

CALIFORNIA BARRACUDA LIFE HISTORY, FISHERIES, AND MANAGEMENT

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ABSTRACT

Despite efforts to manage it, the California barracuda, *Sphyræna argentea*, has markedly declined in abundance from levels exhibited prior to 1950. This paper presents a history of the California barracuda fisheries, a summary of the fish's life history and population dynamics, an evaluation of the resource under current management practices, and recommendations for improvements in current management.

Evaluation of the current status of the resource indicates its abundance off southern California is low but slowly improving, with a marked improvement in size composition. Management recommendations, when adopted, should help increase the rate of recovery.

RESUMEN

La abundancia de *Sphyræna argentea* (espetón o barracuda) ha venido disminuyendo desde antes de 1950, a pesar de los esfuerzos encaminados a regular la pesquería. En este trabajo se presenta la historia de la pesquería del espetón, un resumen de su ciclo de vida y dinámica de poblaciones, así como una evaluación de las reservas que existen, considerando las reglamentaciones actuales y las recomendaciones necesarias para mejorar las existencias.

La evaluación del estado actual de las poblaciones de *Sphyræna argentea* indica que escasean frente a la parte meridional de California, aunque van aumentando con lentitud, presentando una mejoría notable en la estructuración de las tallas. Las regulaciones que se recomiendan, una vez adoptadas, ayudarían a que las poblaciones incrementasen en notable cuantía.

LIFE HISTORY

The California barracuda (*Sphyræna argentea*) is the only member of the barracuda family found off the west coast of the United States; it also occurs along northern Baja California, Mexico.

The fish's reported range is Cape San Lucas, Baja California (Berdegue 1956), north to Prince William Sound, Alaska (Pinkas 1966); however, they are seldom observed north of Point Conception, California, except in years when ocean waters off California are exceptionally warm.

California barracuda are nearshore, pelagic-schooling predators, which feed upon a variety of smaller species including anchovies (*Engraulis mordax*), sardines (*Sardinops sagax caeruleus*), young Pacific mackerel (*Scomber japonicus*), young jack mackerel (*Trachurus symmetricus*), and grunion (*Leuresthes tenuis*). Market squid (*Loligo opalescens*) are eaten when offered as bait, but have not been observed in stomachs examined for food items. Barracuda, in turn, are known to be fed upon by giant sea bass (*Stereolepis gigas*), California sea lions (*Zalophus californianus*), harbor seals (*Phoca vitulina*), and porpoise (Frey 1971).

An annual northward migration of California barracuda along the northern Baja California and southern California coast during late spring and early summer has been well documented through tag-recapture investigations (Pinkas 1966). This northward movement coincides with seasonal warming of nearshore coastal waters. Good correlations between average sea-surface temperatures off southern California from January through June and the numbers of barracuda captured by sport fishermen aboard commercial passenger fishing vessels during the year indicate that the strength of migration also is related to temperature (Figure 1) (Pinkas 1966; Schultze 1981). An annual southward migration along the coast during late summer, fall, or early winter is not as apparent as the northward spring-summer migration. Judging from the diffused pattern of catches made from late summer to early winter, the southward return migration appears more prolonged and less coherent than the northward migration.

California barracuda reach a maximum size of about 120 cm (48 in) in total length, 7.3 kg (16 lb) in weight, and 12 + years of age. Specimens larger than 90 cm (35 in), 2.7 kg (6 lb), and 10 years of age, however, are now seldom seen in either commercial or sport catches. California barracuda grow rapidly during their first 4 years, reaching 65 to 70 cm in length; then growth slows to about 5 cm per year (Walford 1932). Younger fish tend to remain near shore, while older fish are more common over shallow banks farther from shore and at offshore islands.

California barracuda begin maturing during their second year of life (Walford 1932). Males typically

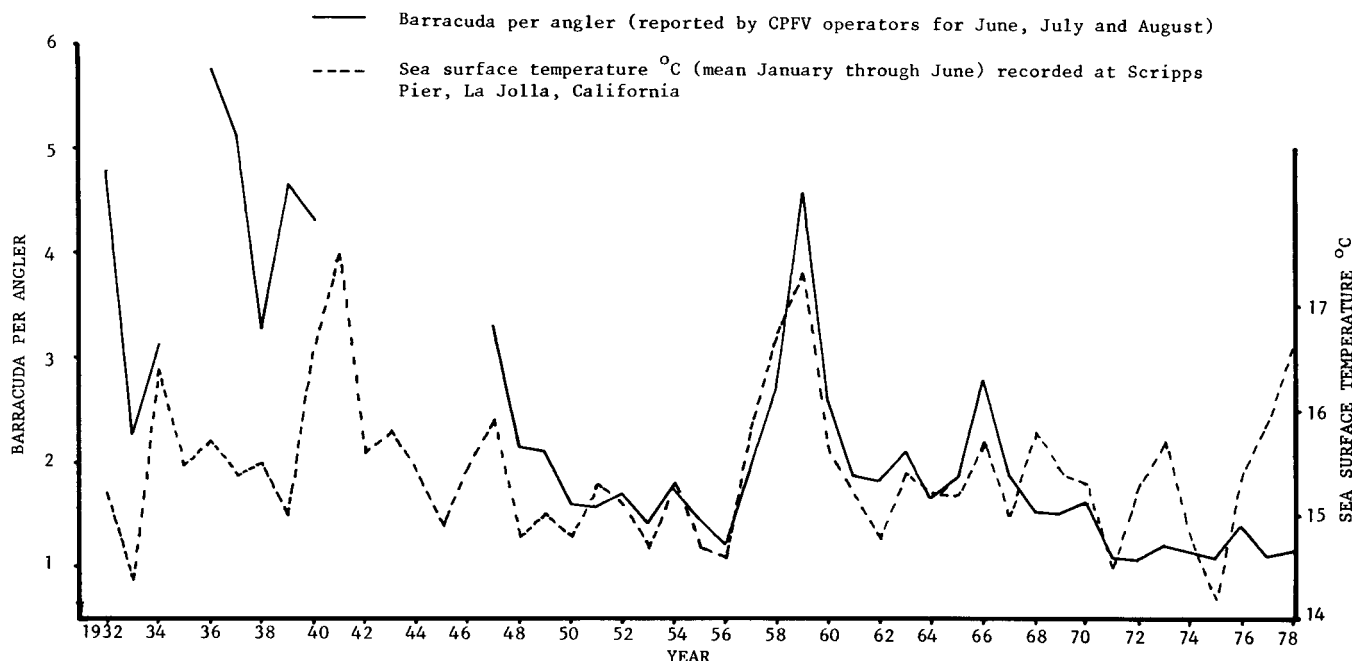


Figure 1. Reported barracuda per angler and sea-surface temperatures off southern California from 1932 through 1978.

mature earlier than females. Although 100% of the males are capable of spawning in their second year, only about 75% of the females are mature in their second year. All of the females are mature in the third year. Spawning occurs primarily during May, June, and July in nearshore waters of Baja California and southern California. Female barracuda, six to seven years of age, were estimated to produce between 300,000 and 400,000 mature eggs for one spawning, and spawning may occur more than once each season (Walford 1932).

FISHERIES

California barracuda are unusual among the world's species of barracuda in having supported relatively large commercial and sport fisheries. Demand for barracuda as a food fish was historically high, and interest in barracuda as a sport-angling species has traditionally been high. Despite a variety of regulations enacted over the years to conserve and manage this resource, landings by both commercial and sport fishermen have declined (Tables 1 and 2, Figures 2 and 3).

Commercial Fishery

The California commercial barracuda fishery began in the 1800s. The fishery developed rapidly following World War I with the introduction of purse seine vessels and the concurrent expansion and development of California fisheries for white seabass (*Atractoscion*

TABLE 1
Yearly Commercial Landings of California Barracuda in Metric Tons

Year	California waters	South of state	Total metric tons
1889	—	—	227
1890	—	—	232
1891	—	—	316
1892	—	—	148
1895	—	—	445
1899	—	—	541
1904	—	—	981
1908	—	—	1,455
1915	—	—	1,632
1916	1,011	209	1,220
1917	1,347	43	1,390
1918	1,765	432	2,197
1919	1,834	811	2,645
1920	2,082	1,642	3,724
1921	2,084	1,379	3,463
1922	2,144	694	2,838
1923	2,332	938	3,270
1924	2,150	1,087	3,237
1925	2,714	936	3,650
1926	1,337	944	2,281
1927	1,978	837	2,816
1928	1,991	939	2,930
1929	1,783	592	2,370
1930	1,596	567	2,163
1931	1,515	382	1,897
1932	1,138	191	1,329
1933	1,323	73	1,396
1934	818	173	991
1935	910	279	1,189

Continued on next page

TABLE 1 (continued)
 Yearly Commercial Landings of California Barracuda
 in Metric Tons

Year	California waters	South of state	Total metric tons
1936	1,021	331	1,352
1937	817	517	1,334
1938	573	576	1,149
1939	1,348	510	1,858
1940	1,156	531	1,687
1941	1,349	559	1,908
1942	1,019	550	1,569
1943	1,082	633	1,715
1944	1,052	605	1,657
1945	792	967	1,759
1946	744	667	1,411
1947	770	441	1,211
1948	500	465	965
1949	410	706	1,116
1950	404	621	1,026
1951	304	653	957
1952	340	612	951
1953	257	396	653
1954	221	489	710
1955	147	371	518
1956	23	319	342
1957	176	134	310
1958	342	74	416
1959	504	19	523
1960	521	37	558
1961	217	105	322
1962	237	102	339
1963	158	14	172
1964	114	38	152
1965	124	40	164
1966	106	39	145
1967	128	14	142
1968	52	12	64
1969	32	2	34
1970	10	1	11
1971	8	<1	8
1972	6	0	6
1973	17	0	17
1974	17	0	17
1975	27	.1	27
1976	74	.2	74
1977	34.8	.2	35
1978	22	.3	22
1979	16.5	.5	17
1980	Unavailable		
1981	30	0	30

nobilis), yellowtail (*Seriola lalandei*), Pacific mackerel (*Scomber japonicus*), and bluefin tuna (*Thunnus thynnus*) (Skogsberg 1925). Commercially landed barracuda have traditionally been landed fresh or on ice, and sold fresh.

TABLE 2
 Number of California Barracuda Reported Landed by
 Southern California Commercial Passenger Fishing Vessel
 Operators

Year	Barracuda
1936	595,062
1937	742,849
1938	374,109
1939	732,878
1940	704,520
1946	598,000*
1947	677,499
1948	383,757
1949	366,423
1950	242,380
1951	269,418
1952	336,562
1953	166,478
1954	281,049
1955	154,939
1956	87,218
1957	577,060
1958	782,226
1959	1,195,579
1960	755,360
1961	391,853
1962	335,507
1963	483,699
1964	303,070
1965	443,304
1966	892,697
1967	470,480
1968	372,246
1969	358,518
1970	373,801
1971	50,474
1972	38,243
1973	92,483
1974	55,284
1975	26,289
1976	107,557
1977	48,701
1978	73,174
1979	69,434
1980	27,909
1981	65,960*

*Figures incomplete

Peak annual commercial landings of over 3,700 MT were made in the 1920s. During this period, gill net and trolling vessels fished barracuda in California waters. Purse seine vessels pursued barracuda in late fall and winter off Baja California, as well as participating in the spring-summer fishery off California. This effectively represented a year-round commercial fishery for barracuda over much of its range. Seasonal exploitation of barracuda by different segments of the

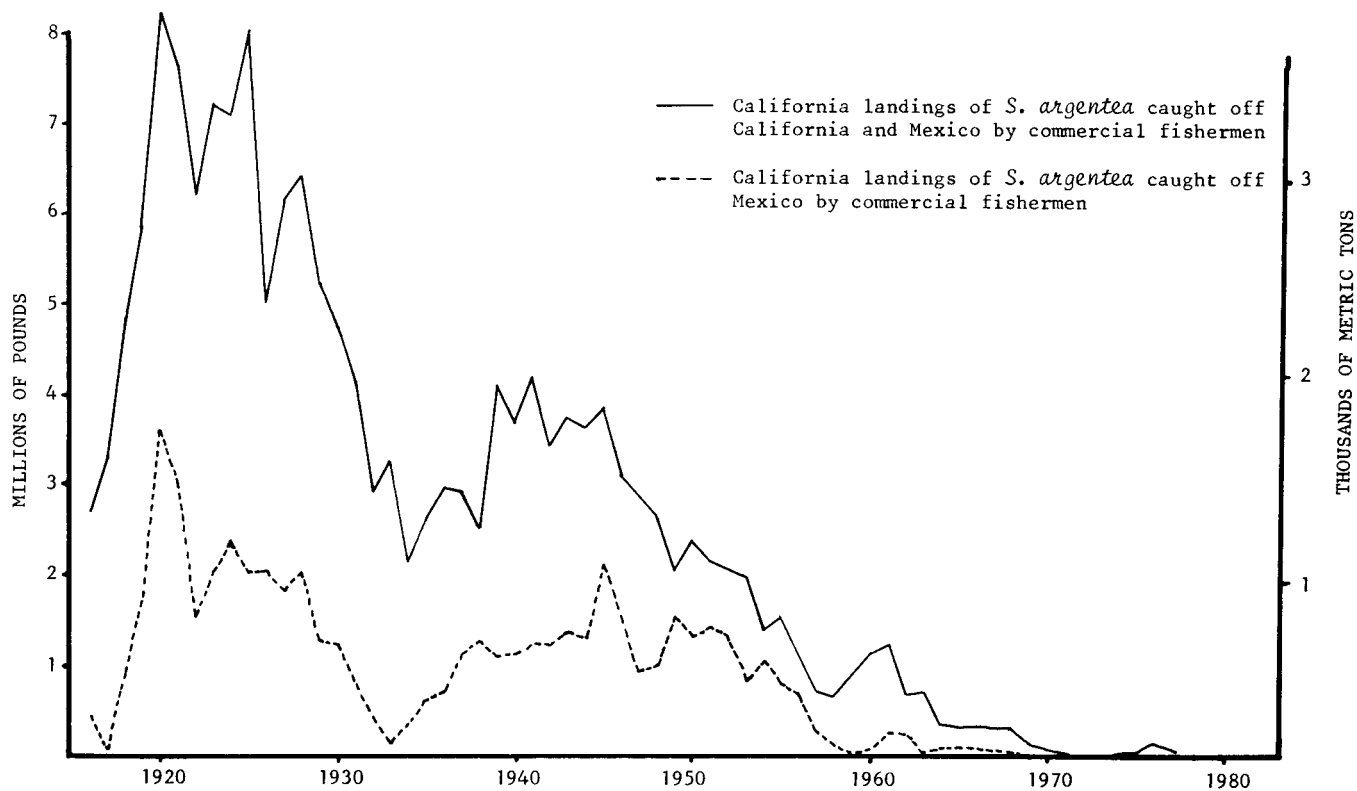


Figure 2. California commercial landings of California barracuda from California and Mexico, and just Mexico.

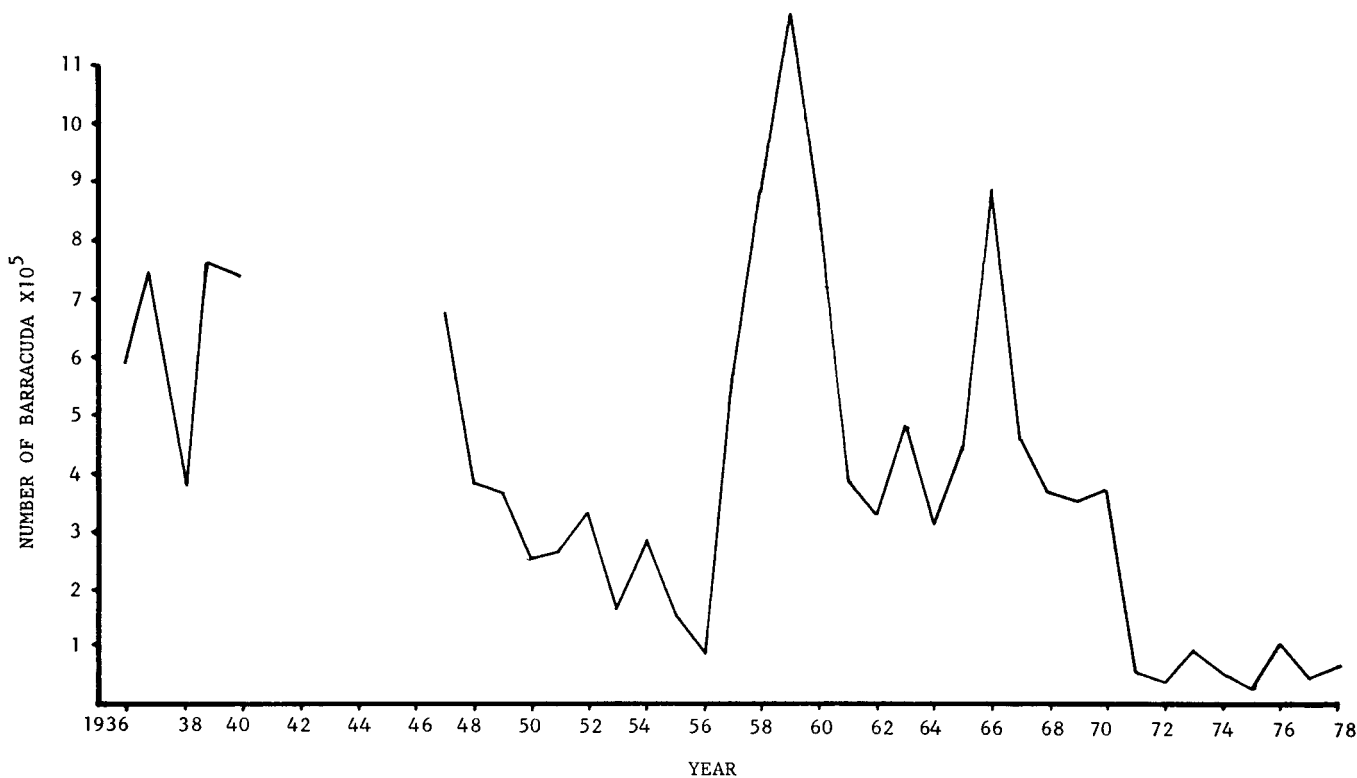


Figure 3. Landings of California barracuda reported by California commercial passenger fishing vessel operators.

commercial fishery off Mexico and southern California continued through the 1940s.

The decline in commercial landings noted during the 1930s is thought to have been primarily a result of (1) a decline in fishing pressure caused by new regulations, (2) the economic difficulties faced by the fishing industry during the depression years, and (3) a suspected but unconfirmed decline in barracuda stock abundance caused by intense exploitation (Janssen 1937; MacCall, et al. 1976). The increase in commercial landings of barracuda during the 1940s appears to have resulted from a combination of good local availability off southern California from 1939 through 1941 because of abnormally warm ocean waters off our coast and increased effort for barracuda as a result of the wartime demand for protein.

Commercial barracuda landings steadily declined following the Second World War. Barracuda appears to have lost some of its marketability following the war, and purse seine captains found it increasingly difficult to (1) locate schools of barracuda off Mexico, (2) obtain orders for barracuda, and (3) make profitable trips with rising operating costs and the moderate-to-low prices paid for barracuda. Purse seine fishing of barracuda off Mexico had virtually ceased by 1956 and has not revived since. A nine-year cooling trend of ocean waters off California from 1948 through 1956 reduced annual northward barracuda migrations, and landings by local gill net and troll fishermen declined as well. A moderate increase in commercial landings occurred during 1957-59, when exceptionally warm ocean waters off the west coasts of California and Mexico resulted in large numbers of barracuda migrating north into southern California coastal waters (Pinkas 1966). Landings by the local gill net fleet declined again during the 1960s, following a return to more normal ocean water temperatures.

The commercial fishery was nearly extinct by 1969, as gill net fishermen found it increasingly difficult to locate commercial quantities of legal-sized barracuda. Commercial landings during the 1970s and 1980s have been small and made almost entirely by a few gill net vessels fishing local waters during May and June. Although increases in the commercial pounds-per-landing of barracuda have occurred in recent years, the market demand for barracuda at this time is relatively low, and less incentive exists now than in past years to pursue barracuda commercially (Schultze 1981).

Sport Fishery

The sport fishery for California barracuda is made up of the partyboat or commercial passenger fishing vessel fleet (CPFVs), from which paying customers

fish for a fee; privately owned boats used for recreational fishing; and anglers fishing from piers, the shoreline, jetties, and breakwaters. By far the most important component of the sport fishery, and the one for which the greatest amount of historic information is available, is the CPFV fishery, which developed in the late 1920s and 1930s. The CPFV fleet was capturing roughly the same number of barracuda during the latter half of the 1930s as the commercial fishery was, or about 400,000 to 700,000 fish per year (Pinkas 1966). However, relatively greater numbers of young barracuda were landed by sport fishermen than by commercial fishermen. The sport fishery declined sharply during World War II, reducing fishing pressure on younger age groups for a period of about five years.

From 1946 through the present, the CPFV sport fishery has accounted for most of the barracuda being landed by both sport and commercial fisheries. The number of barracuda landed by CPFV anglers from 1948 through 1956 declined steadily to a low of 87,000 fish in 1956. With the warming of ocean waters off California from 1957 through 1959, landings of barracuda by CPFV anglers rebounded to record high levels. When ocean waters cooled to more average temperatures following 1959, landings declined to between 300,000 and 400,000 fish per year during the 1960s. By the late 1960s, however, it became apparent that catches were being sustained mainly by young barracuda less than 4 years of age (Schultze 1973). Heavy exploitation of young barracuda during these and previous years undoubtedly accelerated the decline in numbers, and by 1970 it became apparent that the population was seriously depleted.

Numbers of barracuda landed by CPFV anglers during the 1970s averaged less than 100,000 each year. This substantial decline from earlier 1960s CPFV landings is largely a result of a minimum size limit adopted in 1971. Many undersized barracuda are, therefore, returned to the water following capture and are not reported with the legal catch, thereby substantially reducing the reported landings during the 1970s.

MANAGEMENT EFFORTS

The principal regulatory measures undertaken to manage and conserve the California barracuda resource since the rapid expansion of the fishery in the post-World War I era are summarized in Table 3. The 1917 three-pound minimum size regulation on barracuda landed commercially corresponded closely with today's size limit of 28 inches (71.1 cm). However, this size limit, expressed in weight, proved impractical because of difficulty in estimating weights of fish aboard vessels at sea. Enforcement officers also ex-

TABLE 3
 Regulations

Year	Regulation
1915	No barracuda less than 18 inches may be bought or sold. Barracuda designated a game fish requiring a sport license to take.
1917	No barracuda less than 3 pounds may be bought or sold.
1927	Unlawful for purse seine or other roundhaul to take or possess barracuda from May 15 through July 31.
1932	Unlawful for purse seine or other roundhaul to take or possess barracuda from May 1 through July 31.
1934	No barracuda may be sold between May 1 and June 30. No more than 5 barracuda weighing less than 3 pounds each may be possessed each day; they are not to be sold or purchased.
1935	Barracuda not less than 3 pounds may be taken with hook and line. No nets may be used to take barracuda between May 1 and August 31. Between May 1 and August 31 a limit of 500 pounds of barracuda per man or 2,500 pounds per boat.
1939	Daily marine sport bag limit of 15 game fish in aggregate (no more than 15 barracuda if only barracuda caught).
1940	No purse seine or roundhaul may be used to take barracuda north of the international boundary with Mexico. Barracuda gill net mesh must be no less than 3½ inches stretched mesh.
1941	May not sell any sportfish taken under the authority of a sportfishing license. Repeal restriction on 500 pounds of barracuda per person and 2,500 pounds of barracuda per boat.
1947	Weight limit of 3 pounds changed to length limit of 28 inches for sport and commercial. Not more than 5 barracuda less than 28 inches per day in sport bag.
1949	Daily sport bag limit no more than 10 of one species and 15 in aggregate of species.
1957	No more than 2 barracuda shorter than 28 inches allowed in the daily bag limit. Daily bag limit of 10 game fish in aggregate.
1971	No barracuda less than 28 inches allowed in daily bag limit.

perienced difficulty in rapidly identifying sublegal-sized barracuda when moderate-to-large numbers of barracuda were landed. The three-pound limit was changed to 28 inches in 1947.

From 1925 through 1929, California Department of Fish and Game biologists conducted life-history studies on size and age at maturity, fecundity and length-weight relationship, and observed the fishery in an attempt to estimate what portion of the stock should be protected to conserve the resource and maintain landings under the intense fishing pressure of that time (Walford 1932). The observed size and age composition of barracuda in sampled commercial landings during the height of the 1920s commercial fishery was broad, encompassing fish from 2 through 12 years of age. Although large, older barracuda were abundant at that time, samples from the commercial fishery indicated that a large proportion of landings was composed of barracuda smaller than the allowable three-pound minimum (Walford 1932). Observations of

actual fishing practices also revealed that significant quantities of undersized barracuda were wasted when schools of 2-, 3-, and 4-year-old barracuda were captured (primarily by purse seiners but also by gill nets and lampara vessels) and then dumped overboard after discovery that they were undersized (Skogsberg 1925). Most of these discarded barracuda did not survive.

During the 1930s, regulations affecting the use of nets to take barracuda were changed at almost every session of the legislature, with emphasis on prohibiting netting of barracuda during the major spawning months of May and June. Controversy surrounding the excessive destructiveness of purse seines on barracuda raged until 1939, when purse seines were finally banned in state waters; however, their use in waters off Mexico was unregulated and continued until the mid-1950s. Under current California state law, barracuda captured in purse seines off Mexico may be landed in California.

Gill nets used to capture barracuda must, by law, have a minimum stretched mesh of 3½ inches (8.9 cm). This regulation was instituted in 1940, without full evaluation of its ability to protect barracuda less than 28 inches (71.1 cm) TL. Recent investigation suggests that a small increase in mesh size of one-quarter inch should substantially increase protection for barracuda shorter than 28 inches without affecting the legal take of barracuda.

Sport-fishing regulations pertaining to barracuda up until 1971 were permissive, at best. In June 1941 it became illegal to sell sport fish caught under authority of an angling license. A three-pound barracuda size limit until 1947, and a 28-inch size limit imposed after 1947 were liberally tempered by allowing each angler to keep an allowance of undersized barracuda in each daily bag limit. These regulations appear to have been largely ineffective in conserving the California barracuda resource because the allowance essentially cancelled the effectiveness of the size limit. The commercial barracuda fishery was virtually extinct by the late 1960s; sport fishermen were landing fewer and predominantly young barracuda. A 1966 Department of Fish and Game recommendation for a strict 28-inch (71 cm) size limit was finally enacted in 1971 and remains in effect today.

The major efforts at barracuda management since 1971 have centered upon monitoring the catches and population to assess the effects of this strict size limit upon the stock and the fisheries. Monitoring size composition of sport and commercial samples since 1971 has shown a progressive and sustained increase in the number of age classes available to fishermen (Figures 4, 5, and 6) (Schultze 1981; Wine 1979a, b, c, d, and

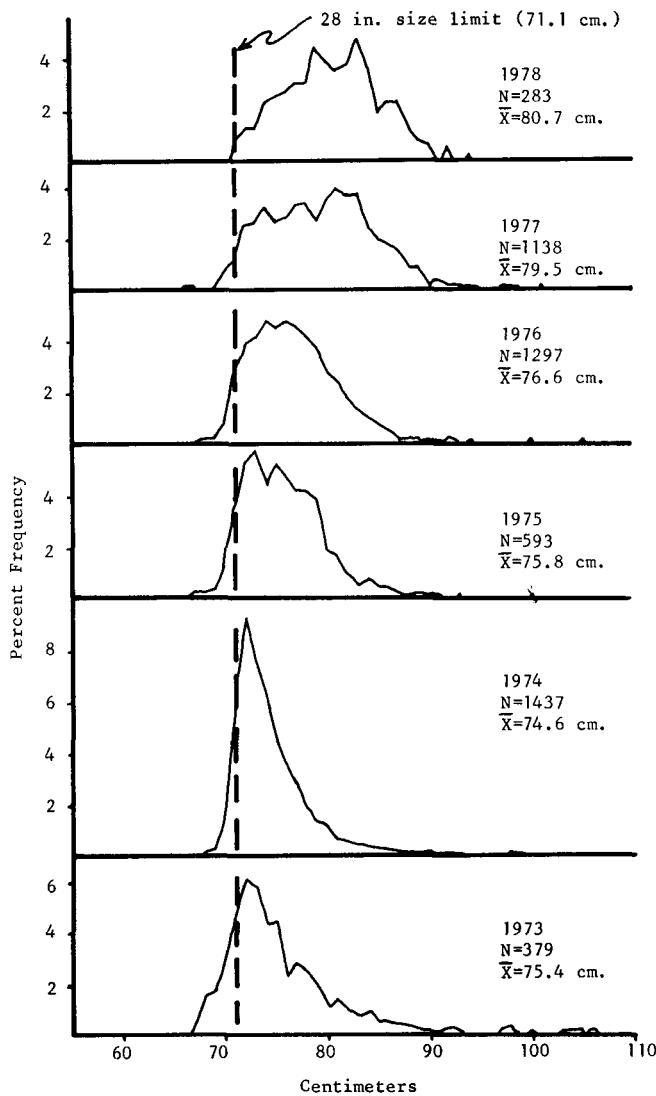


Figure 4. Size composition of commercial landings of California barracuda measured at the San Pedro fresh-fish markets.

pers. comm.). I assume this increase in availability of older fish has resulted from increased survival of barracuda due to reduced fishing mortality on young fish. The gradual reappearance of 7-, 8-, and 9-year-old barracuda in both sport and commercial catches, and their continued and relatively stable presence as components of these catches for five and six years is encouraging. This provides a broader and therefore more stable reservoir of spawning stock from which, presumably, larger year classes can be produced, given oceanographic conditions favorable to spawning and survival.

Identifying real increases in stock abundance (number of barracuda in the population each year) as a result of the strict 28-inch size regulation has been more difficult. As indicated above, there appears to have been some improvement in commercial catch per

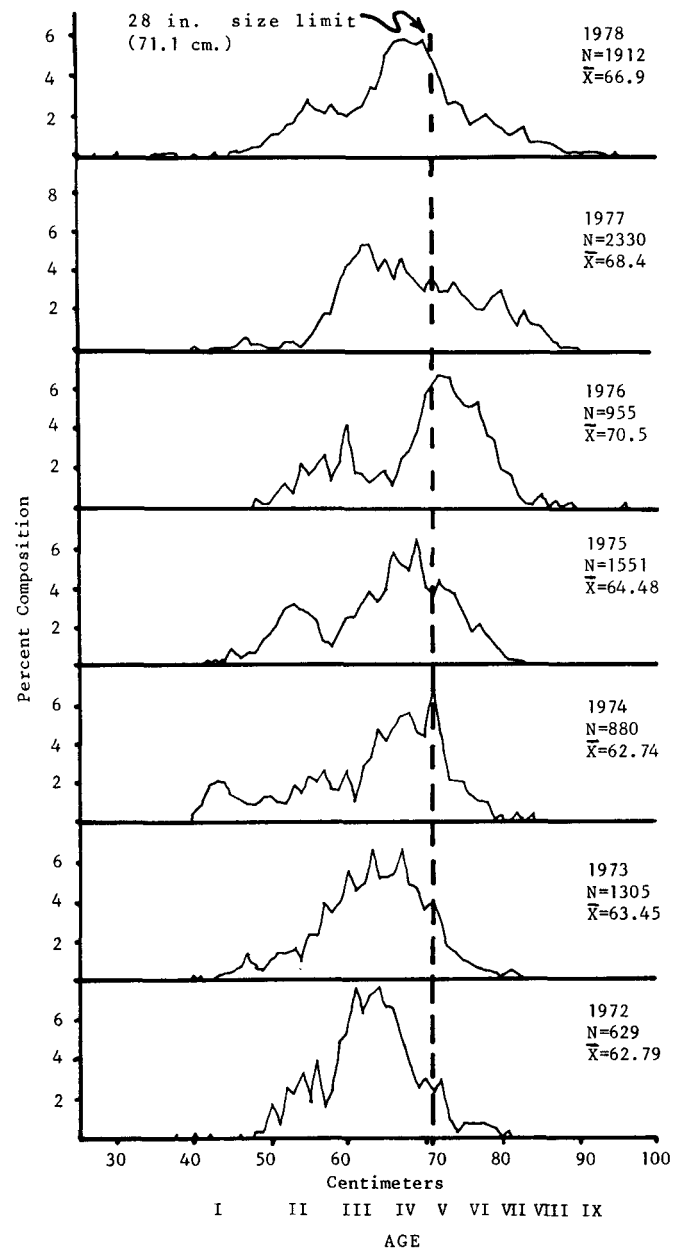


Figure 5. Size and age composition of California barracuda measured aboard southern California commercial passenger fishing vessels from 1972 through 1978. Sampled barracuda shorter than 28 inches were returned to the water.

unit of effort for the mid-1970s, yet numbers of sport fish being landed remain between 50,000 and 100,000 fish per year. One of the major difficulties in estimating changes in barracuda abundance is that we are collecting data on an unknown portion of the stock each year.

RECOMMENDATIONS

It is uncertain how long recovery of the stock might take. Management action should continue to concentrate on ensuring the maximum survival of barracuda

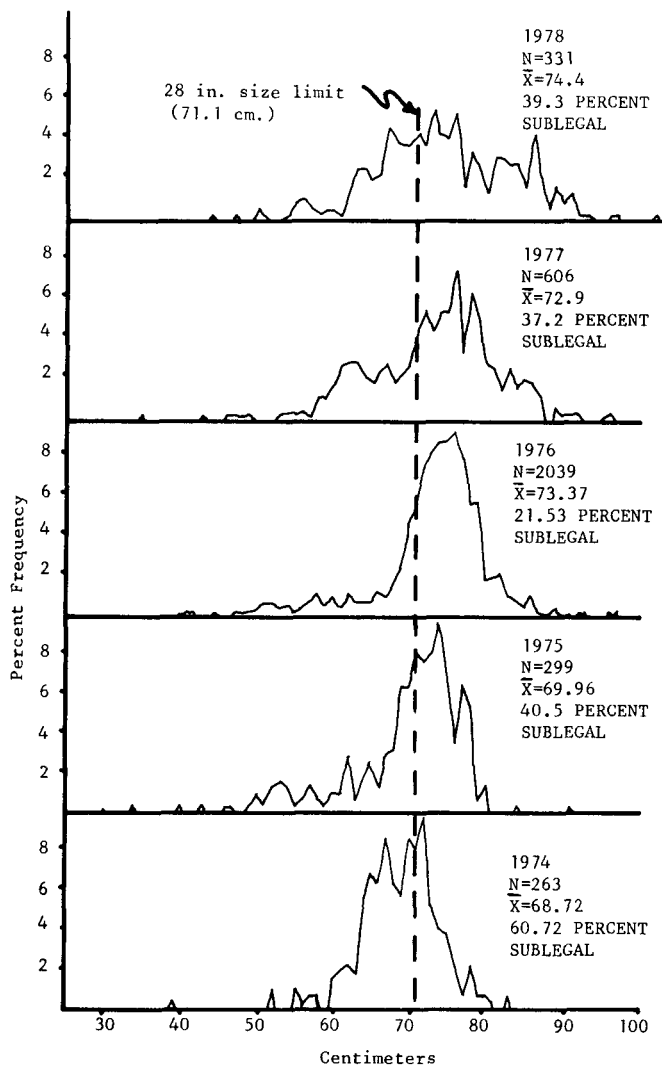


Figure 6. Size composition of California barracuda landed by southern California independent private boat fishermen. Sampled barracuda shorter than 28 inches (71.1 cm) total length were retained by these anglers.

through at least three spawning seasons. The present minimum size limit of 28 inches (71.1 cm) is believed necessary to increase the population and to maintain it at optimum levels under continued exploitation. Although the California barracuda resource shows signs of slow recovery since the late 1960s and early 1970s, there is no assurance that recovery will continue if there is an uncontrolled increase in exploitation.

I believe the following recommendations represent the most effective measures that can be implemented now to restore and maintain the California barracuda resource:

1. Maintaining, monitoring, and enforcing the existing 71.1-cm size limit is the foremost recommendation. Although strict compliance with this

regulation has not yet been fully achieved in California waters, observed compliance by CPFV anglers has been good. Skippers and crew members of these vessels are able to inform anglers of, and urge compliance with, fishing regulations, thereby improving the probability of compliance and increasing the effectiveness of the regulation.

Private boat anglers, on the other hand, appear unwilling to adhere to the regulations, or so the size composition of barracuda sampled from private boats reflects. Although private boat catches at this time make up a relatively small portion of barracuda landings (10-15% of total sport catch) continued noncompliance with the law will retard recovery of the fishery.

2. California barracuda should be considered in discussions with Mexico concerning cooperative management of marine resources. The California barracuda resource has historically proven itself vulnerable to overexploitation; although it appears that Mexico has applied relatively light commercial fishing pressure, its sport fishery claims large numbers of young, maturing barracuda each year. The barracuda stock could benefit substantially from a strict 28-inch size limit on all barracuda caught and landed in Mexico.

If the barracuda resource is to recover to a level of maximum sustainable harvest, then Mexico can be expected to play a key role in how effectively this resource is managed. Data pertinent to management should be made available to Mexico. Heavy fishing effort off Mexico would undoubtedly reduce the availability of barracuda off California. However, historical catch data indicate that if the stock is restored to, and maintained at, moderate-to-large size, successful and sustainable catches should be possible in both southern California and Baja California waters.

3. Allowable minimum gill net mesh size for barracuda should be increased to 3.75 inches. This would bring the size of barracuda caught in gill nets more into line with present size restrictions on other fishermen and allow more 3- and 4-year-old barracuda to escape and spawn. In 1976 an estimated minimum of 5,300 additional undersized barracuda might have escaped to spawn if 3.75-inch mesh had been used. With an increased mesh size, fishermen would expend less effort removing and measuring undersized barracuda from their nets, and the markets would receive fewer sublegal ones.

A change in mesh size will require the construction of new nets, and conversion time should be allowed. Barracuda gill nets tend to last longer than some other nets because of their limited contact with abrasive surfaces and limited exposure to light. Allowing three to five years to convert to 3.75-inch mesh should reduce the financial impact of converting to new nets.

The number of commercial vessels landing barracuda is now the smallest since before World War I, and a change in nets will have less economic impact now than in the future, should the barracuda fishery expand.

4. Limit the depth of the gill nets to 170 meshes or 11.4 meters (6.25 fms). This would reduce their effectiveness if unlawfully used as encircling nets for barracuda, without significantly affecting legal operations. In addition, prohibit any barracuda aboard vessels carrying gill nets of less than 3.75-inch mesh. This should reduce the temptation to fish for undersized barracuda with small-mesh nets, and it will expedite law enforcement by eliminating the need to apprehend fishermen in the act of capturing undersized barracuda with illegal mesh.
5. Apply present size and gear restrictions to all California barracuda landed or imported regardless of origin. This is directed primarily at the roundhaul nets that may still capture California barracuda in Mexican waters. Restriction against roundhaul nets would have no impact upon the current fishery, but it would eliminate future exploitation by this gear. Size restrictions upon imported barracuda would aid law enforcement and encourage conservative practices by Mexican fishermen.
6. Remove the allowance of undersized barracuda for all commercial fishermen with the exception of five per boat per day for gill net fishermen for their personal use (not to be sold). An allowance for other than gill net fishermen is unnecessary because undersized barracuda caught by rod and

reel or trolling (the only other fishing methods, other than roundhaul nets) are easily released alive.

7. Increase efforts to educate recreational fishermen about regulations, species recognition, and release techniques. A reduction in the large numbers of undersized barracuda destroyed by anglers would contribute much towards the recovery of the resource. Simplified aids to fish identification and the reasons for regulations must be made available to all anglers. Newspapers and magazines should be more fully used to distribute this information.

LITERATURE CITED

- Berdegue, A. J. 1956. Peces de importancia comercial en la costa nor-occidental de Mexico. Secretaria de Marina, Direccion General de Pesca e Industrias Conexas, Comision para el Fomento de la Piscicultura Rural: 345.
- Frey, H. W., ed. 1971. California's living marine resources and their utilization. Calif. Dept. Fish and Game, Sacramento. 148 p.
- Janssen, J. F., Jr. 1937. In The commercial fish catch of California for the year 1935. Calif. Div. Fish Game, Fish Bull. 49:1-70.
- MacCall, A. D., G. D. Stauffer, and J. P. Troadec. 1976. Southern California recreational and commercial marine fisheries. Mar. Fish. Rev. 38(1):1-32.
- Pinkas, L. 1966. A management study of the California barracuda, *Sphyræna argentea* Girard. Calif. Dept. Fish Game, Fish Bull. 134:1-58.
- Schultze, D. L. 1973. The status of the California barracuda resource and its management. Calif. Dept. Fish Game. Mar. Resour. Tech. Rep. 6:1-20.
- . 1981. A summary of California barracuda life history, fisheries and management. Calif. Dept. Fish Game. Mar. Resour. Admin. Rep. 80-6:1-79.
- Skogsberg, T. 1925. Preliminary investigation of the purse seine industry of southern California. Calif. Fish Game Comm. Fish Bull. 9:1-95.
- Walford, L. A. 1932. The California barracuda (*Sphyræna argentea*). Calif. Div. Fish Game, Fish Bull. 37:1-122.
- Wine, V. L. 1979a. Southern California independent sport fishing survey quarterly report for July-September, 1976. Calif. Dept. Fish Game Mar. Resour. Admin. Rep. 79-7:1-22.
- . 1979b. Southern California independent sport fishing survey quarterly report for October-December, 1976. Calif. Dept. Fish Game Mar. Resour. Admin. Rep. 79-8:1-19.
- . 1979c. Southern California independent sport fishing survey quarterly report for January-March, 1976. Calif. Dept. Fish Game Mar. Resour. Admin. Rep. 79-9:1-20.
- . 1979d. Southern California independent sport fishing survey quarterly report for April-June, 1976. Calif. Dept. Fish Game Mar. Resour. Admin. Rep. 79-10:1-20.