadal Oscillation. Current conditions indicate that the eastern Pacific is in a warm water regime that favors Pacific sardine over northern anchovy. Northern anchovy is a primary prey species for Pacific bonito.

Pacific bonito are associated with temperate water which may impact migration patterns and localized movements. The presence of warm water effluents at power plants in the Southern California Bight have led to year round resident populations that do not migrate to Mexico in the winter months. Tagged fish that are released into these outflows have been recaptured near the release site 3 years later.

Pacific bonito consume approximately 6 percent of their body weight per day. Prey items include northern anchovy and other small forage fish, market squid, euphausiids and others crustaceans and amphipods. Usually fishes are the primary prey items with cephalopods being the next most frequent, but this may change during El Niño events. A California Cooperative Oceanic Fisheries Investigation cruise during the 1983 El Niño event sampled the stomach contents of 41 troll caught Pacific bonito. The composition of the stomach contents was fish and euphausiids. It is speculated that during an El Niño event cephalopods were not available as a prominent prey species.

Pacific bonito are a short lived (less than 6 years), rapid growing species. They can reach 20 inches (51 centimeters) fork length and 4 pounds (1.8 kilograms) in the first year. The average two year old is 25 inches (64 centimeters) and 8 pounds (3.6 kilograms). Six year olds can measure 32-40 inches (81-102 centimeters), though specimens over 36 inches (91 centimeters) and weighing 17-22 pounds (7-10 kilograms) are rare. Males can mature and spawn at one year and 20 inches (51 centimeters). Females are oviparous and will usually spawn more than once per season. A few females will spawn at two years old, but most are at least 27 inches (69 centimeters) long and three years old at first spawning. Most spawning activity occurs within a 3 to 5 month period, being the longest off Baja California, Mexico near the center of their range. Males are ready to spawn before females, who limit the duration of the spawning season. Older fish (greater than three years old) are ready to spawn earlier in the season than younger fish.

The sexes cannot be distinguished using external anatomy, but behavior and coloration during mating is distinct. In aquarium observations spawning females exhibited a unique swim pattern. During courtship males follow directly behind the female fighting for position. They convey interest and an aggressive nature by displaying strong vertical color barring, which is also displayed at feeding time. The successful male and female synchronize their swimming in tight circles while releasing gametes into the seawater where they are fertilized.

### **Status of the Population**

Warm water conditions in the 1980s and 1990s may have affected the availability of the primary prey species (northern anchovy) of Pacific bonito as evidenced by the sporadic catches. Commercial and recreational landings have trended downwards.

This downward trend may be due in part to a shift in effort to more desirable species. It may also be due to changes in distribution and migration of this northern population in response to oceanographic changes that have taken place over the last two decades. Pacific bonito along with other coastal pelagic species (e.g., northern anchovy, Pacific sardine) have natural population fluctuations in response to decadal oceanographic conditions. Additionally, little is known about the take of Pacific bonito off of Baja California, Mexico.

## Management Considerations

Pacific bonito is included in the federal Highly Migratory Species Fishery Management Plan as a “monitored species”, that means it is not actively managed. Currently, only California statutes and regulations apply to the take of this species. If there is an increase in the take of Pacific bonito, its status could be changed to actively managed. It is legal to target Pacific bonito commercially and recreationally year round.

After the last population assessment in 1982, a minimum size limit of 24 inches (61 centimeters) or 5 pounds (2.3 kilograms) was instituted for both commercial and recreational fisheries. In the recreational fishery there is a 10 fish bag limit and up to 5 undersized fish can be retained (Title 14, CCR, §28.32). Commercial vessels fishing with round haul gear (e.g., purse seine, lampara net) may retain 18 percent or less by number of undersized fish (FGC §8377). When using gill or trammel nets, only 1000 pounds (454 kilograms) or less of undersized Pacific bonito may be retained (FGC §8377).

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## Further Reading

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<b>Pacific bonito commercial landings, 1993-2008.</b>			
<b>Year</b>	<b>Pounds</b>	<b>Year</b>	<b>Pounds</b>
<b>1993</b>	1,047,606	<b>2001</b>	13,005
<b>1994</b>	921,160	<b>2002</b>	73,444
<b>1995</b>	157,439	<b>2003</b>	5,410
<b>1996</b>	980,471	<b>2004</b>	780,209
<b>1997</b>	641,598	<b>2005</b>	23,020
<b>1998</b>	2,495,167	<b>2006</b>	5,481,546
<b>1999</b>	191,269	<b>2007</b>	488,454
<b>2000</b>	96,192	<b>2008</b>	1,770,431

Data Source: CFIS data, all gear types combined.



<b>Pacific bonito recreational catch, 1980-1993.</b>					
<b>Year</b>	<b>Number of fish</b>	<b>Year</b>	<b>Number of fish</b>	<b>Year</b>	<b>Number of fish</b>
1980	2,721,871	1986	1,384,682	1992	---
1981	1,638,915	1987	1,775,189	1993	405,153
1982	850,613	1988	514,623	1994	258,994
1983	1,192,613	1989	569,797	1995	94,509
1984	1,282,954	1990	---	1996	92,087
1985	370,127	1991	---	1997	144,442
				1998	138,592
				1999	1,929
				2000	145,283
				2001	15,201
				2002	3,116
				2003	114,824

Data Source: MRFSS data, all fishing modes and gear types combined. Data not available for 1990-1992. CPFV data not available for central and northern California for 1993-1995.

<b>Pacific bonito recreational catch, 2004-2008.</b>	
<b>Year</b>	<b>Number of fish</b>
2004	732,473
2005	149,580
2006	237,643
2007	101,882
2008	80,883

Data Source: CRFS data, all fishing modes and gear types combined.

<b>Pacific bonito CPFV catch, 1980-2008.</b>					
<b>Year</b>	<b>Number of fish</b>	<b>Year</b>	<b>Number of fish</b>	<b>Year</b>	<b>Number of fish</b>
1980	560,508	1990	265,263	2000	46,820
1981	654,051	1991	116,491	2001	18,970
1982	218,469	1992	115,972	2002	8,880
1983	348,050	1993	139,569	2003	32,942
1984	377,678	1994	112,329	2004	147,890
1985	120,637	1995	44,489	2005	87,990
1986	340,480	1996	85,583	2006	244,179
1987	518,159	1997	115,543	2007	71,615
1988	251,536	1998	68,460	2008	117,896
1989	339,382	1999	3,301		

Data source: CPFV logbook data.