TUNAS

ALBACORE

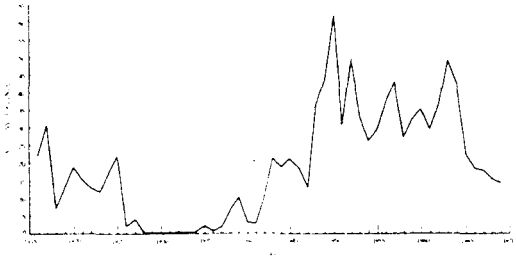
History of the Fishery

The albacore (*Thunnus alalunga*) is a highly migratory species valuable to commercial and sport fisheries in California. Commercial albacore fishing began off southern California near the turn of this century. In 1903, an experimental pack of 700 cases of albacore led to the development of the U.S. tuna canning industry. The fishery expanded quickly in response to the almost instantaneous high demand for canned tuna, which quickly outpaced the supply of albacore. By the 1920's, bluefin, yellowfin, and skipjack tunas were also being canned. However, albacore is the only tuna species which may be marketed as "white meat tuna," and it brings a premium price at the dock and in the can.

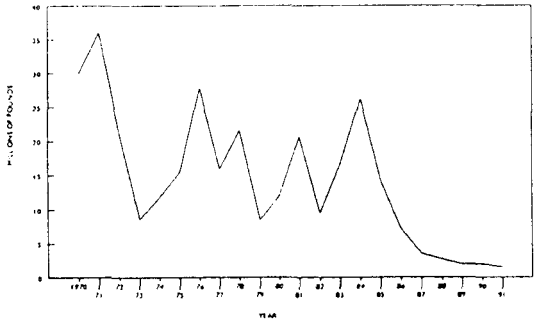
The geographic range of the U.S. north Pacific albacore fishery has expanded during the past eight decades. Early commercial fishermen made one-day trips within coastal waters off southern California. The fishery extended northward and seaward, and by the late 1930's it reached to waters off the Pacific northwest and several hundred miles offshore. There was a major offshore extension in the mid-1970's across the central Pacific to about the Dateline. However, beginning in the mid-1980's, there has been a general shrinking of the breadth of the fishery to within about 500-600 miles of the Pacific west coast.

Since the early 1980's, about 90 percent of the annual albacore catch has been made by trolling jigs and 10 percent by live-bait pole-and-line fishing. In earlier years, live-bait fishing sometimes accounted for up to 40 percent of the annual catch. In some years, up to a few hundred tons of albacore may be caught by purse seine vessels, usually incidental to bluefin tuna fishing. California-based drift gillnet vessels also catch small quantities of albacore incidental to shark and swordfish fishing. Generally, two fishermen conduct fishing operations from troll vessels and three to five fishermen from live-bait vessels. Many vessels which fish for albacore also take part in other fisheries. Their participation in the albacore fishery depends on the price and availability of albacore, the success of other fisheries, and weather conditions during the albacore season. In the 1940's, there were about 500 vessels in the albacore fleet. A high of 3,000 boats was reached in 1950; the number dropped to about 1,000 vessels by 1960, climbed to 2,100 vessels during the 1970's, and dropped to fewer than 500 boats in the late 1980's. The average size of albacore jigboats is about 45-50 feet, with a sea-keeping capability of about one to two weeks. In recent years, there has been a steady increase in vessels of 60-80 feet, which are capable of fishing at sea for six to eight weeks. The larger vessels may participate in a virtual year-round albacore fishery by fishing in mid-North Pacific waters, the North American coastal fishery, and in the recently established south Pacific albacore fishery.

The North Pacific albacore stock is also harvested by Asian fisheries, including a Japanese pole-and-line fishery in the spring, which targets two to five year old fish off the Japanese coast eastward to near the Emperor Seamount chain. There are also Japanese, Taiwanese and South Korean longline fisheries, which target five to seven plus year old albacore in subtropical and temperate waters across much of the Pacific during winter. Beginning in the early 1980's, Asian high-seas drift gillnet fisheries have targeted two to four year old albacore across much of the Pacific. In addition, there is a relatively small Canadian troll fishery for albacore during years when they are distributed in waters off British Columbia.



California commercial landings of albacore, 1916-1969.

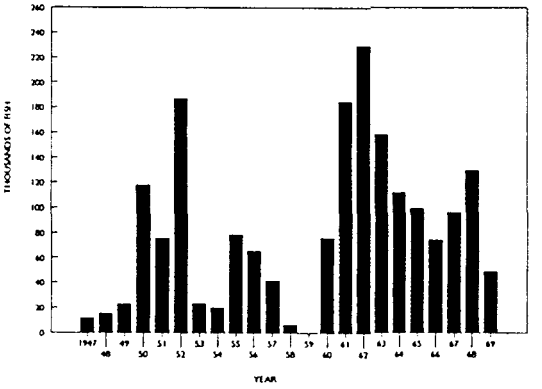


California commercial landings of albacore, 1970-1991.

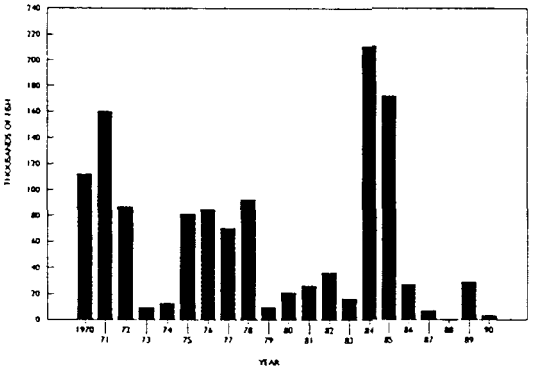
In the late 1890's and early 1900's, sport fishermen on private boats would fish for large bluefin tuna inside the Channel Islands. The 10-20 pound albacore, which would strike the bait intended for a 100 pound bluefin, were considered a nuisance and were usually tossed over the side after landing. Gradually, some boats began to carry sports anglers as paying passengers, who quickly came to appreciate the fighting and eating qualities of the albacore, or "longfin tuna," as they are often called. The fishing for hire partyboats gained in popularity in southern California, and, by the 1950's, about 100-150 fished for albacore in nearshore waters.

In the 1960's, the albacore runs began to shift outside the Channel Islands and to waters off upper Baja California, over 50 miles from southern California ports. In response to this, larger commercial passenger fishing vessels with a greater range were built. Today, there are about 40 large commercial passenger fishing vessels, mostly in southern California and some in the Morro Bay and San Francisco area, that are capable of carrying 20 to 60 sport fishermen on one to three-day fishing

trips. In addition to the large vessels, there are about 50 to 60 smaller vessels that typically are chartered to smaller fishing parties of around six.



California commercial passenger-carrying fishing vessel landings of albacore, 1947-1969.

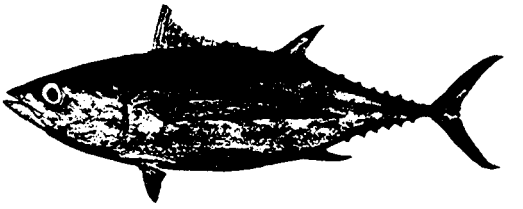


California commercial passenger-carrying fishing vessel landings of albacore, 1970-1990.

As the result of increased numbers of private boats, the ready availability of modern commercial passenger-carrying fishing vessels (CPFV), and improvements in sport fishing gear, albacore sport fishing has become increasingly attractive to California anglers. In fact, the first albacore of the season caught in southern California waters sets off "albacore fever" among recreational fishermen. No other sport fish in southern California elicits the excitement exhibited each year by the thousands of fishermen pursuing albacore. Over 120,000 anglers go out on southern California CPFVs in search of albacore during the course of a season. Albacore sport fishing in southern California contributes about $23 million to the local economy through the purchase of the boat ticket, tackle, food, gas, licenses, and lodging.

Status of Biological Knowledge

The albacore is a highly advanced teleost with many specialized adaptations. It is capable of thermoregulation, has a high metabolic rate, an advanced cardiovascular system, specializations in the circulatory system and blood/gas exchange systems, distinctive enzyme and complement systems, and high energetic costs for migration which may be partly met by utilization of stored fat.



Albacore, *Thunnus alalunga*.

The distribution of albacore is cosmopolitan in subtropical and temperate waters of all oceans. Off the coast of North America, the distribution during summer and fall months may range from lower Baja California, northward to the Queen Charlotte Islands, Canada, and occasionally into the Gulf of Alaska.

There is a growing body of evidence that the North Pacific albacore population is not as homogeneous as is usually assumed. Results from albacore tagging studies suggest that at least two proposed subgroups of fish constitute the North Pacific albacore population and that these subgroups have different migratory patterns, modal sizes in the U.S. fishery, growth rates, and peak spawning periods. While the subgroups are geographically separated and are differentiated by dissimilarities in biological or fishery statistic criteria, they are not believed to be genetically distinct.

Albacore make extensive movements during their lifetime. The degree of migration is geographically most expansive in the pre-adult ages between about two and five years. Fish of these ages may conduct trans-oceanic migrations in temperate and subtropical waters, following well-defined routes between the eastern and western or central Pacific. However, the spawning adults, above about six years, undertake relatively limited movements, mostly within the subtropical and tropical regions of either the western, central or eastern Pacific.

Results from extensive albacore tagging indicate that the northern subgroup of albacore is fished by the U.S. fishery north of about 40° N, the Japanese pole-and-line fishery in the western Pacific, and the Asian longline fishery. The southern subgroup appears to be fished by the U.S. fishery south of about 40° N, and the Asian longline fishery, but only to a limited extent by the Japanese pole-and-line fishery.

Based on physiological research findings, the normal habitat of albacore is within a temperature range of 50°-64° F, with dissolved oxygen saturation greater than about 60 percent. While individuals may temporarily move into waters outside of these values, thermoregulation and respiration functions will be adversely affected and operate marginally. The acoustic tracking of free-swimming albacore has demonstrated that albacore customarily live within the depths of the thermocline, rather than the upper mixed layer as has been generally presumed.

The migration, distribution, availability, and vulnerability of albacore are strongly influenced by oceanographic conditions in the Pacific Ocean, notably oceanic fronts. The seasonal migration of albacore into North American coastal waters is associated with the North Pacific Transition Zone water and its frontal boundaries. In addition, oceanographic conditions also play an important role in the local concentrations and movements of albacore in coastal waters off North America. Albacore tend to aggregate on the warm side of upwelling fronts and move away from the fronts upon their disintegration in response to wind shifts unfavorable for upwelling. Satellite images of ocean color and sea surface temperature and concurrent albacore catch data clearly show that the distribution and availability of albacore off California are related to coastal upwelling fronts and that albacore are most abundant in warm, clear, blue oceanic waters near temperature and color fronts at the seaward edge of coastal water masses.

It is presumed that albacore aggregate in the vicinity of upwelling fronts to feed on small fishes, squids, and crustaceans that are plentiful in these areas. Yet it remains unclear what physical factors prevent albacore from crossing to the cooler side of these fronts in order to reach the highest potential forage biomass. Past beliefs have stressed confinement to a physiological optimum temperature range; however, explanations for environmental preferences of albacore are changing as new knowledge is acquired. The finding that albacore can regulate their body temperatures suggests that temperatures on the cool side of an upwelling front should not be limiting. Studies of free-swimming albacore in relation to ocean thermal structure, using acoustic telemetry and coincident oceanographic sampling, have shown that, while albacore would not cross from the warm side to the cool side of an upwelling front which had a horizontal sea surface temperature gradient of about a 4° F over a few miles, the fish would routinely swim through vertical temperature gradients up to about 18° F. The fish made extensive vertical excursions up to several hundred yards and crossed the thermocline in waters adjacent to the upwelling front. Recent research involving acoustic telemetry of freeswimming albacore, satellite measurements of ocean color and temperature, and oceanographic sampling of water optical and other characteristics, and potential forage abundance, indicates that water clarity as it affects the ability of albacore to detect prey is an important mechanism underlying the aggregation of albacore on the warm, clear sides of upwelling fronts.

Status of Population

Fishing effort and catch of albacore in the Japanese pole-and-line and the U.S. surface fisheries have declined, beginning in the early 1980's. In contrast, recent landings in the Japanese longline fishery have been relatively constant and there has been a rapid development of Asian gillnet fisheries that harvest large numbers of albacore in the North Pacific.

Several factors are associated with the decline in the traditional surface fisheries, but their relative importance is unknown. It appears that no single factor is responsible, but that the decline in catches is a result of complex interactions among factors, including (1) a reduction in overall fishing effort for albacore, (2) lack of fishing in areas of traditional high catch, (3) indications of population decline and (4) major anomaly patterns in oceanographic conditions across much of the North Pacific in the mid-1980's and early 1990's.

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