Tuna

highlights

- The catches of Pacific bluefin tuna and North Pacific albacore tuna have fluctuated considerably from year to year, but no upward or downward trends are apparent for either species.
- Increasing the age at entry of Pacific bluefin into the fishery might increase the yields per recruit of that species.
- The status of North Pacific albacore is uncertain, but most scientists believe that greater harvests of that species would not be sustainable.

background

The Inter-American Tropical Tuna Commission (IATTC) studies the tunas of the eastern Pacific Ocean (EPO), defined for its purposes as the area bounded by the coastline of North, Central, and South America, 40ºN, 150ºW, and 40ºS. The IATTC staff maintains records for most of the vessels that fish at the surface for skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), bigeye tuna (*T. obesus*), and Pacific bluefin tuna (*T. orientalis*) in the EPO. Pacific bluefin and albacore tuna (*T. alalunga*) are the tunas most relevant to the region of interest to PICES.

Pacific bluefin tuna

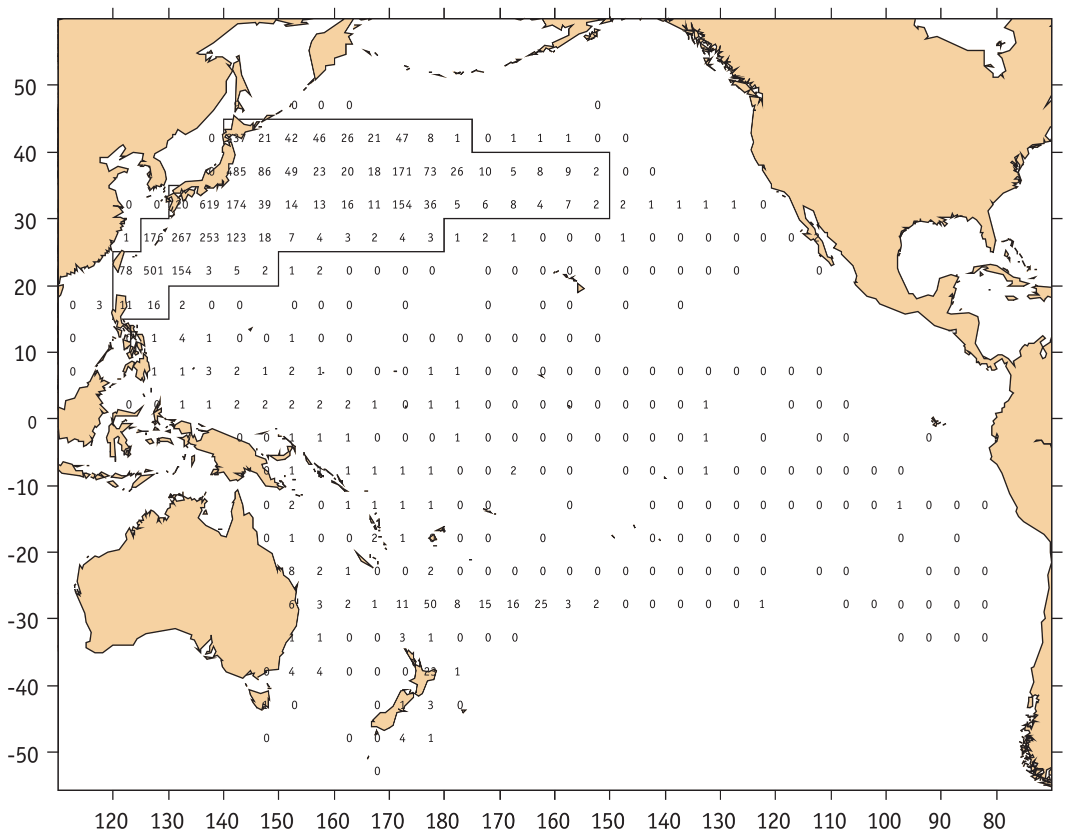
Spawning of Pacific bluefin apparently takes place only in the western Pacific Ocean (WPO). Some juvenile bluefin move from the WPO to the EPO, and then later return to the WPO. Others apparently never move to the EPO.[386]

Pacific bluefin are exploited by various gears in the WPO from Taiwan to Hokkaido.[357] Age-0 fish about 15 to 30 cm in length are caught by trolling during July-October south of Shikoku Island and south of Shizuoka Prefecture. During November-April, age-0 fish about 35 to 60 cm in length are taken by trolling south and west of Kyushu Island.

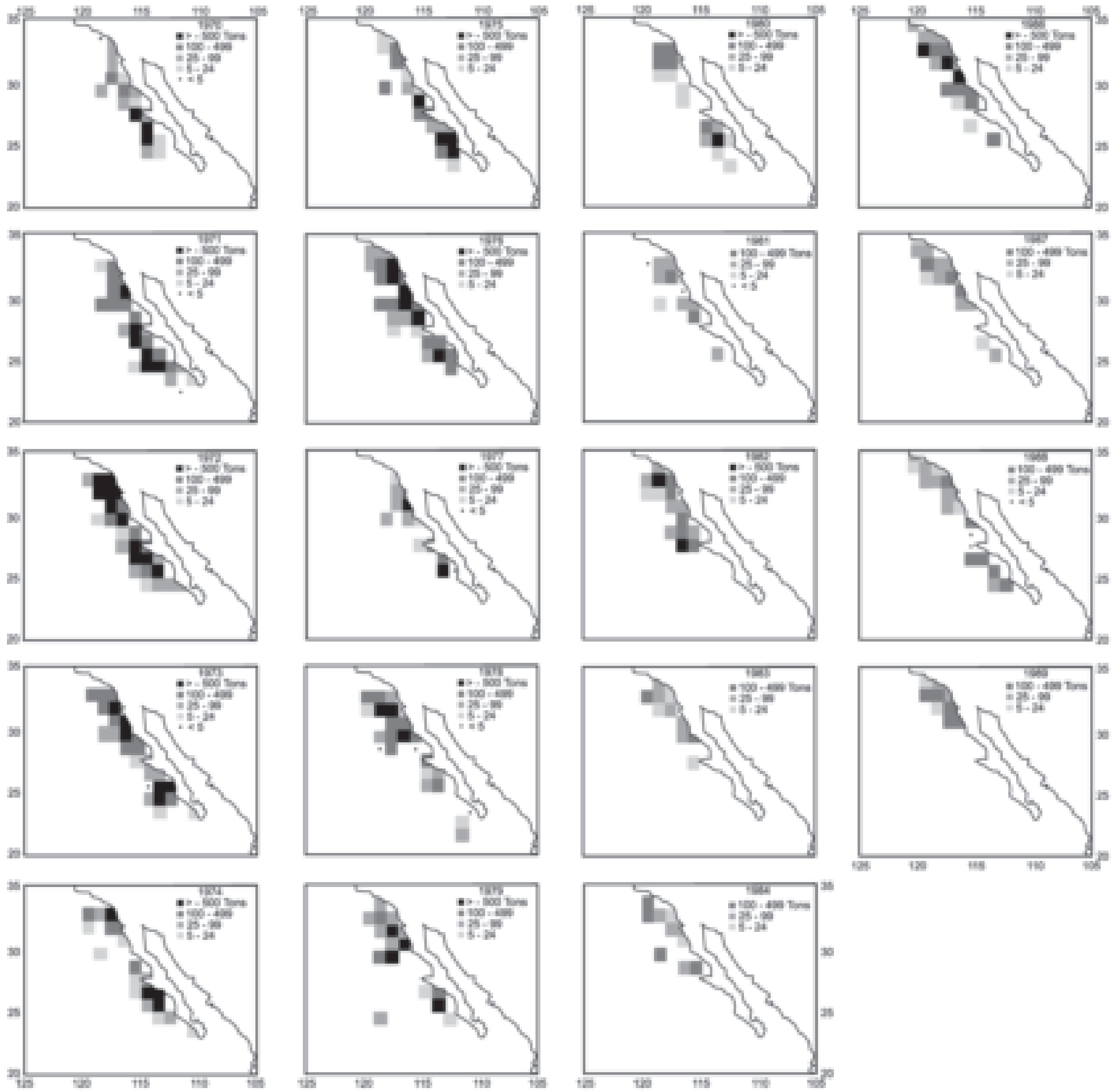
Age-1 and older fish are caught by purse seining, mostly during May-September between about 30°-42°N and 140°-152°E. Bluefin of various sizes are also caught by traps, gillnets, and other gear, especially off the western side of Japan. Bluefin are also caught near the southeastern coast of Japan by longlining. The high-seas longline fisheries are directed mainly at tropical tunas, albacore, and billfishes, but some Pacific bluefin are also caught. Catch distributions of bluefin by Japanese longliners during 1952-1997 in the Pacific Ocean are shown in Figure 145.[387] Small amounts of Pacific bluefin are also caught by Japanese pole-and-line vessels on the high seas.

Most of the catches of Pacific bluefin tuna in the EPO are taken by purse seiners. Nearly all of this catch is made west of Baja California and California, within about 100 nautical miles of the coast, between about 23° and 33°N. Lesser amounts of Pacific bluefin are caught by recreational, gillnet, and longline gear. They are caught during every month of the year, but most of the fish are taken from May to October. The distributions of purse-seine catches of Pacific bluefin tuna in the EPO during 1970-1989 are shown in Figure 146.

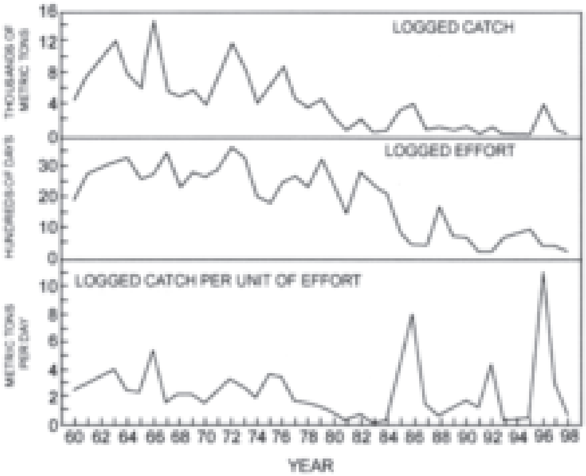
In the EPO, Pacific bluefin tuna are found most often in waters where the sea-surface temperatures (SSTs) are between 17° and 23°C.[389] Fish of about 15 to 30 cm in length are found in the WPO in waters where the SSTs are between 24° and 29°C. Conditions in the WPO probably influence the portions of the juvenile fish there that move to the EPO, and also the timing of these movements. Likewise, conditions in the EPO probably influence the length of their sojourn there and the timing of the return of the juvenile fish to the WPO.



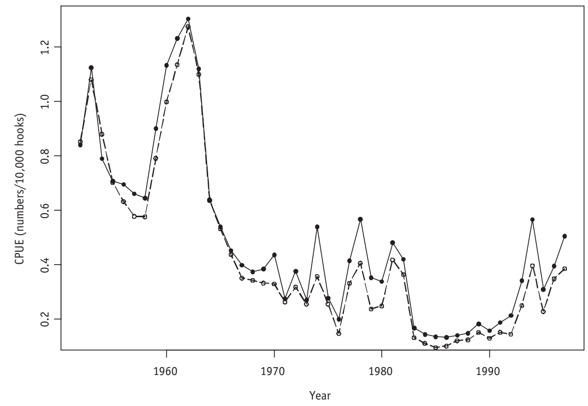
[Figure 145] Five degree areas in which Pacific bluefin tuna were captured by the Japanese longline fleet during January 1952–December 1997.[387] The numbers indicate the total number of Pacific bluefin tuna (100s) removed from each quadrangle during this period (zeros indicate catches of less than 51 fish). The quadrangles inside the polygon extending from Japan to 150°W constitute the core area.[388]



[Figure 146] Annual distributions of Pacific bluefin tuna catches in the eastern Pacific Ocean, 1970-1989.[390]



[Figure 147] Catch, effort, and catch-per-unit of effort for the surface fishery for bluefin tuna in the EPO as determined by the habitat index method. The data for 1998 are preliminary.[390]



[Figure 148] Time series of regional abundance indices for the Pacific bluefin tuna core area. The trend with a dashed line is the time series estimated from the safe abundance indices. The trend with a solid line is the time series estimated from pooling the safe and the extrapolated abundance indices.[387]

Indices of abundance of Pacific bluefin in the EPO have been calculated, but none is entirely satisfactory. The 1° areas north of 23°N and west of California and Baja California (Figure 146) in which the SSTs were 17-23°C from May-October were defined as "bluefin habitat."[391] The annual catches of Pacific bluefin in those areas were divided by the corresponding numbers of unstandardized days of fishing effort to obtain CPUEs (Figure 147). Indices of bluefin abundance in the WPO were prepared for a joint workshop with the National Research Institute of Far Seas Fisheries (NRIFSF) of Japan.[387] The resulting time series for the "core area" (Figure 145) of the Japanese longline fishery are shown in Figure 148.

Scientists of the NRIFSF have been tagging Pacific bluefin tuna with archival tags to study the relationships between their movements and the physical environment.[392,393] The movements of one fish that made a trans-Pacific migration while carrying an archival tag has been described.[394]

There was general agreement at the meeting of the Bluefin Tuna Working Group of the Interim Scientific Committee,[393] held in December 2000, to start the process of developing a Pacific-wide assessment of bluefin tuna, using the length-based age-structured modelling approach used for yellowfin and bigeye tunas in the EPO.

Albacore tuna

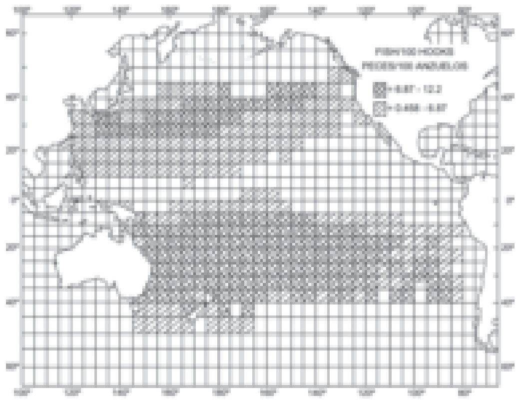
There are two stocks of albacore in the Pacific Ocean, one occurring in the northern hemisphere and the other in the southern hemisphere. In the North Pacific, the adults are apparently most abundant in the Kuroshio Current, the North Pacific Transition Zone, and the California Current, but spawning occurs in tropical and subtropical waters.[395]

Albacore are caught by longliners in most of the North Pacific, but not often between about 10°N and 5°S, and also by trollers in the eastern and central North Pacific, and by baitboats in the western North Pacific.[395] Albacore are caught in the North Pacific primarily by vessels of Canada, Japan, the Republic of Korea, Mexico, Taiwan, and the U.S.A.[396] During the 1980s and 1990s, the catches in the North Pacific have ranged between about 38,000 and 122,000 metric tons.[396]

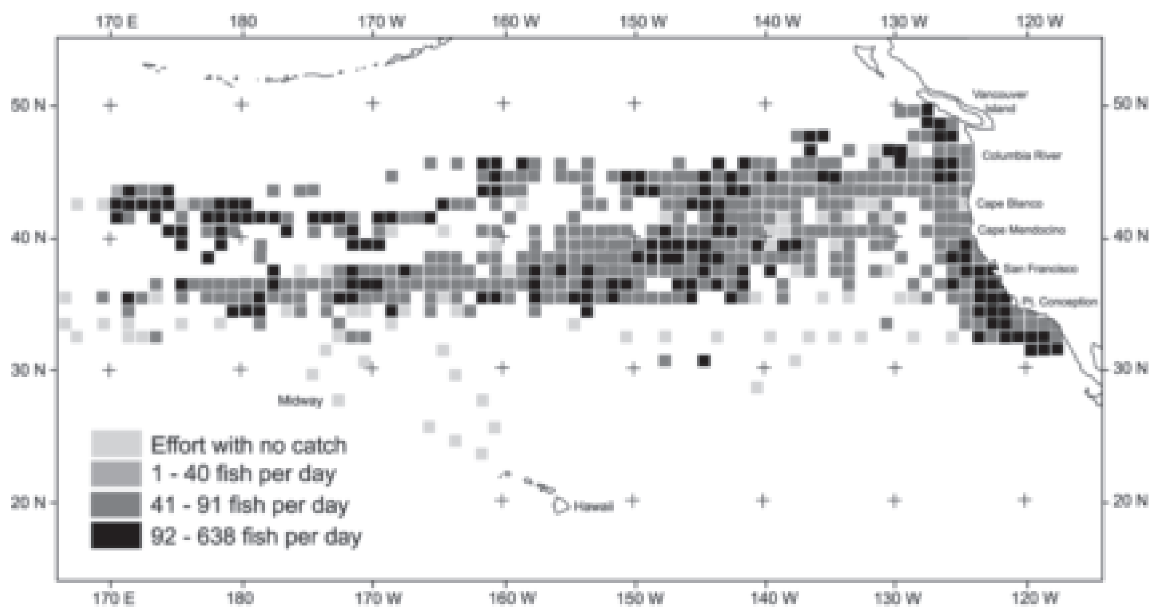
There appear to be two subgroups of albacore in the North Pacific Ocean. The fish of the northern subgroup occur mostly north of 40°N when they are in the EPO.[397] There is considerable exchange of fish of this subgroup between the troll fishery of the EPO and the baitboat and longline fisheries of the WPO. The fish of the southern subgroup occur mostly south of 40°N in the EPO, and relatively few of them are caught in the WPO.

Fish that were tagged in offshore waters of the EPO and recaptured in the coastal fishery of the EPO exhibited different movements, depending on the latitude of release. Most of the recaptures of those released north of 35°N were made north of 40°N, and most of the recaptures of those released south of 35°N were made south of 40°N.

The distributions of catches of albacore tuna per hook by Japanese longliners averaged over 1952-1976[395] appear in Figure 149, and the distribution of catches per day's fishing of albacore tuna caught by U.S. troll vessels in 1999 in the North Pacific[398] is shown in Figure 150. Time series of recruitment, biomass, and average weights have not been prepared by the IATTC for albacore of the North Pacific Ocean.



[Figure 149] Distribution of catches of albacore per hook by Japanese longliners averaged over the 1952-1976 period.[395]



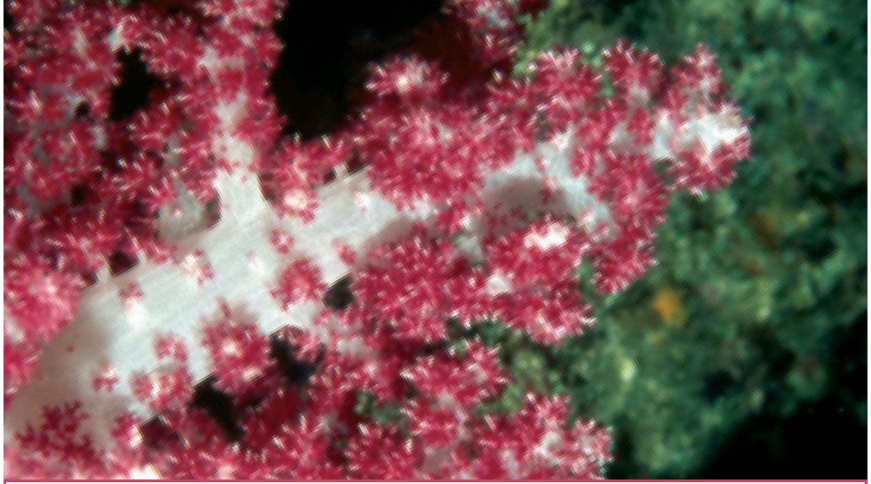
[Figure 150] Distribution of albacore CPUEs by U.S. troll vessels in the North Pacific Ocean during 1999.[398]

Status and trends

The catches of Pacific bluefin and North Pacific albacore have fluctuated considerably from year to year,[399] but no upward or downward trends are apparent for either species. Increasing the age at entry of Pacific bluefin into the fishery might increase the yields per recruit of that species.[390] The status of North Pacific albacore is uncertain, but most scientists believe that greater harvests of that species would not be sustainable.[400]

Ecosystem model and climate forcing

The staff of the IATTC has recently developed a modeling approach to evaluate the ecological implications of alternative fishing strategies in the pelagic tropical EPO.[401] Additional development and evaluation of the EPO ecosystem model was accomplished by a working group[402] funded by the National Center for Ecological Analysis and Synthesis (NCEAS) in Santa Barbara, California. One of the products of the working group was an evaluation of the implications of climate forcing on ecosystem dynamics of the tropical EPO.[403] The physical environment affects ecosystem dynamics by inducing variation in primary production at the base of the food web and by direct effects on predator recruitment. The tropical EPO is strongly influenced by the El Niño-Southern Oscillation (ENSO). Over a large portion of the tropical EPO, the chlorophyll concentrations are reduced during El Niño episodes and increased during La Niña episodes. In addition, annual recruitments of yellowfin tuna were greatest following the 1987-1988 El Niño episode.[404] To simulate ENSO-scale variations in producer biomass in the ecosystem model, the working group constructed an empirical model that relates SST anomalies to surface chlorophyll concentrations. Direct effects of ENSO events were simulated by forcing recruitment to increase for all large fishes except sharks during warm events. The group used time series of SST anomalies to specify trajectories of producer biomass and predator recruitment, and simulated the ecosystem effects of ENSO-scale pulses and cycles and a greenhouse-warming scenario for the 21st century.[403]



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