

**THE STATUS OF
THE PACIFIC BONITO RESOURCE
AND ITS MANAGEMENT**



by

Brian D. Thayer

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ABSTRACT

Pacific bonito, *Sarda chiliensis*, have been fished in California waters since at least the beginning of this century. Commercial landings between 1916 and 1971 varied widely, with a low of 128,000 lbs in 1956 and a high of 21.2 million lbs in 1967 (Table 1). The catch is partly dependent upon availability, but it is strongly influenced by economic factors.

The size and condition of the resource is unknown at present although it appears that the catch could be substantially increased without damage to the resource.

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HISTORY OF THE FISHERY

Commercial Fishery

Pacific bonito, *Sarda chiliensis*, have been fished in California waters since at least the beginning of this century. Commercial landings between 1916 and 1971 varied widely, with a low of 128,000 lbs in 1956 and a high of 21.2 million lbs in 1967 (Table 1). The catch is partly dependent upon availability, but it is strongly influenced by economic factors.

The demand for bonito was limited for many of the years between 1916 and 1965, although it has been relatively high since 1966. Small quantities are delivered to the fresh fish market, but the bulk of the catch goes to canneries.

The bulk of the commercial bonito catch is usually taken in California waters within 12 miles of shore. But during a few years over 50% of the total catch has been taken off Baja California. The Baja California catch is generally made between January and August each year.

Bonito are caught by several types of gear. In "local" waters an appreciable tonnage is caught by trolling while a smaller amount is taken by gill net and lampara net. In recent years, the largest amount of bonito has been caught by smaller purse seiners fishing in waters off northern Baja California and southern California.

Bonito are landed in ports from Eureka to San Diego, however, only the bonito landed at the canneries on Terminal Island are routinely sampled. Approximately 40 samples per year are taken from boats accounting

for about 30% of the total landings. The length and weight of each fish in the sample is recorded. In addition, otoliths and vertebra are collected for age and growth studies, and gonads are saved for fecundity studies.

Recreational Fishery

At times bonito are chief contributors to the southern California marine sport catch. In a 1968 survey, southern California partyboat landing operators as a group, ranked bonito as the fourth most important species to their industry (Young 1969). During recent years, bonito have been abundant inshore.

The sport fishery has shown tremendous growth since 1947. For the 7 years following World War II, the partyboat catch of bonito was relatively low, only once exceeding 15,000 fish. During the next 3 years catches improved considerably, averaging about 50,000 fish per year. With the advent of the warm water years (1957 to 1960), the catch began to climb, reaching almost 1.2 million fish in 1960. The catches did not decline, however, as water temperatures cooled in the years from 1961 to 1969 (Figure 1).

The sport catch of bonito is generally confined to southern California waters, although some are caught north of Point Conception. The heaviest partyboat catch is usually made during August and September from La Jolla to Redondo Beach. The catch declines through October and November and is generally at a low level for the rest of the year. Bonito are occasionally caught in fair numbers by partyboat and pier and jetty fishermen during the winter months, especially around warm water outfalls along the coast. This provides considerable recreation when most fishing is at a low ebb.

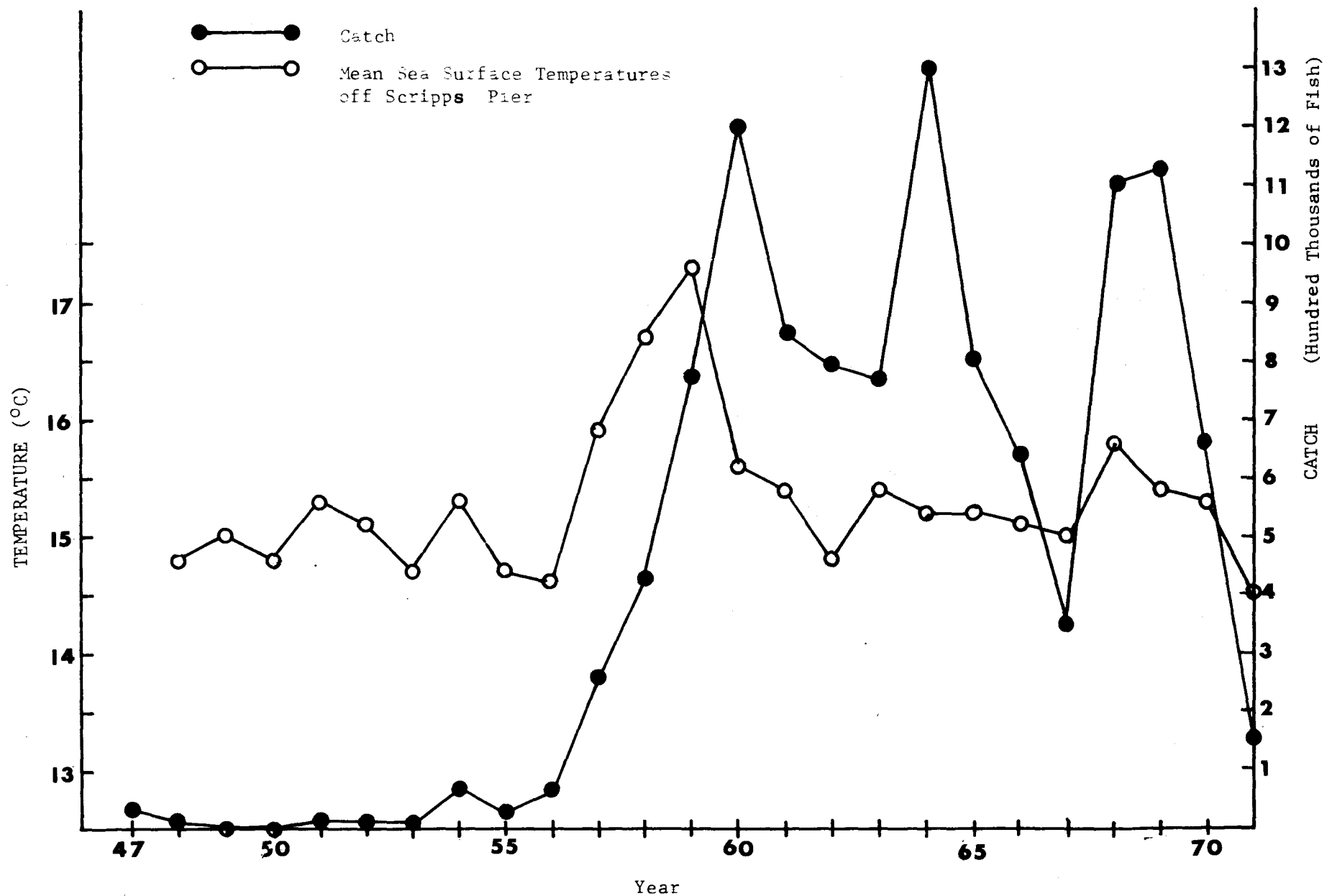


FIGURE 1. Bonito Partyboat Catch vs Mean Sea Surface Temperatures off Scripps Pier.

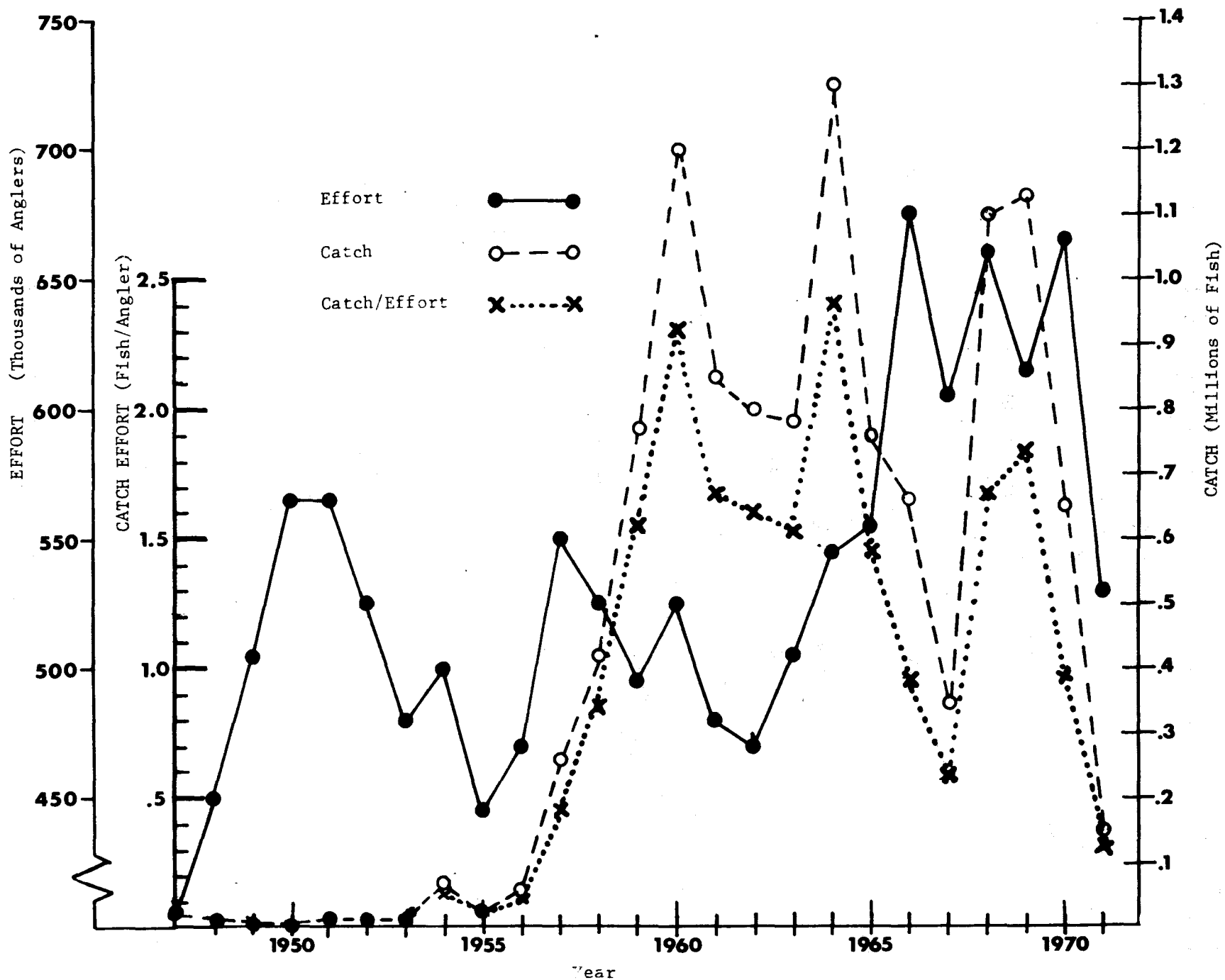


FIGURE 2. Southern California Partyboat Catch, Effort, and Catch per Effort of Pacific Bonito 1947-1971.

The average annual southern California (Pt. Conception to San Diego) partyboat catch for the period from 1947 to 1956 was 24,107 fish, while the average catch from 1957 to 1971 was 746,797. The average annual catch per angler for these two periods increased from 0.05 to 1.33 (Figure 2). The catch per angler curve indicates that the increased catch from 1957 on was not simply a function of increased effort, but reflected change in abundance or availability in California waters.

A survey conducted during the period of 1964-1966 made estimates of the catch and effort of the fishermen from piers and jetties, private boats and shoreline from Point Conception to the Mexican Border (Pinkas, Oliphant and Haugen, 1968). The figures show that partyboat fishermen are, as a group, far more successful in capturing bonito than fishermen in other segments of the sportfishery (Table 2).

The contribution of marine sportfishing barges to the total sport-catch was calculated as 21.2% of the reported partyboat catch, based on data collected in 1966 and 1970. The estimated number of sport-caught fish is presented in Table 3, along with calculated numbers of fish caught by the commercial fishery. The data show that in some years sportcatch compared favorably with the commercial catch (in numbers of fish) (Table 3). More than 2,000 bonito were measured aboard partyboats in 1972, both as part of a sampling program and during tagging operations.

The partyboat catch for 1972 was estimated to consist of over 99% fish 2 years old or younger, while the commercial fishery consists of over 92% (by number) fish 3 years and older.

These differences seem to be a function of both behavior and economics. Small bonito are very susceptible to sport capture methods, while the larger bonito are generally less susceptible. The price to the fishermen has usually been dependent on the size of the bonito landed and cannery demand has caused purse seine fishermen to seek the larger bonito.

BIOLOGICAL DATA

Range

Pacific bonito is a pelagic schooling fish found in temperate waters over the Continental Shelf. They have been recorded in the North Pacific Ocean as far north as Alaska and as far south as Banderas Bay, Mexico, but they are abundant only from Point Conception to Magdalena Bay.

Some investigators believe that the bonito off South America may belong to a different species than those off California. Presently, both are given the specific name *chiliensis*. In any case, they appear to be separate populations since they are over 3,000 miles apart and another bonito, *Sarda velox*, occupies the coastal waters between them. It appears that the bonito off the coast of California and Mexico belong to one population. The situation is currently under investigation through electrophoretic analysis of proteins.

Reproduction

Very little is known about bonito reproduction. They appear to spawn off southern California and Baja California between January and May. This is based on observations of eggs and larvae (Klawe, 1961; Pinkas, 1961) and gonadal condition. A fecundity study by the Department of Fish and Game has recently been initiated to study bonito spawning patterns.

Size, Age and Growth

A study of bonito age and growth utilizing otoliths and vertebrae is currently being conducted. The ages of the larger fish are difficult to determine.

Fish 6 to 10 inches long are observed in the early summer, and by the following spring the fish, now 1 year old, are 10 to 15 inches in length and weigh 1 to 2 lbs. These fish will weigh 3 lbs or more by fall, and by the following May will weigh 5 to 6 lbs. The next year these

three-year-olds will weigh 10 to 12 lbs and be about 25 inches long. There is a verified report of bonito 40 inches in length weighing 25 lbs, and an unverified report of a 37 lb fish (Bell, 1960).

Migration

In 1968 a tagging project was initiated to study the movements and growth rates of bonito. Since 1968 over 11,200 bonito have been tagged and released along the coast from Monterey Bay, California to Cape San Lazaro, Baja California. Over 770 tags have been recovered from sport and commercial fisheries. These have provided information about bonito movements and have confirmed short-term growth rate estimates. Fish appear to move randomly in local waters, although there is a definite movement down the southern California coast during the winter months.

The majority of tags came from fish that had traveled less than twenty miles. A large proportion have been recovered by pier and jetty fishermen which indicates that the jetty contribution of this segment of the fishery to the bonito sport catch may be higher now than when the sportfishing survey was done in 1963.

Several bonito tagged off Baja California in June were recaptured by purse seiners near Santa Barbara 4 to 6 months later. Bonito tagged near Santa Barbara have been recovered a year and a half later off Baja California. Bonito that traveled long distances moved from Mexico to local waters in the summer months and back again in the winter.

Only two bonito have been recovered more than 2 years after tagging. Both were recovered within 1 mile of the release point at King Harbor, Redondo Beach.

Mortality

Mortality and survival rates are difficult to determine for bonito as neither the sport nor commercial fishery exploits all size groups with

any consistency. The calculation of exploitation rates will have to await the availability of catch and effort data from all segments of the fisheries.

Food Habits

One study revealed that the northern anchovy, *Engraulis mordax*, was the major food item in the diet of Pacific bonito. Common squid, *Loligo opalescens*, forms an important part of the bonito diet from January through June. Miscellaneous fish, such as sardines, and a few crustaceans make up a small portion of the diet (Oliphant, 1971).

REGULATION AND MANAGEMENT

Currently, there are no laws regulating the catch of bonito, other than a possession limit of 10 for sportfishermen and incidental gear restrictions placed on commercial fishermen. There is no evidence at present indicating that the Pacific bonito stock off our coast is in anything but a healthy condition. The fishery should be carefully monitored, however, to detect changes in stock size which may result from increased fishing pressure.

DISCUSSION

Our sampling program for both the sport and commercial fisheries should be expanded. A great deal of additional work should be done to gather catch and effort data for all fisheries affecting bonito, especially for fishing from private boats, piers and jetties and the Mexican sport and commercial fisheries. Also, much work remains to be done to determine the relationship of various physical and biological factors to bonito abundance. The evidence indicates that there has been a tremendous change in bonito abundance or availability off California in the last decade. The reasons for this are as yet unexplained.

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TABLE 1. Yearly Landings in Pounds - Pacific Bonito

Year	California waters	South of state	Total pounds
1916	465,691	14,715	480,406
1917	889,376		889,376
1918	2,265,047	176,667	2,441,714
1919	2,908,745	600,353	3,509,098
1920	672,393	201,255	873,648
1921	241,859	82,878	324,737
1922	894,292	63,650	957,942
1923	478,771	636,476	1,115,247
1924	843,095	202,187	1,045,282
1925	782,868	96,298	879,166
1926	2,942,906	178,698	3,121,604
1927	1,121,476	596,532	1,718,008
1928	1,336,719	770,370	2,107,089
1929	593,886	2,324,658	2,918,544
1930	3,866,496	1,297,764	5,164,260
1931	3,014,135	65,538	3,079,673
1932	1,676,487	1,185,799	2,862,286
1933	1,967,244	284,955	2,252,199
1934	3,003,048	199,646	3,202,694
1935	2,263,740	5,632,744	7,896,484
1936	2,216,679	4,999,237	7,215,916
1937	5,707,212	2,100,858	7,808,070
1938	4,684,570	3,155,423	7,839,993
1939	6,697,249	3,221,626	9,918,875
1940	3,553,121	1,738,019	5,291,140
1941	7,850,496	3,057,106	10,907,602
1942	860,833	789,856	1,650,689
1943	801,535	1,480,764	2,282,299
1944	326,175	492,696	818,871
1945	339,664	2,374,517	2,714,181
1946	582,948	5,042,700	5,625,648
1947	384,327	13,312,856	13,697,183
1948	214,992	8,920,134	9,135,126
1949	99,244	1,730,297	1,829,541
1950	33,456	662,158	695,614
1951	54,047	722,756	776,803
1952	7,504	2,135,013	2,142,517
1953	19,069	3,083,578	3,102,647
1954	218,701	2,100,359	2,319,060
1955	40,354	99,636	136,990
1956	22,491	105,123	127,614
1957	110,174	108,975	219,149
1958	4,804,784	742,022	5,546,806
1959	3,003,058	8,558	3,011,616
1960	1,219,682	30,862	1,250,544
1961	8,439,400	73,572	8,512,972
1962	2,071,998	62,904	2,134,902
1963	4,013,505	9,017	4,022,522
1964	2,606,411	5,558	2,612,269
1965	5,632,399	5,941	5,638,340
1966	18,308,175	840,319	19,148,494
1967	17,841,537	3,377,894	21,219,431
1968	14,903,357	18,572	14,921,929
1969	13,174,505	4,027,342	17,201,847
1970	8,793,788	398,516	9,192,304
1971	10,476,268	9,792,716	20,268,984

TABLE 2. Comparison of Sportfishing Catch and Effort.

Source	Year	Catch Nos.	Effort	Catch per hour
Pier & jetty	1963	283,068	5,100,100*	0.06
Partyboat	1963	773,036	2,480,054**	0.31
Private boat	1964	401,575	2,773,405*	0.14
Partyboat	1964	1,297,741	2,679,545**	0.48

* - Effort in man/hours

** - Effort in angler/hours

Partyboat figures are for southern California fleet only.

TABLE 3. Number of fish in the California bonito catch - 1947-1971.

Year	<u>Number of Fish</u>	
	Commercial	Sport
1947	1,409,873	69,488
1948	937,463	27,644
1949	191,598	10,228
1950	72,556	4,491
1951	82,167	27,561
1952	216,930	14,564
1953	314,705	12,035
1954	249,225	133,429
1955	16,601	42,667
1956	14,430	116,914
1957	29,671	492,289
1958	889,322	804,569
1959	509,857	1,477,462
1960	209,843	2,283,445
1961	1,437,839	1,616,458
1962	357,540	1,519,974
1963	681,166	1,438,134
1964	442,357	2,471,624
1965	955,244	1,534,450
1966	3,187,962	1,226,322
1967	3,365,190	665,959
1968	2,527,869	2,098,887
1969	2,639,769	2,150,849
1970	1,530,727	1,240,561
1971	2,766,522	290,769