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A SURVEY OF THE AMERICAN AND JAPANESE ALBACORE TUNA FISHERIES IN THE PACIFIC THROUGH EXAMINATION OF CATCH STATISTICS

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CONTENTS

ABSTRACT

Catch statistics of the American and Japanese albacore fisheries in the temperate and tropical Pacific Ocean are presented. There has been a fourfold increase in Pacific albacore landings since the prewar years. The Japanese account for about 75 percent of the landings.

Judging by catch statistics alone, the two Japanese North Pacific fisheries appear to be quite stable, even at the present high level of production. There is no indication of a declining resource. While the Japanese South Pacific fisheries are relatively recent in origin, and have not stood the test of time, the present status is encouraging. The American fishery has been beset with marked fluctuations in landings but there is no evidence that fishing has adversely affected the stock.

All indications on the present status of the albacore fisheries point to the parallel rise in effort and catch.

INTRODUCTION

The three major fisheries for albacore tuna, Germo alalunga (Bonnaterre), in the Pacific, all of which are located in the Temperate Zone of the North Pacific Ocean are: (1) the Japanese spring and summer live-bait fishery, (2) the United States west coast summer and fall fishery, and (3) the Japanese winter long-line fishery. In addition, the Japanese tuna long-liners catch much albacore in the tropical Pacific (see fig. 1).

Statistics from each of these fisheries are presented. Certain biological information is also examined for possible clues to the relationship of fish making up the stocks in the various fisheries. By examining the statistics, it is hoped that enough evidence can be gathered which will lead to a knowledge of the population structure of the Pacific albacore, and more important, to a definition of the present status of this important resource. For a population study, much more detailed statistics than are available would be required.

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MAJOR PACIFIC ALBACORE FISHERIES

JAPANESE SPRING AND SUMMER LIVE-BAIT FISHERY: A description of this fishery has been given by Van Campen[1/], and only a few of the more important points are repeated here. This fishery is conducted near Japan from late April to July, and is a part of the more extensive pole-and-line fishery for skipjack (Katsuwonus pelamis). Boats fishing for skipjack tuna, which appear in early spring off southern Japan, begin to fish for albacore which become available off central Honshu, Japan, about late April or early May. The surface schools of albacore follow the northward extension of the warm Kuroshio Current along the coast of Japan;

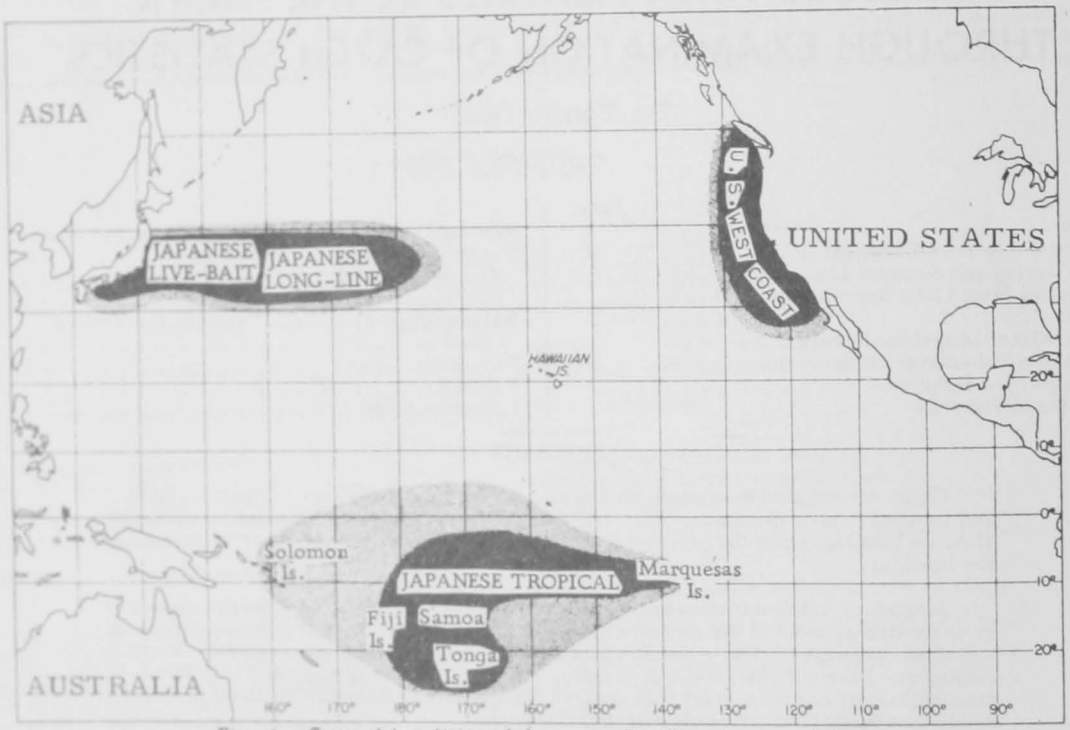

Fig. 1 - General localities of the major Pacific albacore fisheries.

their availability quickly reaches a peak in June, and then rapidly drops off as schools move farther offshore to the eastward. During July, the boats begin to return to skipjack fishing as the albacore go out of range or disperse and become harder to locate. Van Campen has pointed out that in recent years there was an eastward extension of the albacore grounds from about 155° E. to 165° E. longitude, and that this undoubtedly reflects the growing proportion of larger vessels in the fleet which are able to go farther offshore in pursuit of the fish.

UNITED STATES WEST COAST SUMMER AND FALL FISHERY: The albacore occurs along the Pacific Coast of North America from southern Baja California to Alaska between latitudes 25° and 59° N. (Clemens 1955). Since 1945 the majority of the fish have been caught in an area between Baja California and San Francisco within 400 miles of the coast, while between 1937 and 1945 large quantities were also taken off Oregon, Washington, and British Columbia. The year 1956 marked the return of the albacore to Pacific northwest waters after several years' virtual ab-

1/Van Campen, W. G. Manuscript. The Japanese Summer Albacore Fishery. Submitted for publication.

sence. Typically, the fishery begins in June off southern California, develops rapidly in July, reaches a peak in August and September, declines during October and November, and ends in December. Like the Japanese live-bait fishery, it is based on surface schools of albacore. The fish are taken by trolling and live-bait fishing. As the season progresses the fishery tends to move northward along the coast and also outward from the coast.

JAPANESE WINTER LONG-LINE FISHERY: This fishery is conducted between November and April over a broad area of the Temperate Zone of the North Pacific extending from the coast of Japan to the vicinity of 175° W. longitude generally between 30° and 40° N. latitude (Nakamura 1951, Suda 1954). The fishing ground gradually shifts southward as the season progresses, being centered between about 34° and 40° N. in November, and between 26° and 32° N. in March. This southward movement ceases in March and there is a reversal in the movement of the fishery beginning in April. The winter long-line fishery is terminated in April, and the live-bait fishery begins soon after.

The description of this fishery as well as that of the live-bait fishery are overly simplified versions of a more complex picture. Van Campen[1/] pointed out that while Japanese writers often imply that all pole-and-line fishing is done in the spring and summer and all long-lining in winter, some albacore are taken by both methods in all months of the year.

OTHER JAPANESE FISHERIES FOR ALBACORE

Two relatively new fisheries, which yield significant amounts of albacore for the Japanese, are the mothership-type fishery and the so-called "foreign-based fishery," both of which exploit albacore along with other species of tunas in the tropical Pacific Ocean. Fishing is done by the long-line method. The mothership-type tuna operations began soon after World War II, while the fisheries based in foreign ports are of more recent origin.

MOTHERSHIP-TYPE FISHERY: The first large-scale commercial mothership-type tuna expedition in Japanese fisheries history was undertaken by the Taiyo Fishing Co., Ltd., in June 1950 following a directive issued by the Supreme Commander for the Allied Powers which permitted the Japanese to send expeditions to certain defined areas of the high seas adjacent to the Caroline, Marianas, and Marshall Islands. This expedition was composed of a 10,000-ton mothership and 25 long-line boats ("catchers"), which fished for a period of 2½ months. Details of this venture and several which followed, as well as the history of this type of operation in the Pacific, are presented by Shimada (1951), Ego and Otsu (1952), and Van Campen (1952). Such expeditions were authorized under the premise that fishing vessels operate only within a specified area, and under the rigid control and supervision of a mothership. That the Japanese found these large-scale ventures successful is attested to by the fact that they have been continued even after all restrictions on movements on the high seas were removed by the ratification of the Peace Treaty.

The announced plans for 1958 mothership operations involve three separate expeditions as follows: A 3,000-ton mothership and 23 catchers operating from May 20 through September 30, a 3,800-ton mothership and 35 catchers operating between May 10 and September 20, and an 11,000-ton mothership with 50 catchers operating in August and November.[2/] These operations are reported to be similar in scope to the 1957 operations.

FOREIGN-BASED FISHERIES: At the present time there are two fisheries operating out of foreign ports in the Pacific; one at Espiritu Santo, New Hebrides, and

1/See page 2.
2/Fisheries Economic News.

the other at Pago Pago, American Samoa. No statistics are available for the operation based in New Hebrides; an enterprise reportedly involving American, British, and Japanese capital. According to information available, the fishing base was completed in November 1957, and operations were under way in July 1958 with about eight Japanese tuna long-line boats.

The fishery in American Samoa, a joint enterprise between a large United States west coast cannery and certain Japanese fishing firms, began in 1954 (Van Campen 1954). Starting with a small fleet of 7 Japanese tuna boats, this operation has expanded considerably, and today the American Samoa cannery is being served by a fleet numbering more than 30 long-liners. Albacore, along with other tunas and spearfishes, are landed throughout the year. There is no clear seasonal variation in albacore landings but the more productive months appear to be from August through February.

ALBACORE LANDINGS IN THE UNITED STATES AND JAPAN

Annual United States west coast and Japanese albacore landings are presented in figure 2. These and other statistics given in this article are in short tons. The source data are those cited by Van Campen.[1/] The Japanese landings include fish taken by the two major fisheries as well as lesser amounts landed by independently-

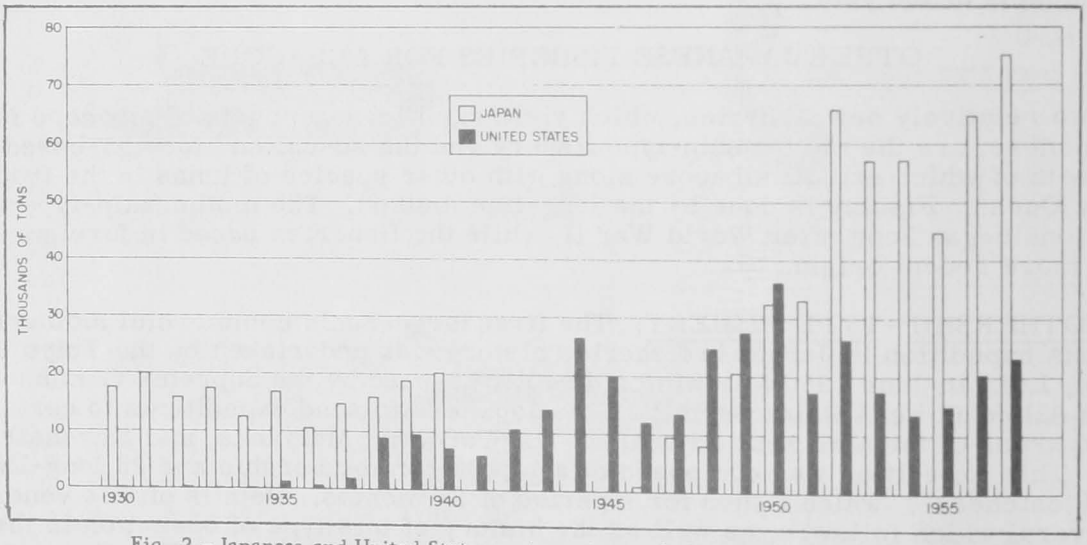

Fig. 2 - Japanese and United States west coast annual albacore landings, 1930-57.*

*The 1957 Japanese landings were obtained from statistics provided by the Nankai Regional Fisheries Research Laboratory, Japan.

operating tuna long-liners from tropical waters of the Pacific and Indian Oceans. The statistics do not permit segregation of Pacific and Indian Ocean albacore landings. However, since most of the albacore are taken in Pacific waters, it is probably of little consequence to ignore the distinction, and perhaps even consider the Indian Ocean as a further extension of the Pacific grounds. There are certain irreconcilable discrepancies. Judging from the landings shown in figure 2 and the annual landings of the two major fisheries shown in figure 4, it appears that Japanese landings accounted for by other than the two major fisheries are included in the figures of total Japanese landings only for certain years. The figures as given by Japanese sources are presented without any adjustments.

The United States landings of albacore were at an extremely low level during the early 1930's. Albacore providied the major portion of the tuna pack from the beginning of the industry in California in 1903 to the early 1920's. There were average landings of about 9,000 tons a year between 1916 and 1925--the years for which statistics are available. Following a record year in 1925 when about 11,000 tons

1/See page 2.

were landed, albacore suddenly failed to appear on the West Coast in its usual abundance. For the next 12 years the albacore catch was negligible in the United States. In waters off the Pacific Northwest, albacore showed up in commercial quantities for the first time in 1937, and a commercial pack was put up in Oregon and Washington in 1938 (Powell and Hildebrand 1950). This marked the beginning of a fishery in the Pacific Northwest which grew for several years and reached a peak in 1944 with landings of 17,000 tons. This fishery then declined until virtually no landings were made in 1952. In 1956 the albacore again returned in commercial quantities to waters off the Pacific Northwest.

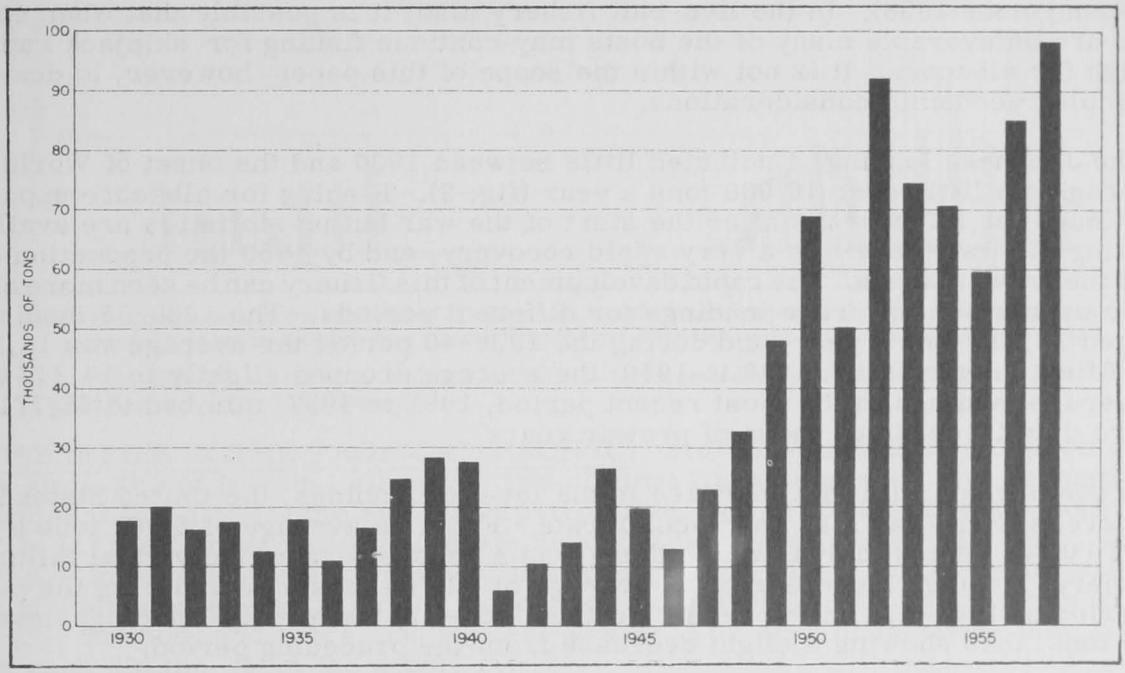

Fig. 3 - Total annual albacore landings (United States and Japan), 1930-57.

Following the recovery of the fishery around 1938, there have been some marked fluctuations in the landings from year to year, reaching relatively high levels in 1944 (26,000 tons) and in 1950 (36,000 tons). After peak landings in 1950, there was a gradual drop to a low of 13,500 tons in 1954. But in the last few years landings have again increased.

The Japanese began to export albacore to the United States in 1931 following the drastic drop in landings on the United States west coast. Prior to the establishment of this important export market, which has grown steadily over the years and has in recent years become a matter of serious concern to the United States fishing industry, Japanese fishermen had never sought this fish for domestic consumption (Van Campen[1/]). The albacore is considered too soft in texture, too pale in color, and even tasteless, by the Japanese who customarily eat tuna raw ("sashimi"). The export market, which developed in response to the failure of the California albacore fishery in the late 20's, has continued to grow because of the increasing demand in the United States for canned albacore which could not be supplied by United States landings alone.

Like most large commercial fisheries, the albacore fishery in the United States occasionally suffers serious setbacks due to economic difficulties. For example, Samson (1955) points out that had price disputes not hampered fishing in the middle of the 1955 season, albacore production that year could have been much greater because there apparently were unusually heavy runs of albacore at that time. However,

1/See page 2.

it appears that in general the West Coast landings have fluctuated according to the availability of fish along the West Coast.

Japanese landings of albacore are also dependent upon economic considerations, to perhaps an even greater extent than the United States fishery. This situation is aggravated by the fact that nearly all albacore are exported. It has been reported that when an unfavorable export situation exists, and prices are low for albacore taken in the spring live-bait fishery, many of the boat owners are reluctant to go into winter long-lining for albacore, and may instead, turn their efforts toward fishing in the tropical Pacific or engage in some other fisheries such as that for mackerel (Anonymous 1958). In the live-bait fishery also, it is possible that when conditions are unfavorable many of the boats may continue fishing for skipjack rather than fish for albacore. It is not within the scope of this paper, however, to deal with the complex economic considerations.

The Japanese landings fluctuated little between 1930 and the onset of World War II, averaging a little over 16,000 tons a year (fig. 2). Fishing for albacore apparently continued for a few years after the start of the war but no statistics are available. Following the war there was a very rapid recovery, and by 1950 the production exceeded the prewar levels. The rapid development of this fishery can be seen more clearly if we examine the average landings for different periods. The 1930-35 landings averaged 16,706 tons a year, and during the 1936-40 period the average was 16,110 tons. After the war, from 1946 to 1950, the average dropped slightly to 14,344 tons. The average landings in the most recent period, 1951 to 1957, climbed to 56,771 tons, or more than three times those of prewar years.

In comparison with this increase in the level of landings, the United States landings increased at a far less spectacular rate. From an average of 5,562 tons a year in the 1936-40 period, during which there was a recovery from the virtual failure in the fishery, landings increased to an average of 22,755 tons a year during the postwar period of 1946-50. In the recent period, 1951-57, the average landings have been 18,976 tons, thus showing a slight decrease from the preceding period.

The combined yearly albacore landings of the United States and of Japan for 1930 to 1957 are shown in figure 3. With the exception of the war years, total landings of the two countries have shown a rather marked upward trend. From average annual landings of just under 17,000 tons in the 1930-35 period, the present level has reached approximately 76,000 tons (1951-57). This fourfold increase over the prewar period reflects the greatly increasing United States demand for canned tuna, of which albacore is the most highly prized.

That Japan is the leading producer of albacore is clearly seen in figure 2. Only during the war years and a few years following did the United States take the lead in total production. From 1951 to 1957, Japan accounted for an average of 75 percent of the total combined landings of the two countries.

TRENDS IN THE JAPANESE FISHERIES

TEMPERATE NORTH PACIFIC FISHERIES: Annual Japanese landings of the spring live-bait and winter long-line fisheries are compared in figure 4. Similar statistics are unavailable for 1938-1945. From 1931 through 1937 there was a steady decline in the landings of the live-bait fishery. The long-line fishery, on the other hand, showed some increase around 1935. This increase was due largely to a concerted effort made by the Japanese Government to compensate for the decline in pole-and-line catch by exploring grounds farther offshore beginning in 1933. The exploratory program resulted in an extension of the long-line grounds eastward. The landings correspondingly increased to a point where this fishery constituted the major source of albacore to the Japanese for a few years following.

In recent years the live-bait fishery has come to dominate tuna landings. Between 1951 and 1957, the live-bait fishery accounted for an average of 64 percent of the landings made by these two fisheries. This increased yield of the live-bait fishery has also been accompanied by an extension of grounds eastward, which was made possible by the addition of larger vessels in the fleet.

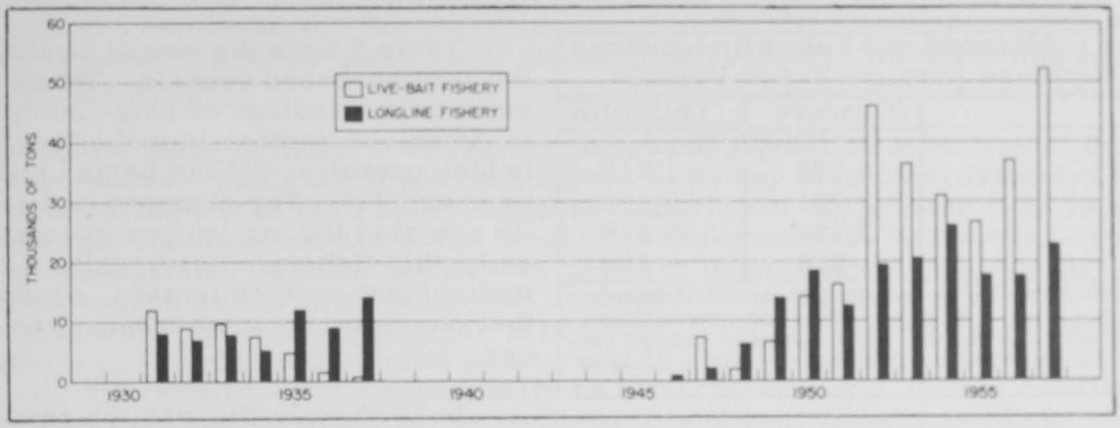

Fig. 4 - Comparison of the landings of the Japanese live-bait and long-line albacore fisheries. (Long-line landings do not include fish taken on mothership-type operations or by vessels based in foreign ports.)

The 1957 figures are estimated from monthly statistics provided by the Nankai Regional Fisheries Research Laboratory, Japan.

FISHERIES IN THE TROPICAL PACIFIC: For convenience in discussing the catch statistics of tropical albacore, two distinct fisheries have been described for the tropical Pacific, (1) the mothership-type fishery, and (2) the foreign-based fishery. In (1) the fishing vessels operate around a mothership using the latter as a base, and in (2) the vessels work out of a foreign land base. But there is little basis for considering these as separate fisheries. Both exploit subsurface tunas by the long-line method, and there are no clear seasonal or area differences that would make each distinct from the other.

While not given a special designation like the other fisheries, the numerous independent Japanese long-liners which ply the waters of the tropical Pacific and eastern Indian Oceans are nevertheless important contributors of long-line albacore. These vessels, capable of operating for considerable periods without logistic support of motherships or land bases, account for significant quantities of tropical tuna. Their contributions are reflected in the tremendous increase in overall Japanese albacore landings (fig. 2).

The annual albacore landings by the mothership-type operations are given in table 1. For purposes of comparison the landings of yellowfin tuna (Neothunnus macropterus) are also shown.

Table 1 - Albacore and Yellowfin Landings of Japanese Mothership Fleets[1/]

Year	Albacore	Yellowfin
	. . . (Short Tons) . . .	
1956	4,069	2,229
1955	5,409	3,221
1954	3,920	4,285
1953	321	4,794
1952	79	4,429
1951	137	5,432
1950	49	4,109

1/ 1957 figures are unavailable.
Sources: Annual Reports of Catch Statistics on Fishery and Agriculture, Statistics and Survey Division, Japanese Ministry of Agriculture and Forestry, 1955 edition; 1956 figures, source cited as the Japanese Fisheries Agency.

Yellowfin dominated the mothership landings during the first few years of operation, while albacore has become an important constituent only in more recent years. This is mainly a reflection of the shift in area of operations of the fleets, which during the period of restrictions exploited waters of the U. S. Trust Territory of the Pacific Islands, lying to the north of the Equator, where the predominant tuna species are the yellowfin and big-eyed (Parathunnus sibi) tunas. Probably

because of the favorable acceptance of long-line caught albacore in the market, many of the fleets now operate in more southern waters, such as in the vicinity of Fiji and Tonga Islands, where albacore are found in great numbers. In 1955 and 1956, albacore landings outweighed yellowfin landings by 40 and 45 percent, respectively. Unquestionably there has been a shift in emphasis on the part of the Japanese toward a higher production of albacore in recent years.

Table 2 - Albacore and Yellowfin Landings of Japanese Foreign-Based Vessels

Year	Albacore	Yellowfin
	. . . (Short Tons) . . .	
1957	6,236	1,719
1956	3,781	2,159
1955	3,228	2,895
1954	270	638

Sources: 1954 and 1957 figures are from records of cannery in America Samoa. Weights of gilled and gutted yellowfin were roughly adjusted to round weights by adding 9 percent; 1955 and 1956 figures ascribed to Japanese Fisheries Agency.

Table 2 lists the annual landings of the foreign-based vessels. These are essentially landings of long-liners based in American Samoa since the New Hebrides operation did not begin until November 1957. The albacore and yellowfin are also the major tuna species taken by this fishery. Here again, a shift in dominant species is seen, similar to that shown by the mothership-type fishery.

In 1954 yellowfin was the predominant species, and albacore accounted for only 30 percent of the combined albacore and yellowfin landings. In 1955, albacore accounted for 53 percent; in 1956, 64 percent; and in 1957, 78 percent of the combined landings of these two species. Thus there has been a gradual tendency for albacore to figure more importantly in the Samoa catch each year since the inception of this fishery.

This shift has come about from a movement away from the old fishing grounds, which in 1954 and early 1955 were chiefly in the vicinity of Samoa and to the north. As vessels began working in more distant and southerly waters (e.g. Tonga Islands), catches of albacore increased noticeably. Today, more and more fishing is done in waters productive of albacore, a shift in emphasis which can be attributed largely to the good canning quality of these long-line caught tropical albacore and the higher price this species generally commands.

RELATIONSHIP OF ALBACORE TAKEN IN THE VARIOUS FISHERIES

At present little is known of the relationship of albacore found in different parts of the Pacific Ocean. As mentioned, the bulk of the Pacific albacore production is from the Temperate Zone of the North Pacific with Americans and Japanese conducting seasonal fisheries for the species. Available evidence from tag returns leads us to believe that there is a single population of albacore in the North Pacific (Blunt 1954, Ganssle and Clemens 1953, and Otsu MS[3/]). Albacore tagged off the United States west coast have been retaken off the coast of Japan, and those tagged in mid-ocean north of Hawaii have been retaken in the Japanese fishery as well as in the United States west coast fishery, thus showing that there is considerable movement of fish from one fishery to the other. The tag returns, therefore, support the contention that the Americans and Japanese are both exploiting a single, intermingling population of albacore in the Temperate Zone of the North Pacific.

Furthermore, examination of gonads of albacore from various areas has shown that the Temperate Zone North Pacific fish are without exception juveniles, or are sexually-immature adults which evince no signs of incipient or past spawning (Otsu and Uchida, in press). It appears then that the North Pacific albacore are but a segment of a much larger population which is ecologically separated into spawning and nonspawning components. This same study suggests that the spawning segment of the population occurs in tropical or subtropical waters. There may be a movement

3/Otsu, T. Manuscript. Albacore Migration and Growth in the North Pacific Ocean as Estimated from Tag Recoveries. Prepared for publication in Pacific Science.

of the larger fish from Temperate Zone waters into subtropical waters, possibly into the North Equatorial Current area where some spawning appears to take place (Ueyanagi 1957, Otsu and Uchida, in press), or possibly farther south into the equatorial Pacific. It may be that these large fish spread out over a vast area in the tropical Pacific, or, as postulated by Suda (1956), the albacore occurring in the tropical South Pacific may comprise a spawning group of another population to be found in the southern hemisphere. The latter implies that the north Temperature Zone albacore is unrelated to the albacore of the tropical South Pacific now being exploited by the Japanese.

Obviously, there is much to be learned about the population structure of this valuable resource. While there does not appear to be any serious problems of overexploitation facing any of the Pacific albacore fisheries at the present time, a knowledge of the population structure would be of vital importance in formulating conservation or management policies should they prove to be necessary. If there are several discrete populations of albacore, the depletion of one would of course not affect a fishery based on another population. If however, the Americans and the Japanese are exploiting a single population of albacore in the North Pacific, then the problems concerning the resource would necessarily be of mutual concern. In this situation the effect of overexploitation would not be confined to whatever fishery is responsible, but would be shared by the other fishery as well. It is clear that the knowledge of the population structure constitutes a valuable adjunct to the understanding of problems inherent in these fisheries.

Although not well documented, frequent reference is made to the apparently close relationship between the major North Pacific albacore fisheries, that good and bad years appear at the same time in both the American and Japanese fisheries. If such a relationship does exist, it would be well worth noting because the American fishery follows the Japanese live-bait fishery in time, and the American industry is in a position to benefit by an advance indication of the relative magnitude of the season's landings.

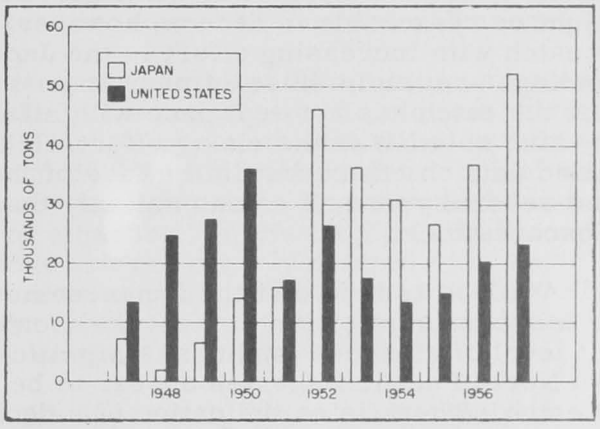

Fig. 5 - Comparison between the landings on the United States west coast and by the Japanese live-bait fisheries, 1947-57.

In figure 5, landings on the United States west coast and by the Japanese live-bait fisheries are compared. For the more recent years, after 1950, the landings show some corresponding trends. For example, 1952 was a particularly good year in both fisheries, and 1954 and 1955 were relatively poor in both. This apparent relationship breaks down if the earlier years are included.

From the point of view of fish sizes exploited by these two fisheries, with the American fishery taking smaller fish in general than the Japanese fishery (Otsu, T.[3]), it would appear more reasonable to expect correspondence in landings not on a year-to-year basis, but rather between year N in the American fishery and year N+1 or N+2 in the Japanese fishery if the fluctuations in annual landings are reflections of actual abundance. This assumes that availability factors remain the same from year to year, which of course is not entirely true for the albacore. While it is possible that an exceptionally good year in the Japanese fishery would be followed by a good season in the American fishery, or vice versa, there are probably other factors which affect the occurrence of fish in the two fisheries to such an extent that any clear relationship in the landings could not be expected.

3/See page 8.

DISCUSSION

It has not been possible to compile satisfactory statistics on fishing effort to be examined in relation to the gross landings statistics presented in this report. It is known that following the war the Japanese have continued to enlarge their fishing fleets, and have built larger vessels capable of fishing in more distant waters. A recent survey conducted by the United States Department of the Interior (Anonymous 1958) found that the number of Japanese fishing vessels had doubled since 1951. This expansion, although not applied to the albacore fishery alone, has nevertheless affected the catch of albacore, particularly in that portion of the landings accounted for by the numerous independently-operating long-liners fishing in distant tropical waters. While the Japanese have increased their fishing capacity with a view toward increased production, the situation on the United States west coast has been quite different. According to the same survey, the United States albacore fleet has been reduced from 3,000 to 1,000 boats in recent years. The general situation can perhaps be deduced from conditions prevailing in the tuna industry as a whole. According to Samson (1957), the 1957 California tuna clipper fleet (vessels over 50 gross tons) numbered only 146 as compared to the 1951 total of 210. Similarly, the tuna purse-seine fleet underwent a drastic reduction of from 163 vessels in 1947 to 58 by the end of 1957.

The available data on fishing effort do not permit a detailed analysis of the effect of effort on the level of landings. Judging from gross catch statistics alone, it might be reasonable to deduce, however, that there was perhaps a parallel increase in catch with increasing effort in the Japanese fishery. The fact that their present landings are triple those of prewar years attests to this. It is of course possible that the catch has not kept pace with effort, and that there is a general leveling off of catch relative to the rising effort. It is not possible to determine this without detailed data on effort, but in the face of the continued high level of production in the last several years, it seems unlikely that exploitation has seriously affected the albacore stock.

While it is true that the Japanese have had to build larger vessels and go farther from Japan in order to meet their catch goals, it must be realized that the present level of albacore landings is significantly higher than the prewar level. Their two North Pacific fisheries appear to be quite stable, even at the present high level of catch. There is no indication of a declining resource. While the South Pacific fisheries are relatively recent in origin and may not have stood the test of time, the present status of the Samoa-based fishery or the mothership operations is encouraging as far as albacore catch is concerned.

Catch statistics, although not reliable when considered alone, indicate that the albacore resources in the Pacific are extensive, and that production can probably be increased particularly by exploitation of new grounds, as shown by the Japanese in the South Pacific. In the absence of catch per unit-of-effort data it is not possible to evaluate the situation in the present North Pacific grounds with any degree of confidence. While the annual fluctuations in the landings of these fisheries from "good" through "poor" years may possibly indicate that much heavier exploitation will not substantially increase production, it also appears unlikely that these fisheries are being overexploited at present. All indications on the present status of the albacore fisheries point to a parallel rise in effort and catch through a background of erratic natural fluctuations.

SUMMARY

1. Catch statistics are presented for the major Pacific albacore fisheries which include: (1) the United States west coast summer to fall fishery, (2) Japanese winter midocean long-line fishery, (3) Japanese western Pacific spring to summer live-bait

fishery, (4) Japanese tropical Pacific mothership fishery, (5) Japanese tropical Pacific foreign-based fishery.

2. The American fishery has been beset with marked fluctuations in production. With the establishment of the canning industry in California in 1903, albacore landings increased until 1925 when the species suddenly failed to appear on the west coast in its usual abundance. Landings were negligible until around 1938. In the last decade, the landings have shown a downward trend following the peak year of 1950 with 36,000 tons until 1954 when approximately 13,500 tons were landed. The last few years again showed a trend toward greater catches.

3. The Japanese landings of albacore, which averaged a little over 16,000 tons a year between 1930 and the onset of World War II, have in recent years increased to an average of more than 55,000 tons (1951 to 1957), or more than three times those of prewar years. This tremendous increase reflects the increasing demand in the United States for canned albacore, since the bulk of the Japanese landings are exported to the United States for that purpose.

4. Japan accounts for an average of 75 percent of the combined albacore catch of the two countries, United States and Japan.

5. Of the several Japanese fisheries for albacore described, the two oldest, and also the most important, are the winter long-line and the spring-summer live-bait fisheries. Both of these fisheries are conducted in the Temperate Zone of the North Pacific. The live-bait fishery is the leading source of Japanese albacore.

6. The tropical fisheries are relatively recent in origin. Two distinct tropical fisheries, the mothership and the foreign-based, are described. There is a third category, not considered in this report due to lack of separate statistics, and this is the group of independent Japanese tuna long-liners which operate in tropical waters without benefit of either a mothership or a foreign base. These vessels undoubtedly account for significant quantities of albacore. In the tropics all albacore are taken by the long-line method, and seasons are not clearly defined as in the Temperate Zone North Pacific fisheries. It is shown that albacore has come to figure more prominently in the landings of these fisheries in recent years, and this is believed due to a purposeful shift in species emphasis.

7. Since frequent reference is made to the apparently close relationship between the American and Japanese fisheries, that good and bad years appear at the same time in both fisheries, the landings of the American fishery were compared with landings of the Japanese live-bait fishery. A relationship as alluded to is not clearly evident.

8. Although detailed data on albacore fishing effort are not available, the general situation prevailing in the tuna industries of the two countries may be indicative of any general trends. This shows that the Japanese have been building larger vessels and have continued to enlarge their fishing fleet ever since the end of World War II. In addition, they have expanded their fishing grounds to include more distant waters. Along with this increasing effort, there was a parallel rise in the level of albacore landings. The situation is apparently quite different in the American albacore fishery and it is unlikely that there was any increase in fishing effort over the last few years.

9. Catch statistics of the various albacore fisheries show no evidence that exploitation has had any detrimental effect on the albacore stock. There appears to have been a parallel rise in effort and catch through a background of erratic natural fluctuations.

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SWIMMING SPEEDS OF FISH

Swordfish can swim at speeds up to 70 miles an hour; the wahoo can hit 37, the blue shark 24, salmon 24, trout 23, pike 20, bass 12, carp 7.6, and man 4.01.