TUNA

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United States Department of the Interior, Fred A. Seaton, Secretary
Fish and Wildlife Service, Arnie J. Suomela, Commissioner
Bureau of Commercial Fisheries, Donald L. McKernan, Director

TUNA INDUSTRY CONFERENCE PAPERS, MAY 1959

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FOREWORD

During the past decade the tuna industry in the United States has declined under economic pressures. Specifically, domestic producers have been increasingly displaced in open-market competition by foreign fishermen and foreign products. A direct solution of this problem through legislation or arbitration lies outside the function of the Bureau of Commercial Fisheries and the United States Department of Interior. Any solution is complicated by considerations of foreign policy.

The Bureau of Commercial Fisheries, however, can strive to improve the competitive position of the domestic industry through a well-designed program of research and services. This program would include the best possible understanding of oceanography and the biology of the tunas, aiding the industry in the development of improved harvesting and processing techniques, and the timely dissemination of pertinent information to various segments of the industry.

Accordingly, the Bureau is intensifying the study of world trends in tuna production, processing, and marketing, and is expanding its biological and technological research. To help formulate a program, the Bureau invited representatives of the domestic fishing and processing industries to participate in a discussion of the present and future plans. The result was the Government-Tuna Industry Meeting held at University of California, Scripps Institution of Oceanography, La Jolla, California, May 19 to 21, 1959, under the chairmanship of the Director, Bureau of Commercial Fisheries. At this meeting, staff members and contractors of the Bureau, the California Department of Fish and Game, and the Inter-American Tropical Tuna Commission, presented for review a comprehensive survey of the world tuna fisheries and the problems of the domestic producers and processors. Current and possible future research was outlined and discussed.

This report includes the contribution of the Bureau and the other research agencies named above, in essentially the same form as given at the meeting. The extensive discussion and the comments of industry participants have all been recorded but are not reported here. The transcript may be consulted by interested industry members in Washington or in principal offices of the Bureau in the area. The formal proposals of industry representatives and the entire proceeding are receiving careful study by the Bureau.

Donald L. McKernan
Director

PART 1

THE WORLD TUNA RESOURCE AND FISHERY

THE TUNA RESOURCE IN RELATION TO OCEANOGRAPHIC FEATURES

by

Vernon E. Brock 1/

The tuna resources of the world occupy the surface waters of the open sea, and thus are known as pelagic fishery resources. More than a dozen species are included in the catch, but the most important are yellowfin, skipjack, albacore, bigeye, and bluefin. In weight of landings the bonito outranks several tuna species. Bonito, however, is not strictly a tuna, and the fishery is relatively localized, principally in waters exploited by Peru.

The principal kinds of tuna named above are not necessarily true species, but composites of several closely related forms. Bluefin tuna, particularly, include several species not very closely related. The common names do, however, characterize fish of similar habits, caught in general by the same fishing methods, hence suitable for discussion as a unit.

FOOD RELATIONSHIPS

Let us consider very briefly the role of the tuna in the economy of the sea. Tuna are predaceous fishes living in the upper layers of the ocean; even the so-called sub-surface species, such as large bigeye, yellowfin and albacore in the Tropics, find suitable habitats in the upper 100 fathoms of water, a very thin layer in terms of the average oceanic depths of 2000 to 3000 fathoms. The large tuna - bigeye, yellowfin, and bluefin - rank among the climax predators, while medium-sized and smaller forms are intermediate predators that feed on even smaller forage animals and are eaten in turn by larger predators. It is of interest and of importance to consider this aspect of the food habits of tuna in some detail, even if relatively little is known on the subject.

As is true on land, all food chains in the open sea begin with plant life, and in this case with single-cell drifting plants, the phytoplankton. These in turn are consumed by many of the small animals forming collectively the assortment of creatures called zooplankton. These animals are in turn fed upon by predaceous members of the zooplankton and by small fishes and squid. In general the predatory forms are larger than the prey and there are fewer of them. Each level in a food chain is estimated to pass along only one-tenth as much material it obtains from the level below it; hence, the greater the number of steps an animal is removed from the primary food (phytoplankton), the smaller will be the mass of predators it can support.

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Tuna are at best four or five steps above phytoplankton in the food chain and are, therefore, likely to constitute less than a few percent of the total mass of animal life in the sea. As tuna grow they shift their position along the food chain, feeding generally on larger predaceous fishes and squid, which in turn implies that the total weight of large tuna which the sea can sustain is less, and it may be much less, than the total weight of the smaller sizes.

This aspect of the relation of tuna sizes in food chains is mentioned since it may be of interest in the consideration of yields from longline fisheries, which seem to fish the larger tunas rather selectively.

OCEANOGRAPHIC FEATURES AND TUNA HABITATS

Let us consider the major oceanographic features of the oceans in relation to tuna habitats. First let us review the major current systems of the oceans of the world (fig. 1). In the equatorial regions of the Atlantic and Pacific there is a westward transport of water north and south of the equator by the North and South Equatorial Currents. As these currents approach the western boundaries of the oceans they turn poleward, skirting the eastern shores of the continents, thereby transporting large large volumes of relatively warm water into temperate latitudes. In the Northern Hemisphere between 30° and 40°N. these currents leave the continental shores to flow in a northeasterly direction. Southerly-flowing cold currents, the Oyashio in the Pacific and the Labrador Current in the Atlantic, join and mingle with the Kuroshio and Gulf Stream as they carry the water back again to the eastern sides of the oceans. Processes of mixing and cooling change the characteristics of these currents, so that when they reach the western shores of the continents they are no longer tropical, but cool and temperate. Here again the currents divide, in the Pacific forming an eddy in the Gulf of Alaska and the southward flowing California Current, in the Atlantic penetrating as far north as Spitzbergen and the Norwegian coast and also forming the Canary Current off Spain and the west coast of Africa. These currents are cool, but not cold, and transport cool water well into the tropics, where they swing offshore once again in the equatorial region, completing the cycle.

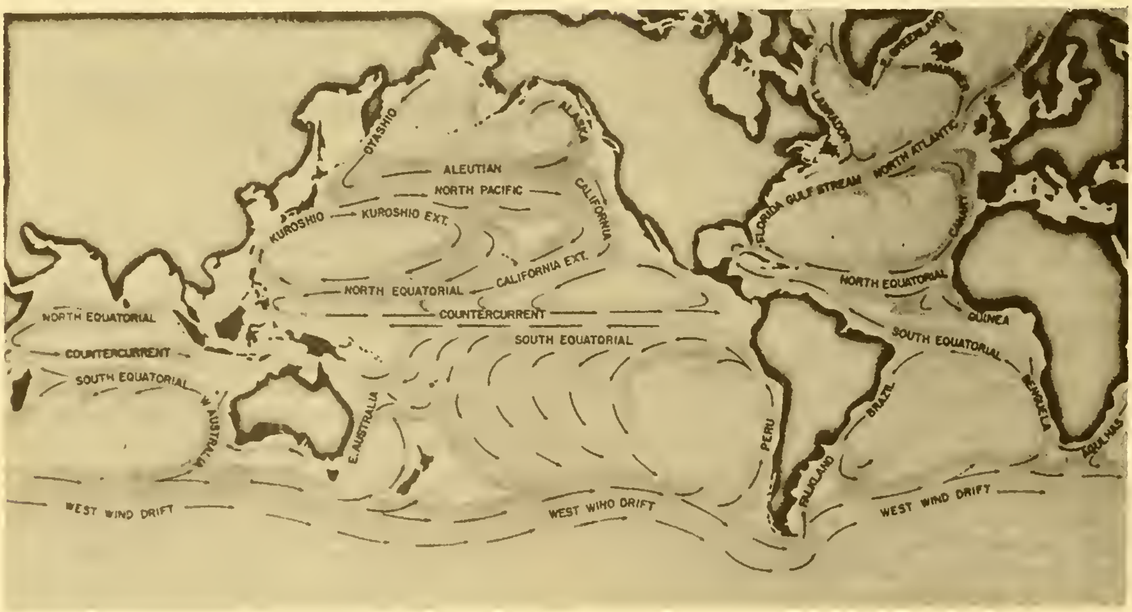

Figure 1.--Ocean current systems.

of the ocean, flows along the coastal area towards the Equator. This current is cool, but not cold, and transports cool water well into the tropics, where it turns offshore and the cycle repeats itself with the current again crossing the ocean in the equatorial area.

This circulation gives rise to substantial differences in the general conditions on the western and eastern sides of the oceans. The western sides are characterized by a very broad belt of tropical water and a very narrow belt of temperate water with rapid transition to the cold waters of higher latitudes. The eastern sides, however, are characterized by a very broad belt of temperate water and a very narrow belt of tropical water. These differences affect the thickness of the upper mixed layer in which there are virtually no vertical temperature differences. Generally in the tropical areas in the eastern portion of the oceans this layer is quite thin, from 50 to 200 feet thick, with a layer of cold water lying immediately below. Conversely, on the western side of the ocean the upper mixed layer is quite thick, frequently over 400 or 500 feet. Figure 2 is a cross section along the Equator of the Pacific Ocean from west to east, showing the relatively greater thickness of the mixed layer of warm water on the western side.

Seasonal warming and cooling of the northern and southern portions of the oceans also influences the depth of the upper mixed layer. In the northern summer months the northern waters warm up, forming a shallow warm layer over the surface of the sea (figs. 3 and 4, page 4). As winter approaches and temperatures fall, this mixed isothermal layer becomes deeper but colder (figs. 5 and 6, page 5). The same process takes place six months out of phase in the Southern Hemisphere. In effect the depth of the mixed layer changes seasonally in temperate latitudes, becoming shallow and warm in summer and deep but colder during the winter, but the seasonal pattern is less pronounced in the tropics (fig. 7, page 6). The effect of a limited tropical situation on the eastern side and an extended one on the western side in the summer seems to have an important influence on the distribution of the tunas and their fisheries. Attention is drawn to the marked seasonal change in sea surface temperature in North Western Pacific as contrasted with those in the North Eastern Pacific (fig. 7).

The areas which have a shallow warm water layer, (fig. 8, page 6) the eastern margins of the tropical oceans, are the only ones where major live-bait fisheries for yellowfin exist and where purse seining as a method for harvesting tropical tuna seems successful.

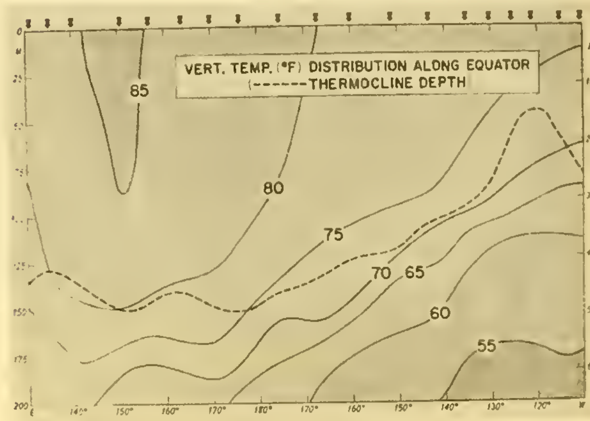

Figure 2.--Cross section of the Pacific along the Equator showing greater thickness of mixed warm water above the thermocline from vicinity of the Line Island westward (scale of depth in feet at right).

DISTRIBUTION OF TUNA

Essentially, what we know of the distribution of tunas comes from the location and volume of tuna catches. The characteristic of the fishery therefore affects the picture we have of the distribution and this should be kept in mind. Nevertheless, it is apparent that in general the distribution of the tunas falls within certain temperature limits and that they tend to be more abundant in regions of high biological productivity.

Defining distribution in terms of these and other environmental features is not yet practical, however, because so little is known of the specific habitat requirements of the fish. Distributions can only be described at present on the basis of catch data.

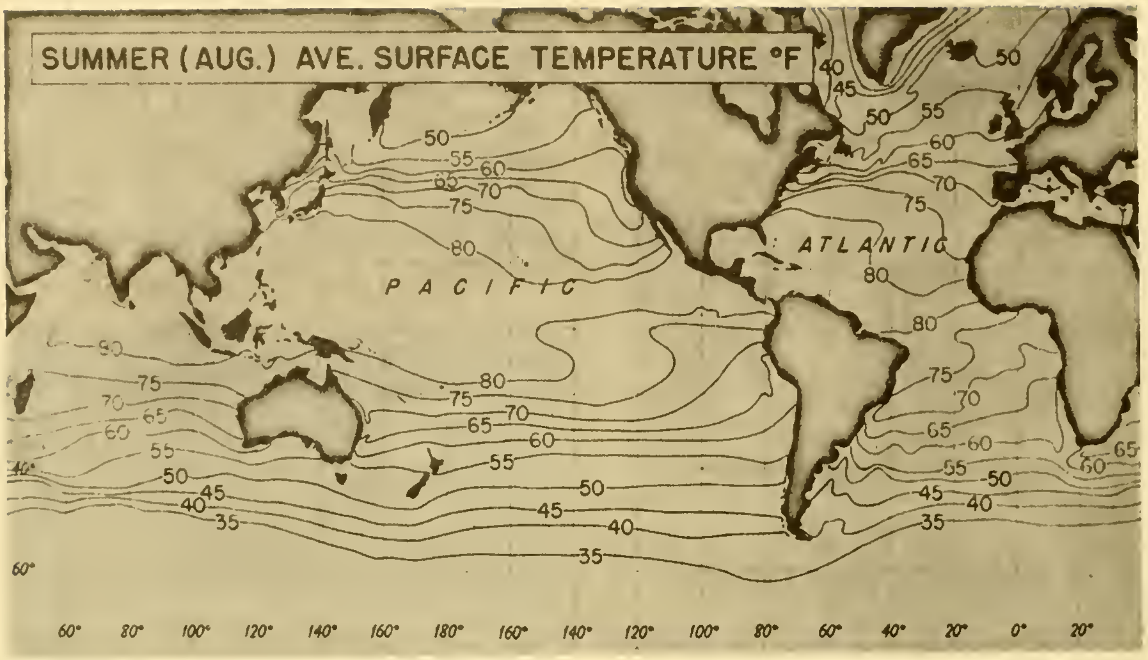

Figure 3.--Summer (August) average surface temperature.

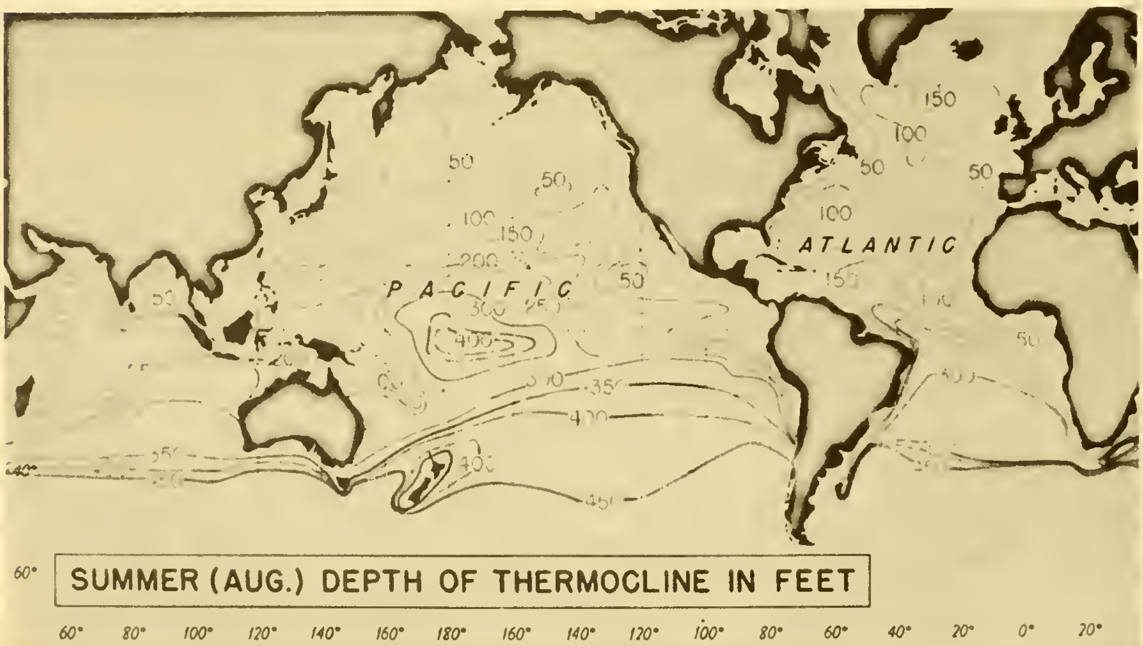

Figure 4.--Summer (August) depth of thermocline.

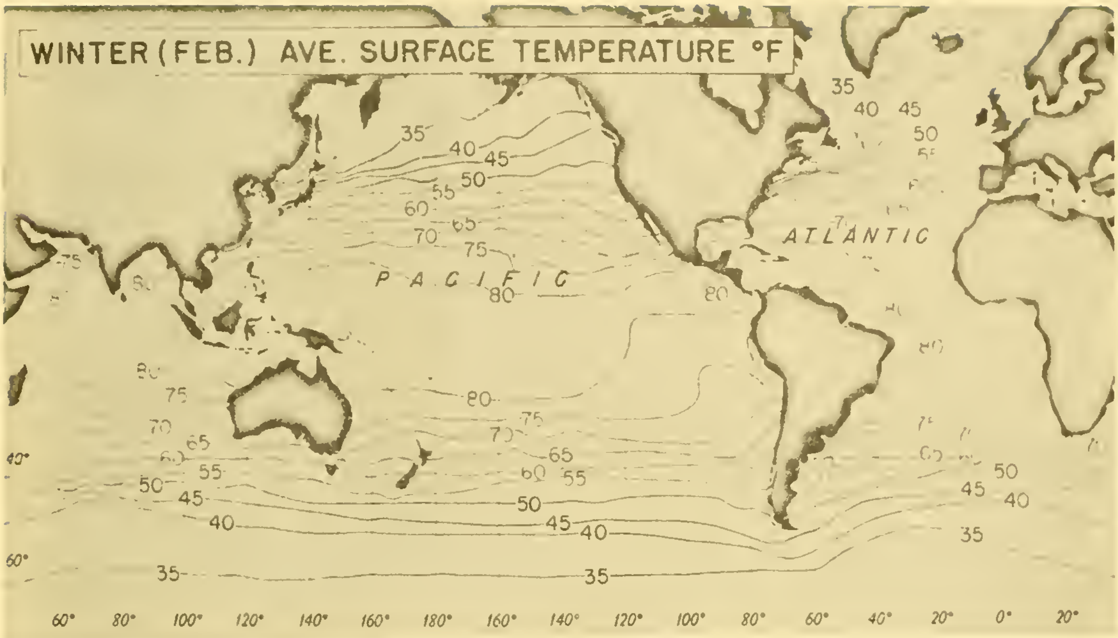

Figure 5.--Winter (February) average surface temperature.

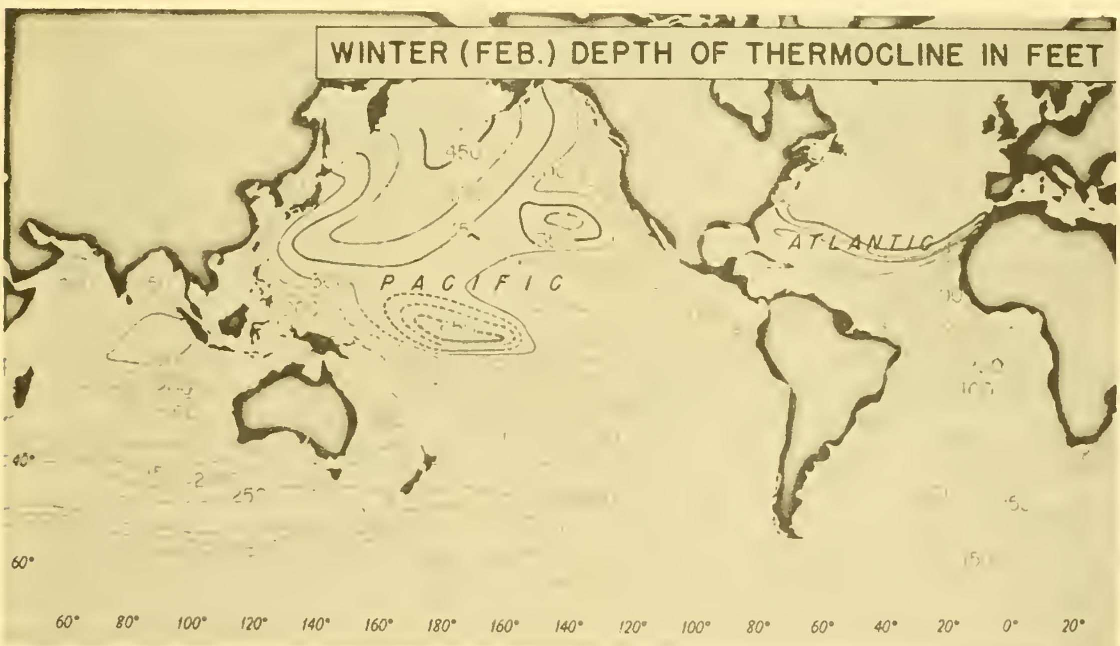

Figure 6.--Winter (February) depth of thermocline.

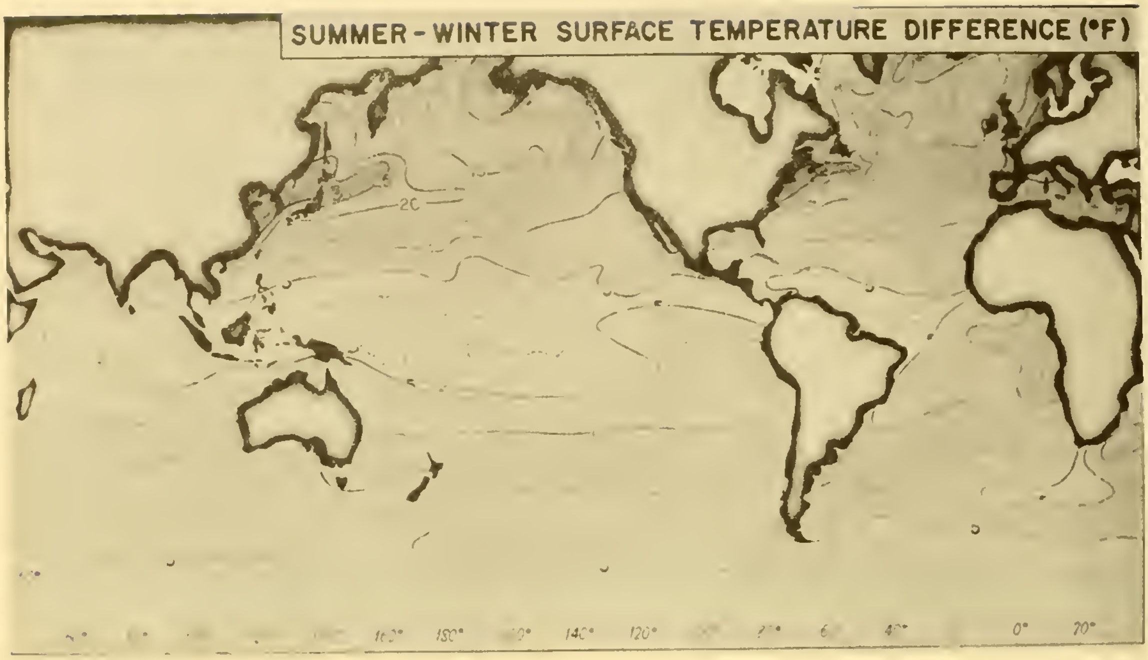

Figure 7.--Summer-winter surface temperature difference.

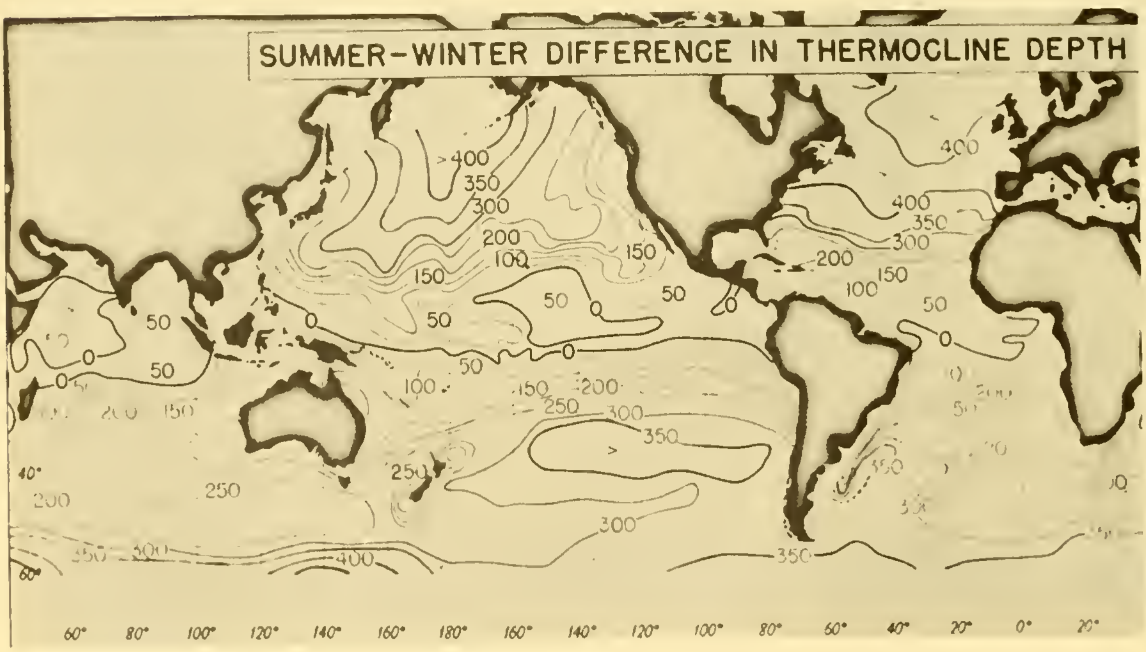

Figure 8.--Summer-winter difference in thermocline depth.

Yellowfin Tuna

The yellowfin tuna is a tropical species with seasonal poleward extensions in range. The pattern of distribution as shown in figure 9 is based, among other things, on information from the greatly expanded Japanese longline fishery which developed in the last few years, among others. The figure does not indicate seasonal difference in the occurrence of the fish so that relationships between the distribution of the fish and various seasonal oceanographic changes are obscured. The poleward extension in range coincident with summer warming is one example.

The Japanese fishery for yellowfin tuna in the western part of the Pacific extends far eastward toward Central America, and Ocean. In the eastern Pacific an American fishery extends along the west coasts of the Americas. Catches in the tropical Atlantic from Brazil to Africa represent a recent expansion of the Japanese longline fishery into that Ocean. A recently-developed and growing live-bair fishery for yellowfin exists off the west coast of Africa.

Skipjack Tuna

Figure 10 illustrates the distribution of skipjack stocks in the world. This species seems to have a somewhat more poleward range from the tropics than does the yellowfin. It seems to be somewhat more capable of penetrating areas of summer warming. Of the various species shown in the series of figures, the distribution of this one is probably the least accurate because skipjack is taken in substantial quantities only by live-bait boats and some purse seiners close to the west coast of Central and South America. The catches made by longline gear are so small and so scattered that they constitute evidence of the occurrence of the fish at a locality, nothing more. The live-bait fisheries are constrained by their need for bait to confine fishing operations where bait supplies are available; hence the figure really shows the areas where live-bait resources and skipjack populations coincide.

The purse-seine fisheries for this and other species seem to be confined to those areas which possess a relatively shallow mixed layer, a feature characteristic of the eastern sides of the various oceans. There is an absence of skipjack catches from a large area in the tropical western Pacific north of the Equator. This absence of tuna shows up also in the distributional patterns for other species, indicating that the current gyral which occurs here is probably an area of low productivity that will not support a large population of tuna.

Albacore

Albacore have a world-wide distribution (fig. 11). There are general similarities between this and the pattern of distribution for other species of tuna estimated from Japanese longline catches

Figure 9.--Yellowfin tuna distribution.

Figure 10.--Skipjack tuna distribution.

Figure 11.--Albacore distribution.

Figure 12.--Bigeye tuna distribution.

Figure 13.--Bluefin tuna distribution.

in the various oceans. There seems to be a center of abundance off Japan in the Pacific, spreading to the east across the Pacific and reflecting the location of the summer live-bait fishery and the winter longline fishery. Another center occurs along the west coast of North America and reflects the location of live-bait and troll fisheries. A third center representing catches of Japanese longliners spreads across the South Pacific and Indian Ocean, while a fourth area extends across the tropical part of the South Atlantic Ocean.

Albacore range somewhat further north and south than do either skipjack or yellowfin tuna, possibly indicating greater adaptability to cooler water than the latter two species. The tropical catches are longline catches taken at depths where presumably the water is cooler than that at the surface.

Bigeye Tuna

Figure 12, showing the catch of bigeye tuna, illustrates a distributional pattern similar to that of the other species discussed, with perhaps the better catches being made in an area of the North Pacific north of Hawaii and another broad band just north of the Equator, representing a zone of enrichment due to the interaction of the equatorial current systems. Here again, information concerning the distribution of bigeye comes primarily from Japanese longline catches, since the bigeye is not taken except occasionally and in small quantities by surface fishing methods, and where this does occur the species is frequently confused with yellowfin tuna.

Bluefin Tuna

Bluefin has essentially a different pattern of distribution than the more pelagic tuna species heretofore discussed (fig. 13). This species is harvested by traps in the coastal waters of Japan and the Mediterranean, by purse seines along the west coast of the Americas, and by seines and hook-and-line fishing in other areas. Several species are included under the name "bluefin", with the Australian northern bluefin (_Kishinoella tonggol_) being the most distinct. There is an Australian southern bluefin, and in the western North Pacific the bluefin is called _Thunnus orientalis_, or black tuna. The species in the eastern Pacific and in the Atlantic are both known under the same scientific name even though three distinct stocks of fish are probably here involved.

Tuna Spawning Areas

Figures 14 and 15 contain the available information on the areas of spawning and larval occurrence for two species of tuna, yellowfin and skipjack. The identification of the larvae of other species from plankton catches has not yet been made. Essentially these represent areas in which samples of plankton have been sorted for tuna larvae and the resultant data are available. They are poor guides to the relative abundace of tuna larvae, especially for the Indian Ocean where the collections from the rich Dana collections were not available. These figures illustrate two points:

1. Larvae appear to be abundant in tropical waters of the open ocean.

2. Although important skipjack fisheries exist off the coasts of Japan and the Americas, larvae are quite scarce in these regions.

Figure 14.--Distribution of yellowfin tuna larvae.

Figure 15.--Distribution of skipjack tuna larvae.

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TUNA FISHING METHODS AND THEIR APPLICATION

by

Vernon E. Brock 1/

The relative importance of different methods of fishing tuna are demonstrated by their contributions to the catch. The limitations and advantages of the various methods are a function of the distribution and behavior of the several species in relation to certain features of the environment. Such differences are described, particularly for the Japanese fisheries, which are the largest and most diversified in the world.

In brief, the more important methods of fishing are:

(1) gillnetting - chiefly of importance for the bonito in Peru;
(2) traps - used in both Japan and Europe for bluefin;
(3) trolling - important here and in Europe for albacore;
(4) purse seining - used in the U.S. chiefly for bluefin, but takes also substantial quantities of yellowfin and skipjack; used in Japan for bluefin tuna.
(5) live-bait fishing - important here for skipjack, yellowfin and in Japan, for skipjack and albacore;
(6) longline fishing - important chiefly in the expanding Japanese high-seas fishery for all species except skipjack, and in fact the method by which the largest quantity of tuna is taken by the Japanese; it constitutes the basis of the expansion of their tuna fisheries and is the only method presently available which appears to take such fish as the larger tunas in areas of the tropics where the mixed layer is deep.

JAPANESE TUNA CATCH BY SPECIES AND GEAR

Data for 1952 and 1957 are graphically presented in figure 1. In 1952 the live-bait method produced 60.6 percent of the total tuna catch (including yellowfin, bigeye, black tuna, albacore and skipjack), followed by longline which took 31.3 percent. In 1957 the picture has changed considerably with long line becoming the principal gear for tuna production.

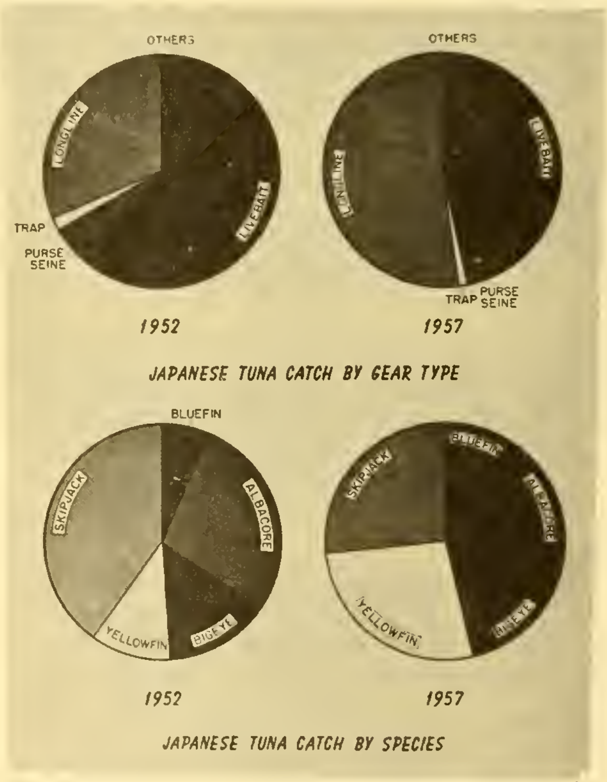

Figure 1.--Japanese tuna catch by gear type and species.

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Longline in 1957 took 52.1 percent of the total landings followed by live-bait with 41.7 percent. This changeover can be attributed to the increased effort on the part of the Japanese in exploiting tropical waters. Mothership expeditions have continued to increase production, vessels were based in foreign ports (such as Samoa and New Hebrides) and more and more larger vessels have been built which are capable of long voyages independent of motherships or foreign bases. This increase in longline catches (the picture for 1956 is quite similar to that shown for 1957) came about by the expansion of fishing grounds into the Indian Ocean around 1953 and the Atlantic at the end of 1956.

In 1952 skipjack dominated the landings accounting for 40.1 percent of the total tuna landings in Japan. Next in importance was albacore with 28.0 percent. There was a change in 1957 with yellowfin landings increasing tremendously (27.2 percent) followed by skipjack with 26.6 percent. This change is also attributable to increased exploitation by the larger longliners in

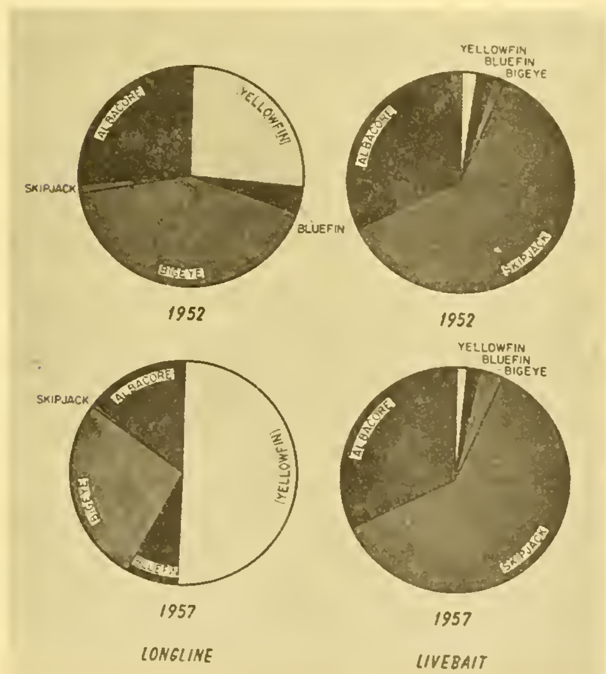

Figure 2.--Species composition of Japanese longline and livebait fisheries.

the tropical Pacific, Indian and Atlantic oceans. This change is quite apparent in figure 1.

The longline catch in 1952 consisted very heavily of bigeye tuna (42 percent) followed by equal amounts of albacore and yellowfin (26.5 and 26.2 percent). Bluefin (black tuna) and skipjack are rather insignificant in longline catches.

In 1957, yellowfin dominated longline landings (50.3 percent). This changeover is again due to increased longlining effort in recent years. Yellowfin landings which amounted to 25,500 tons in 1952, increased to 109,500 tons in 1957.

While not indicated in figure 2, in 1957, 96 percent of the total skipjack catch was made by the live-bait method. The remainder was taken by longline, trap, purse seine, and other methods. Similarly, 96 percent of the yellowfin catch was made by the longline method.

In the case of the bigeye tuna, 91 percent was made by longline and 9 percent by live-bait. Albacore was largely taken by live-bait (64 percent) and longline (36 percent). Forty-two percent of the bluefin (black tuna) was taken by purse seine and 41 percent by longline. About 9 percent was taken by traps (set nets).

The live-bait method accounts for about 75 percent of the United States Eastern Pacific tuna catch. However, purse seiners have increased their share of the catch of tropical tunas in the last three years.

OBSERVATIONS ON GEAR SELECTIVITY

Shown in the five panels of figure 3 are typical examples of albacore sizes taken by the different types of gear. For longline, we have shown two panels, one for a sample of sizes taken in the winter longline fishery by the Japanese, and the other from data obtained at the cannery in Samoa. The second represents sizes taken in the tropical South Pacific.

It may appear strange that the modal size of winter longline albacore in the North Pacific is slightly smaller than that of the Japanese summer live-bait fishery. As discussed in certain Japanese publica-

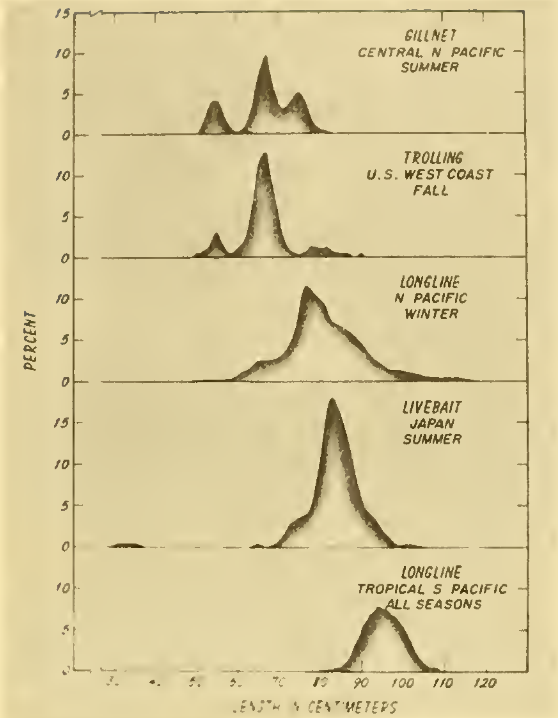

Figure 3.--Albacore sizes taken by various kinds of fishing gear.

tions, there is an alternate year shift in the modal sizes in longline albacore and our example happens to show the frequency for a year when the modal size was small. However, the important point of difference between longline and live-bait albacore in the North Pacific is the absence in the latter of the largest fish (above 50 pounds).

The size is greater in the tropical South Pacific. In Hawaii, although few fish are taken, the sizes are generally larger (60 to 70 pounds).

The gill net size frequency is based on albacore taken by POFI in the central North Pacific in the summer of 1956. The trolling data were obtained from landings made in Oregon during the 1958 season.

Examples of yellowfin sizes are given in three panels of figure 4. Live-bait catches on the U. S. west coast (data obtained from Inter-American Tropical Tuna Commission Bulletin II(5): 215-217); troll catches in the Line Islands; and longline catches in the Line Islands. The latter two panels were constructed from data published by Iversen and Yoshida (1957, Special Scientific Report--Fisheries No.203), based on work of the Honolulu laboratory.

Perhaps it is important to point out that yellowfin taken by longline throughout the tropical and subtropical Pacific differ widely in average size. Yellowfin from the Hawaiian Islands are, on the whole, the largest sampled to date, and there is also a general increase in size from west to east along the Equator in the Pacific. Examination of Hawaiian yellowfin samples showed that the mean size of the males is greater than the mean size of females in the dominant size groups sampled by longline. For example, in one year studied, the dominant female modal group was centered at about 120 pounds, and that of the male at about 130 pounds. There is also an unequal sex ratio among the larger fish in favor of the males (as is the case with albacore). Hawaiian yellowfin range in weight roughly between 50 and 290 pounds, while the Line Islands sample shown in the figure ranges upward to around 200 pounds.

In summary, the tremendous expansion of the Japanese tuna fisheries during recent years has been based on their use of the longline fishing method, which is an effec-

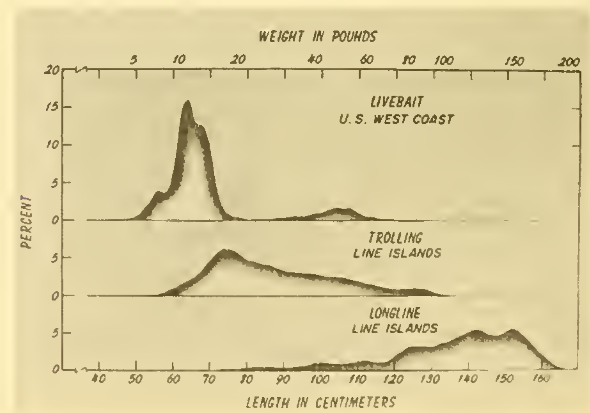

Figure 4.--Yellowfin sizes taken by various kinds of fishing gear.

tive method for taking most of the pelagic species of tuna, with the exception of skipjack, and is apparently the only practical method for taking these species in tropical waters where the mixed layer is of substantial thickness.

Japan, has, by using the longline method, expanded her fisheries throughout the tropical oceans of the world. This expansion also has been aided by establishing shore bases in various countries and by using motherships.

The temperature structure of the tropical oceans seems to be such that the live-bait method is not generally useful for yellowfin tuna except in those areas where the warm surface layer is relatively thin, 200 feet or less. This situation seems to occur only along the eastern borders of the Pacific and Atlantic oceans, and it is in precisely these areas that live-bait fisheries for yellowfin are important.

The longline seems to harvest rather selectively the larger size fish, and it is likely that these larger fish are substantially less abundant in terms of weight and especially in terms of numbers than are the smaller fish composing the same populations. This would imply that fishing techniques, which could be utilized where the mixed layer is relatively thick and would take broader ranges of sizes than is true for the longline, might permit harvesting of substantially greater amounts than could be obtained by the use of the longline method. Modest quantities of skipjack are taken by purse seines in the eastern borders of the ocean, but here, as elsewhere, skipjack catches are dependent upon the availability of live bait. Bait fishes are characteristically fishes of inshore areas, whereas skipjack appear to be generally abundant throughout the tropical ocean regions, hency adequate bait supplies are not usually available in areas where skipjack are abundant. This explains the concentration of skipjack fishing at the borders of the ocean.

It is of interest to observe that the Japanese live-bait fisheries have not undergone any expansion during recent years. In fact, the only expansion of major importance in live-bait fishing would seem to be that principally by the French along the west coast of tropical Africa.

The under utilization of some of the stocks of skipjack can be judged by an examination of the recent history of one Japanese fishery for skipjack in the western Pacific. In 1937 the Japanese took over 30,000 tons of skipjack from the mandated islands fisheries. There is no significant skipjack harvest from this area today because they are not permitted to obtain bait from the inshore waters of these islands.

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WORLD TUNA PRODUCTION

by

Donald R. Johnson [1]

The United States tuna fishery began in about 1900, and was a minor fishery for many years. After 1920 the production of lightmeat varieties of tuna, particularly skipjack and yellowfin, increased rapidly. By the 1930's a fishery reaching into waters off Central and South America was established (fig. 1). As is well known to the tuna fishing industry, and as we shall learn more fully in the course of our meeting, the Japanese tuna fishery is the chief competitor of the United States fishery both in supplying the United States consumer and in leading world tuna production.

The Japanese fishery adjacent to the Home Islands is of great antiquity and references to fishing long before the era of the power boat can be found in Japanese literature. With the advent of powered boats, the Japanese commenced fishing their local areas more effectively and the supply and demand for tuna in Japan rose accordingly. Though the Japanese consume primarily light-meat tunas, there has developed a considerable Japanese fishery for albacore for export to the United States. Export of albacore to the United States started in the mid-1920's and was well established by the 1930's.

With the increasing demand for tuna products, operations in home waters approached saturation and it became evident that a further increase in production would require exploitation of new fishing grounds. Accordingly, in the 1930's the Japanese made extensive explorations for new grounds ranging throughout the entire western Pacific Ocean as far east as the Hawaiian Islands, south to the areas around New Guinea and the Dutch East Indies and southwest into the Indian Ocean. The initial expansion was based on live-bait fishing operations and the primary production in the distant areas (Philippines, Dutch East Indies and Mandated Islands) was skipjack. Long-line operations did not begin until the late 1930's. Exploitation of the mid-Pacific albacore grounds also commenced during the 1930's. The military operations of Japan during the 1930's and 1940's however, arrested this expansion, but it was resumed shortly after World War II ended.

Figure 1.--Tuna fishing areas in Eastern Pacific Ocean.

1/ Area Director, Bureau of Commercial Fisheries, Terminal Island, California.

Peru is the World's third most important producer of tuna, ranking after Japan and the United States, Peru is situated immediately adjacent to some of the richest ocean waters of the world, but until the 1940's its tuna production was negligible. During the war, however, there was a demand for protein food and the tuna fishery was stimulated by outside investment and is now a factor of significance in the world picture. Roughly 85 percent of the catch is bonito.

There are numerous other tuna fisheries in the world, many of great antiquity. Some of them will be discussed briefly in later sections of this paper.

Sources of Data on Tuna and Bonito by Countries

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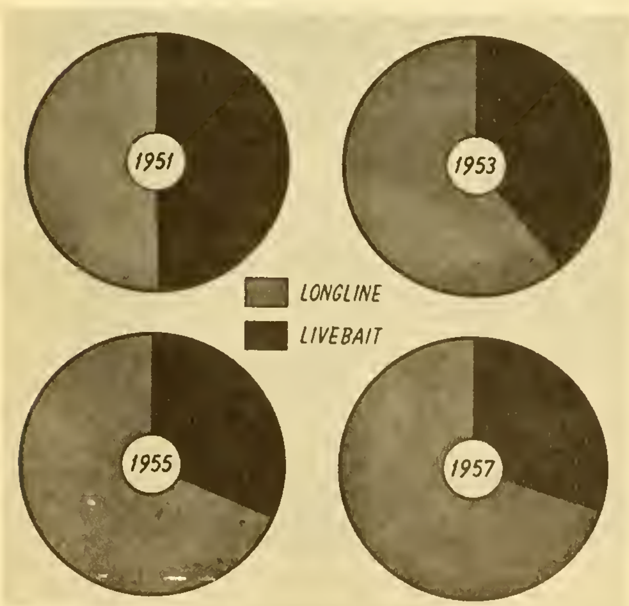

Figure 2.--Percentage composition of Japanese tuna vessels larger than 50 tons (1951, '53, '55, and '57).

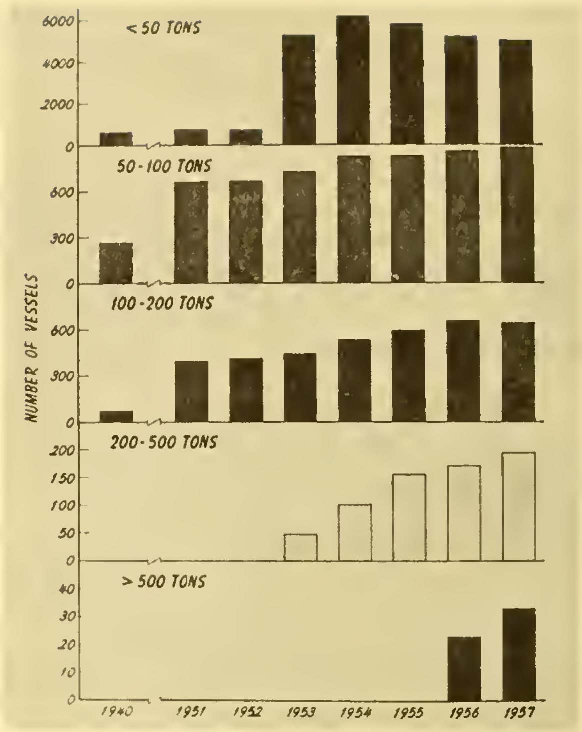

Figure 3.--Number of Japanese tuna vessels - longline and live bait (1940 and 1951, '53...'57).

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EXPANSION OF JAPANESE TUNA FISHERIES

Japan is the leading fishing nation of the world. Crowded as the Japanese are on the home islands with a large population and limited arable land, they have turned their attention to the sea and consider that they have a stake in the fish of all the world's ocean.

In 1957 Japan's fisheries produced over 11 billion pounds of fish and other aquatic products (More than double the United States catch). Japan produces roughly half of the world's tuna while the United States produces only about one fifth.

Fleet Expansion

The Japanese tuna fleet has long been one of the world's largest and since the war it has increased considerably through the aid of a Government vessel subsidy program. Over 500 tuna vessels (77,000 gross tons) have been built in less than two years. The gross tonnage of the fleet has risen from 78,517 in 1947 to 197,760 in 1956 (table 1).

Table 1.--Increase in size of Japanese tuna fleet, 1947-56.

Year	Vessels	Gross tonnage	Average gross tonnage
1947	1,314	78,517	60
1948	1,811	101,008	56
1949	1,893	106,897	56
1950	1,895	108,753	57
1951	1,698	103,978	61
1952	1,590	108,319	68
1953	1,672	124,132	74
1954	1,801	154,133	86
1955	1,825	176,243	97
1956	1,772	197,760	112

It should also be noted that during the period of reconstruction of the Japanese fleet in the early 1950's there was a shift toward building larger and larger vessels. In 1948 the average vessel size was 56 tons and by 1956 the average size was 112 tons, or double, with some larger vessels approaching 1000 tons. More recently there has been a return to building more modest-sized vessels.

Geographical Expansion

We have already noted how Japan's ancient tuna fishery rapidly developed after the advent of powered vessels and how there was a continual expansion of her fishing area, curtailed only by pre-world War II military demands (fig. 4). Japan's economy after World War II was at first controlled by the Allied Military Government and fishery operations were limited. With the end of the Occupation in 1952 however, Japanese vessels quickly spread their activities in to the western, central and south Pacific and the Indian Ocean (the groundwork had been laid by prewar Government research). In 1956 they moved into the Atlantic (fig.5) and more recently there has also been some Japanese fishing in the Eastern Tropical Pacific. Although the geographical expansion may be approaching a maximum, Japan is continually searching for new fishing grounds.

Foreign Based Operations

There were no restraints on Japan's fisheries in the world's oceans after April 1952; a few notable exceptions are areas along the Chinese and Korean Coasts, the Sea of Okhotsk and the North Pacific off Kamchatka. Accordingly, her fisheries rapidly spread, and especially in search of tuna, they operated at greater and greater distances from the homeland. As distances to fishing grounds increased, bases abroad were sought and fishery operations based overseas came into existence. An outstanding advantage of foreign based operations to the Japanese is that fishing can be carried out with short-range vessels. Joint overseas fishing enterprises have been sponsored primarily to invest Japanese capital in areas where rich fishery resources exist, to relieve pressure on Japanese resources by removing vessels or fishermen from the Japanese coastal fisheries, to foster emigration, and by providing them with bases nearer the fishing grounds, to reduce the cost of operating large vessels in overseas areas.

Kinds of Japanese overseas fishery arrangements are (1) joint companies to conduct fishery and processing operations, (2) contracts or concessions to supply fishery products to local markets or processing plants or for export, (3) technical assistance, (4) exploratory fishing, (5) refueling or transshipment bases, and (6) direct sale of high seas catches in a foreign port. The agreement with any foreign country may include one or more of these arrangements. Some joint fishing enterprises are conducted at the request of foreign countries to train their nationals in modern fishery methods and to provide fishing products for the local market or export. Some have been established primarily to explore the possibility of tuna fishing in waters distant from Japan.

Recent information indicates that joint fishing companies are actually in operation in about 15 countries, principally in Asia and Latin America. The Japanese Overseas Fishery Cooperative Association,

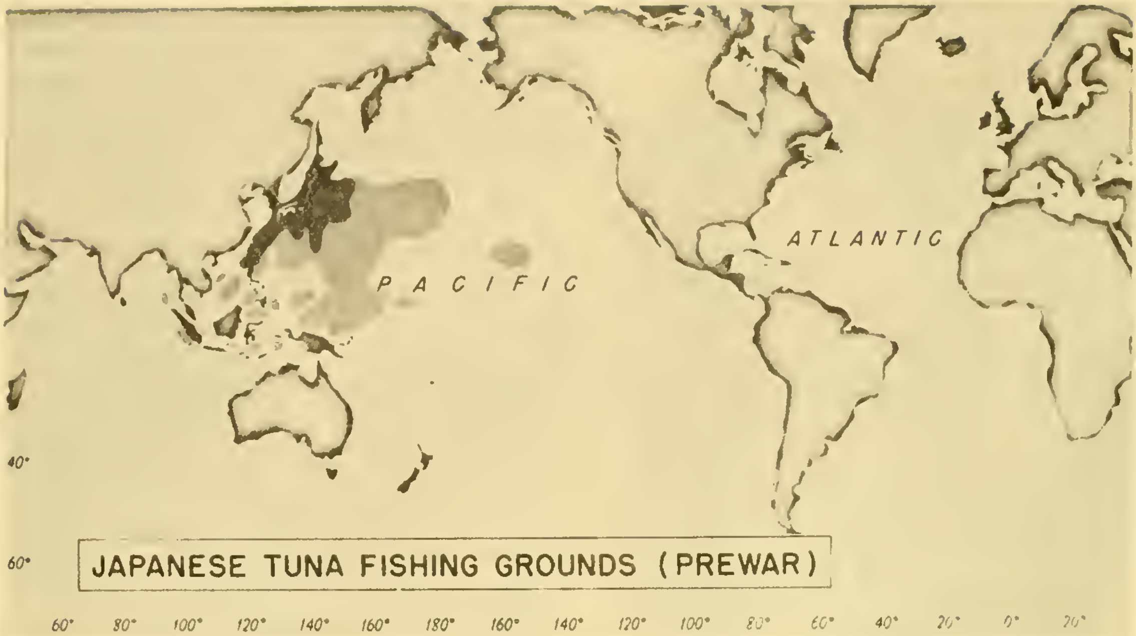

Figure 4.

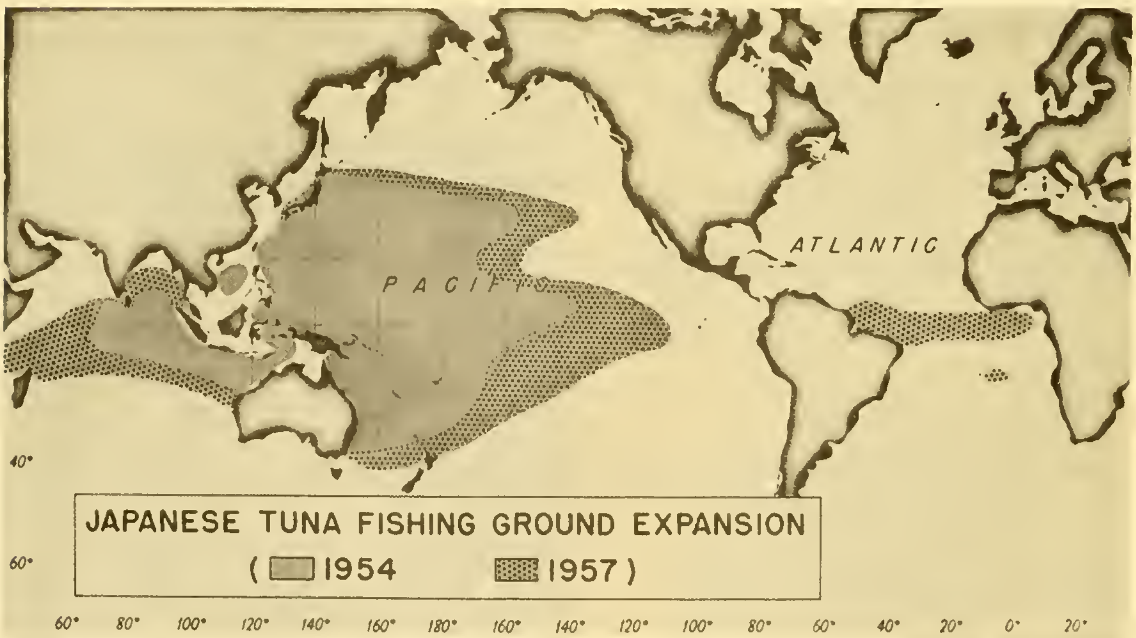

Figure 5.

founded in 1956, reported that by mid-1958 there were 38 active overseas projects. These included 12 joint enterprises, 9 programs in which vessels or technical guidance were provided, 16 foreign based fishing operations, and 1 arrangement for direct export. At that time nearly as many more projects were in various stages of implementation.

Japanese overseas fishery enterprises in one or more of their many forms are now in operation or planned in more than 35 countries. Approximately 140 Japanese fishing vessels are based in foreign countries and engaged in joint operations, concession fishing, or in training or investigational work with respect to tuna. The areas of overseas tuna activities are presently the Indian, and South Central and Eastern Pacific and the South and Central Atlantic Oceans (annon., 1959b, fig. 1), as illustrated in figure 6. Tuna processing plants are being planned, built or are in operation in about fifteen countries.

Japanese governmental control and sponsorship of overseas fishery operations is considerable and is exercised through the Japanese Fishery Agency and the Japanese Overseas Fisheries Cooperative Society. Bilateral and multilateral agreements between fishing companies of Japan and other governments or foreign companies also play a large part in controlling overseas operations.

The Japanese Government controls overseas fishing operations chiefly through licensing fishing operators and by limiting the number of licenses in some areas. Joint Japanese-foreign enterprises are not included in this quota or license system because the fishery is considered a part of the national product of the foreign country.

In order to assess trends it is useful to examine the monies budgeted by the Japanese Government for various activities. With respect to the development of new overseas fishing grounds, recent sums budgeted by the Fishery Agency were: 1956, $546,000; 1957, $545,000; 1958, $552,000; 1959, $981,000. For the promotion of foreign based fisheries the sums budgeted were: 1956, $38,000; 1957, $57,000; 1958, $14,000; 1959, $173,000. In each instance it will be noted that the amounts budgeted in 1959 are significantly increased over previous sums.

WORLD CATCH OF TUNA

The world catch of tuna, including bonito, has more than doubled from about 680 million pounds in 1948 to over 1.7

Figure 6.--Japanese fisheries based in overseas areas.

billion pounds in 1957 (fig. 7).

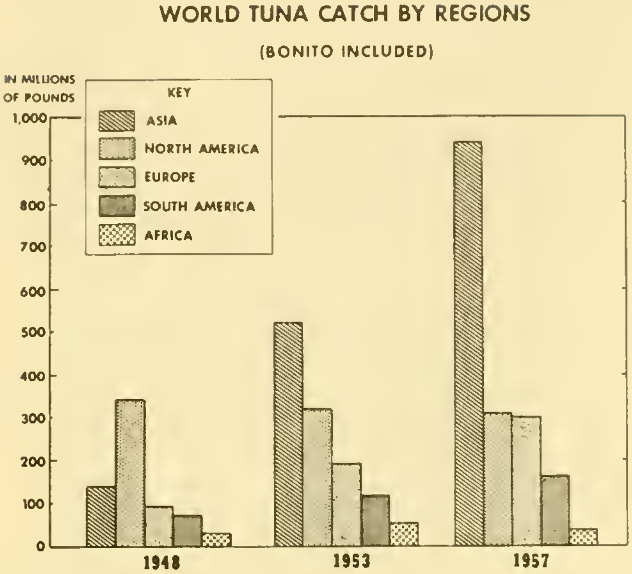

Figure 7.--World tuna catch by regions (1948, '53, '57), bonito included.

Note: The catches listed for each region are the catches made by the countries in the region regardless of where the fish were caught or landed.

To examine the trends statistical data will be compared for the years 1948, 1953, and 1957. In some instances, data for additional years are also considered.

Catch by Species

The world catch by species for 1948, 1953 and 1957 is shown in table 2. It is clear that production has been increasing steadily and that yellowfin has been dominant throughout. The largest category is "other tuna" but this includes bluefin, bigeye, little tuna, frigate makerel, and certain amounts of yellowfin, skipjack and albacore. The catch of Japan in 1948 was not recorded by species so it is included in "other tuna." Bonito has made an important contribution throughout.

Table 2.--World tuna catch by principal species, 1948, 1953 and 1957. (in millions of pounds)

Species	1948	1953	1957
Albacore	66	175	277
Skipjack	77	313	345
Yellowfin	203	218	379
Other tuna	223	333	446
Bonito	111	177	304
Total	680	1,216	1,751

Note: Adjustments made in F.A.O. French and Spanish catch data because breakdown was not complete.

Catch by Region

With the exception of North America, all regions of the world have shown increased tuna catches. During this decade the North American catch, consisting almost entirely of tuna landed by U. S. fishermen, declined from about 342 million pounds to about 310 million pounds. On the other hand, the Asiatic catch--dominated by Japan --has increased from about 145 million pounds to about 940 million pounds. The European catch, which includes that of Turkey and the European U.S.S.R., has tripled to about 300 million pounds; no single country has dominated the tuna fisheries of Europe. In South America tuna landings between 1948 and 1957 more than doubled to about 165 million pounds; Peru is the leading producer of tuna in this region.

Bonito is included with the tuna catch because it is interchangeable with tuna in certain markets, chiefly in Europe.

Table 3.--Tuna catch by regions, 1948, 1953 and 1957 (bonito included). (in millions of pounds)

Country	1948	1953	1957
Asia 1/	143.7	523.5	937.9
North America	342.4	323.8	308.8
Europe 2/	93.4	172.0	301.0
South America	73.4	123.3	163.2
Africa	26.5	54.2	35.9
Total	679.5	1,196.8	1,746.8

1/ Includes Australia.
2/ Includes Turkey and European USSR.

Catch by Country

The rank order, relative importance, and total catch of tuna and bonito made by the world's important tuna producing countries is shown in figure 8.

Landings are shown for all countries having a catch of at least 5 million pounds in any one of the three years selected for comparisons (fig. 8). As in the previous sections, a significant increase in production is apparent. Although tuna fishing is conducted by almost every maritime country

WORLD TUNA CATCH BY PRINCIPAL COUNTRIES, 1957
(BONITO INCLUDED)

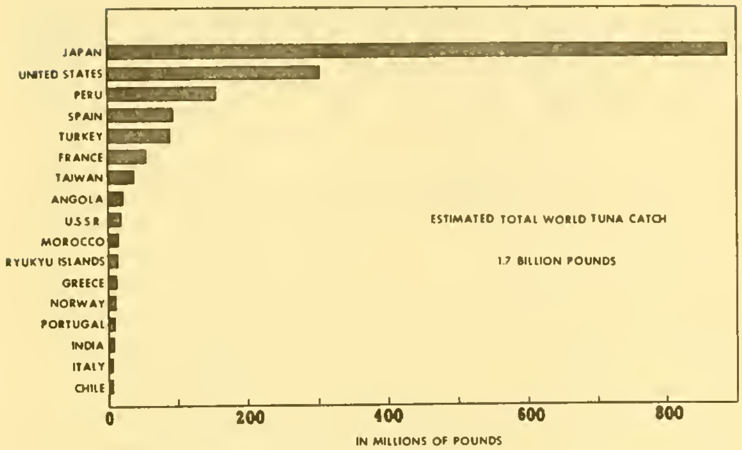

Figure 8.--World tuna catch by principal countries 1957 (bonito included).

great advances in tuna production will be made eventually by African countries.

In Asia, exclusive of Japan, the principal tuna producing country is Taiwan; Taiwan is in an excellent locality for expanding its tuna fisheries.

An examination of the species composition of the catch by countries will illustrate the basis of the fishery in each country and the manner in which they have developed during the post-war period. The seven principal producers will be discussed in the order of their importance in 1957.

bordering tropical and temperate waters, the fisheries are dominated by Japan and the United States. During this decade Japan has overtaken the United States and expended its tuna fisheries to produce a catch of 877 million pounds in 1957, compared with 305 million pounds for the United States.

In Europe most tuna producing countries have been increasing their catches; the most significant increases in this region have been made by France, Norway, Spain, and Turkey. Turkey is a producer principally of bonito which is plentiful in the Dardanelles, the Bosporus, and the Sea or Marmara. The USSR catch is believed to consist entirely of bonito taken in the Black Sea.

Countries on the Atlantic coast of South America are becoming tuna conscious because Japanese operations are showing that the fish are available in large quantities. Catches are small now but can be expected to increase, largely owing to joint Japanese-South American enterprises.

Sizeable tuna catches are being made in Africa by Angola and Morocco. However, no marked increase in their catches has occurred recently mainly because these countries lack the trained men and the gear necessary to conduct large-scale tuna fisheries. Japanese fishing operations in the South Atlantic and Indian Oceans indicate that large tuna resources exist off the African coast, and it is anticipated that

Table 4.--Tuna catch by principal countries 1948, 1953, and 1957 (bonito included).
(in millions of pounds)

Country	1948	1953	1957
ASIA			
India	(1)	2.0	6.6
Japan	125.0	491.5	877.2
Ryukyu Islands	7.7	7.1	13.5
Taiwan	10.8	21.6	38.4
NORTH AMERICA			
United States	338.9	321.6	305.3
EUROPE			
France	17.0	33.3	55.3
Greece	(1)	2.9	11.7
Italy	3.1	5.7	6.4
Norway	0.9	17.6	11.0
Portugal	6.6	15.9	9.7
Spain	61.5	72.3	93.1
Turkey	(1)	20.3	89.7
USSR	(1)	(1)	18.7
SOUTH AMERICA			
Chile	5.9	6.8	5.7
Peru	67.5	113.8	155.2
AFRICA			
Angola	12.6	34.6	20.5
Morocco	13.9	19.6	15.4
Total (principal countries)			1,733.4

NOTE: Country shown only if catch was 5 million pounds or more in 1948, 1953, or 1957.

NOTE: This does not include countries landing less than 5 million pounds of all species of tuna and bonito combined. If they were included the grand total for 1957 would be 1,746.8 million pounds (see table of catch by regions).

(1) Data not available.

JAPAN: TUNA CATCH BY SPECIES

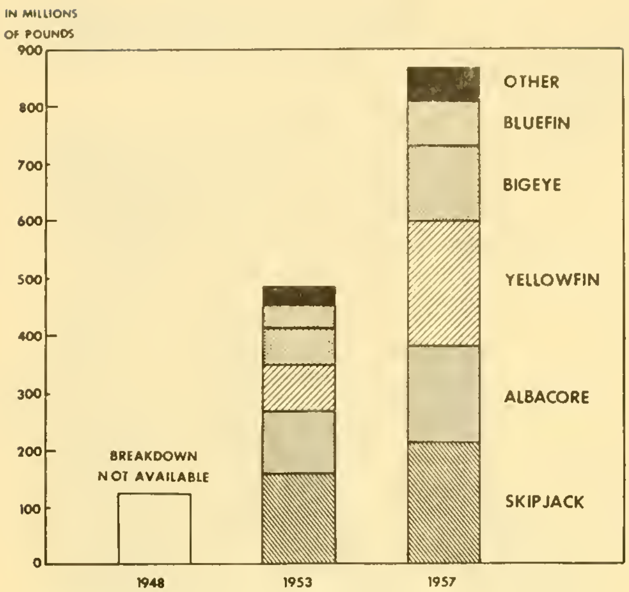

Figure 9.--Japan: Tuna catch by species (1948, 1953, 1957).

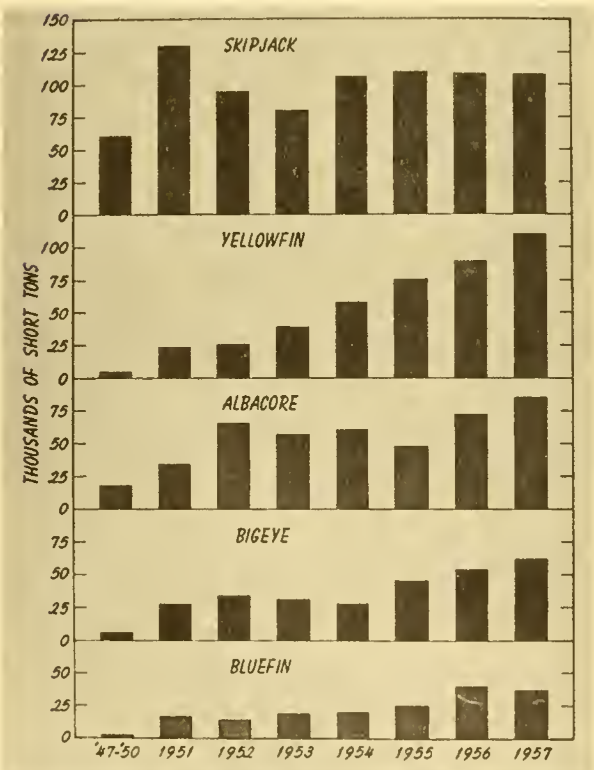

Figure 10.--Total Japanese tuna catch by species (1947-50 and 1951-57).

Japan

The Japanese tuna fisheries are diversified and produce species both for home consumption and for a constantly increasing export trade. The principal species consumed by the Japanese are skipjack, bluefin, and bigeye tuna. Albacore and yellowfin tuna are mainly exported. In 1953 Japan's tuna catch was 492 million pounds; by 1957 it had reached 877 million pounds (fig. 9).

One of the most noticeable changes in the Japanese tuna fishing industry has been the increasing use of long-line gear for fishing operations throughout the Pacific, Indian, and South Atlantic Oceans. Long liners accounted for 48 percent of the tuna catch in 1957 compared with 36 percent in 1954.

In figure 10 the average annual landings of the principal tuna species are given in one panel for the years through 1950 and in the other for the years 1951 through 1957. Only the skipjack catch has remained relatively constant throughout these two periods. Striking increases in the catches of yellowfin and bigeye tuna are largely due to the advent of long-line fishing.

Table 5.--Japan: Tuna catch by species, 1948, 1953, and 1957. (in millions of pounds)

Species	1948	1953	1957
Albacore	)	114.6	171.4
Yellowfin	)	79.1	219.5
Bigeye	)	64.3	133.0
Bluefin	) 125.0	38.8	75.5
Skipjack	)	160.3	214.9
Other 1/	)	34.4	62.9
Total	125.0	491.5	877.2

Note: Data not available on 1948 breakdown by species.

1/ Includes frigate mackerels and probably some bonito. In 1957, also includes 17.8 million pounds of young tunas not broken down by species.

United States

The trend in the United States catch of tuna has been downward. Figure 11 and table 6 shows the United States catch, including that of Hawaii for 1948, 1953, and 1957; Puerto Rican landings are not included.

The peak United States catch was made in 1950 when 403 million pounds were landed. Since then, the annual catch has fluctuated above the 300-million-pound level in all years except 1955, when it fell to 282 million pounds.

In most of the postwar years yellowfin was the leading species, followed by skipjack. In 1953 and 1954 the positions of these two species were reversed. These tropical tunas make up 80 to 85 percent of the United States catch. Albacore and bluefin are the other species landed.

Bluefin is at present the principal species landed on the Atlantic and Gulf Coasts. Little tuna, yellowfin, and bonito are lumped in the "Other" category in figure 11. "Other" also includes small quantities of yellowfin and albacore in 1948.

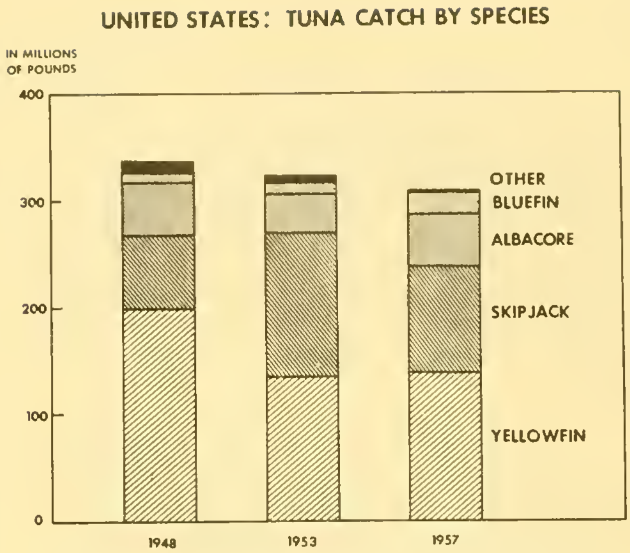

Figure 11.--United States: Tuna catch by species (1948, 1953, 1957).

Table 6.--United States: Tuna catch by species, 1948, 1953, and 1957. (in millions of pounds)

Species	1948	1953	1957
Albacore	49.5	34.7	46.7
Bluefin	9.5	11.7	21.3
Skipjack	68.6	135.0	97.0
Yellowfin	199.4	134.0	138.3
Other 1/	11.9	6.2	2.0
Total	338.9	321.6	305.3

1/ Bigeye, little tuna, and bonito. Also includes some albacore and yellowfin in 1948.

Table 7.--Peru: Tuna catch by species, 1948, 1953, and 1957. (in millions of pounds)

Species	1948	1953	1957
Skipjack	0.9	10.8	22.7
Yellowfin	3.8	5.1	5.3
Bonito	62.8	97.9	127.2
Total	67.5	113.8	115.2

Peru

The most important species in the tuna catch of Peru is bonito (figure 12). In 1957 bonito accounted for 82 percent of the total catch. Skipjack and yellowfin are also caught in considerable quantities. Total landings have been increasing rapidly.

Sizable amounts of bonito are consumed locally. Most, however, is canned for export. The United States and the United Kingdom are the principal markets for Peru's canned bonito.

The largest part of the skipjack and yellowfin catch is frozen and exported to the United States for canning. The remainder is either consumed locally or canned for export.

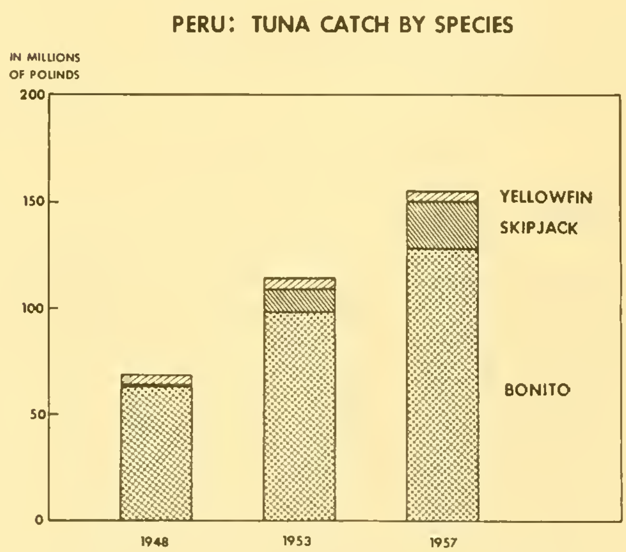

Figure 12.--Peru: Tuna catch by species (1948, 1953, 1957).

Spain

The Spanish tuna fisheries have been the most important in Europe. In 1957 the catch was 93 million pounds (fig. 13). The principal species are bluefin, albacore, and bonito; available statistics, however, include the large albacore catch under bonito. In 1957 albacore was believed to have contributed about 20 million pounds of the 51 million pounds indicated in figure 13 for the bonito catch. Little tuna, frigate mackerel and yellowfin are of lesser importance.

Since 1956 some Spanish vessels have travelled as far as the waters off Dakar, Africa, where they have made large catches of yellowfin. These waters are fished only during the winter season when fishing is poor close to Spain. A clipper-type tuna boat has recently been put into operation in Spain and successful trials by this boat may be the prelude to an extension of the range of Spanish operations.

Table 8.--Spain: Tuna catch by species, 1948, 1953, and 1957
(in millions of pounds)

Species	1948	1953	1957
Bluefin	23.8	29.1	32.6
Bonito 1/	32.4	38.8	51.2
Other 2/	5.3	4.4	9.3
Total	61.5	72.3	93.1

1/ Bonito includes some albacore.

2/ Other includes little tuna and frigate mackerel.

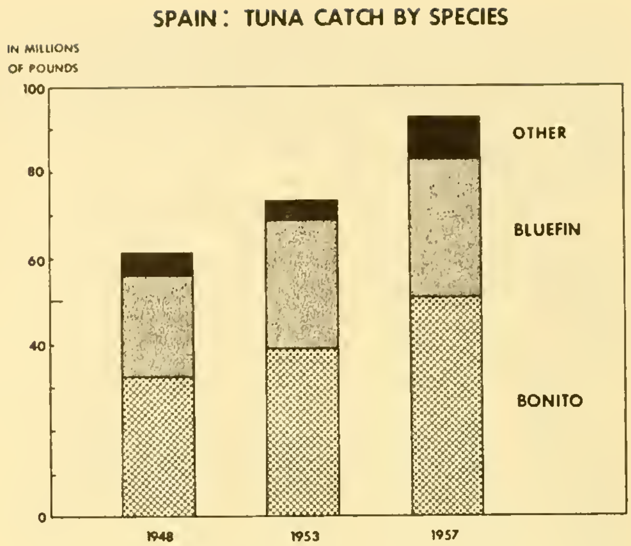

Figure 13.--Spain: Tuna catch by species (1948, 1953, 1957).

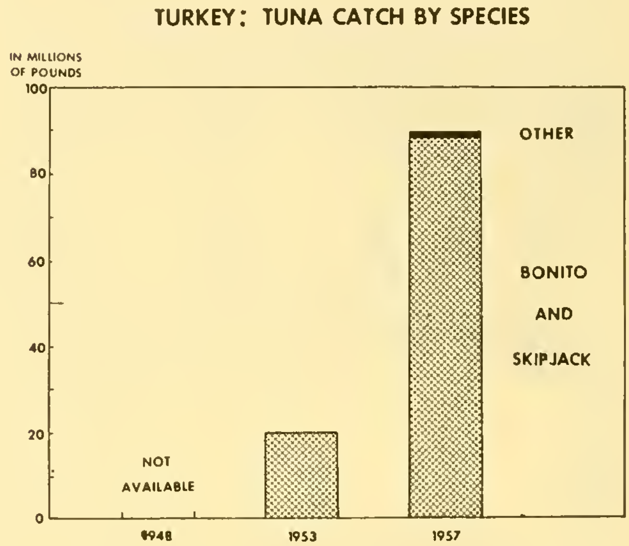

Figure 14.--Turkey: Tuna catch by species (1948, 1953, 1957).

Turkey

Turkey which straddles the Dardanelles, The Bosporous and the Sea of Marmara, is ideally located in relation to available tuna resources. Bluefin tuna and bonito pass through these waters on their migrations to and from the Black Sea. The category shown in figure 14 as "bonito and skipjack" consists mainly of bonito which is the principal species landed in this country. Some of the catch is consumed locally, principally as fresh fish, and the remainder furnishes Turkey with its most important fishery export. Bonito and tuna are mainly exported either fresh, chilled, or frozen; a small amount of bonito is also exported, canned, smoked, or dried. In 1956 Turkey exported 43.5 million pounds of bonito and tuna -- 17.0 million pounds to Greece and 14.5 million pounds to Italy.

The large Turkish catch for 1957 is not unusual. Annual catches of this magnitude have been reported for the years before World War II.

Table 9.--Turkey: Tuna catch by species, 1948, 1953, and 1957.
(in millions of pounds)

Species	1948	1953	1957
Tuna 2/	1/	1/	1.7
Bonito 3/	1/	20.3	88.0
Total	1/	20.3	89.7

1/ Data not available.

2/ Probably bluefin.

3/ Includes skipjack.

France

The tuna fisheries of France have been dominated by the albacore fishery. Albacore is taken in the Bay of Biscay and for some distance offshore in the Atlantic. The fish are caught by trolling during a short season, lasting from July to October.

Bluefin is another important species landed in France. It is caught in both the Atlantic and the Mediterranean by seining as well as trolling. American-type live-bait tuna clippers have been introduced and have been responsible for an extension of the fishing range. Yellowfin tuna are now being caught off French West Africa.

Bluefin is generally sold fresh and albacore is generally canned. Landings in France are summarized in table 10 and figure 15.

Table 10.--France: Tuna catch by species, 1948, 1953, and 1957.
(in millions of pounds)

Species	1948	1953	1957
Albacore	14.1	25.4	39.3
Bluefin	2.9	7.9	4.8
Yellowfin	---	---	15.5
Total	17.0	33.3	59.6

Taiwan

In 1957 the tuna catch (including bonito) of Taiwan was over three times that of 1948. Although the 38 million pounds produced in 1957 (fig. 16) is small compared with the Japanese tuna catch, Taiwan ranked seventh in the world production of tuna. Taiwanese statistics show a large bonito catch -- 22,700,000 pounds in 1957, but this category probably includes skipjack, frigate mackerel, and other tunas.

Taiwan has been enlarging its tuna long-line fleet. Ten tuna long-liners in the 100-gross-ton class have been built in the last two years. Furthermore, Taiwanese fishing vessels have been increasing their range of activity. Some vessels are now ranging as far as the Indian Ocean.

FRANCE: CATCH BY SPECIES

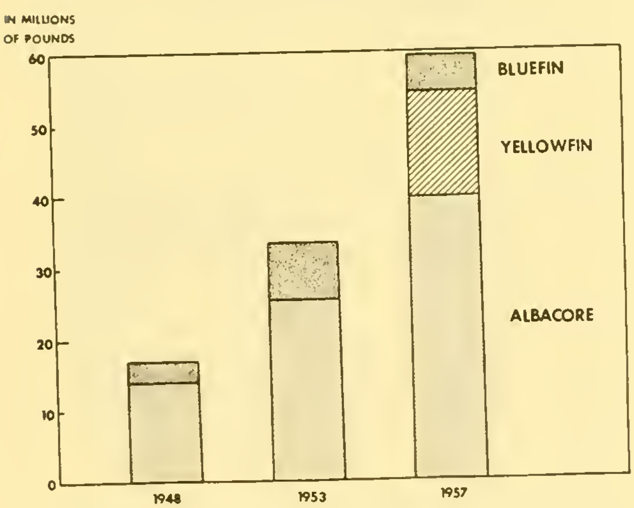

Figure 15.--France: Catch by species (1948, 1953, 1957).

TAIWAN: TUNA CATCH BY SPECIES

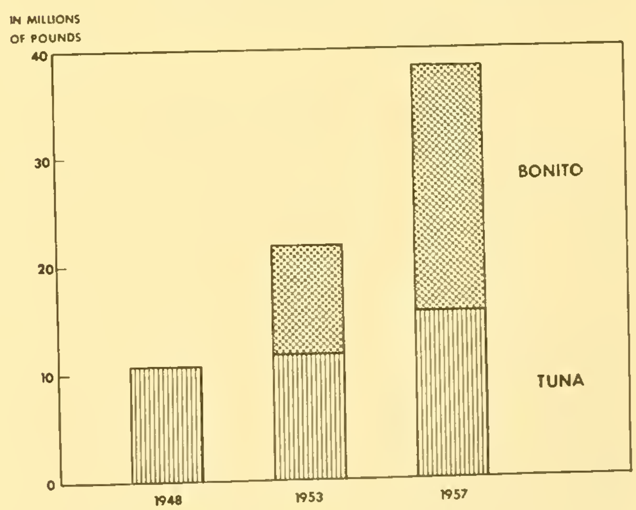

Figure 16.--Taiwan: Catch by species (1948, 1953, 1957).

Table 11.--Taiwan: Tuna catch by species, 1948, 1953, and 1957.
(in millions of pounds)

Species	1948	1953	1957
Tuna 1/	10.6	11.0	15.7
Bonito	2/	10.6	22.7
Total	10.6	21.6	38.4

1/ Breakdown by species not available.

2/ Data not available.

CATCH BY OCEAN

To understand and follow the production trends in the various world oceans, it is useful to have information on the catch by species by ocean. Such information is scarce because catches are usually tabulated by the country of origin with no record of the ocean from which the catch was taken. This is particularly true with respect to adjacent areas of the Mediterranean and the Atlantic and likewise the catches in the Indian and Pacific ic Oceans by the Japanese.

Pacific Ocean

Because of the difficulty and confusion of defining catches by country of origin rather than by ocean, it was quite difficult to obtain data for the Pacific Ocean. For some countries bordering on the Pacific, data on the tuna are not available at all. For the most part, the total landings of such countries are small and eliminating them from consideration does not change the general trends and conclusions.

For a number of other countries the tuna landings are not listed by species and in some instances even include mackerel and spear fishes. For certain countries, e.g. Formosa, the skipjack landings have been approximated according to estimates of species composition given in the literature. In others, such as Australia, total tuna landings have been included in the bluefin tuna group inasmuch as a major part of the landings consist of bluefin. In other cases where it is suspected that mackerel landings make up a large portion of the total tuna, mackerel and spear fish landings, e.g. Thailand and Philippines, such landings have been omitted entirely. The Japanese data for the Pacific are estimates provided to the Bureau by the Konagawa Prefectural Fisheries Experimental Station in Kanagawa, Japan. In general the Japanese statistics do not permit an accurate breakdown of landings made in the tropical Pacific and Indian Oceans. Accordingly, that portion of the Japanese catch assignable to the Pacific Ocean was based on estimates.

The principal published sources of information were: FAO Publication on World Landings of Marine Products, by A. W. Anderson, et al., 1952 (Special Scientific Report--Fisheries No. 104), S. Shapiro, 1949 (Fishery Leaflet 297), Japanese journals, a and unpublished Japanese data received through correspondence.

Figure 17 shows Pacific-wide tuna landings and indicates the proportion of the catch taken by the Japanese for the years 1937, 1938, 1939 and 1940 and the years 1950 through 1957. Considering the various species and comparing the two periods, 1937 to 1940 and 1950 to 1957, it is apparent that the skipjack landings show the smallest increase of all the species (approximately 24 percent).

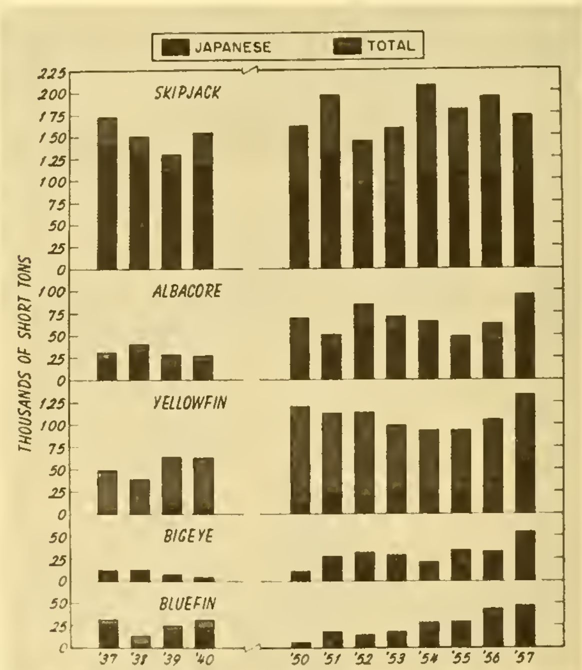

Figure 17.--Pacific-wide tuna landings (and proportion of catch by the Japanes) (1937-40 and 1950-57).

It should be noted that Japan's landings in prewar years included those from their appreciable fisheries in the Mandated Islands, plus catches from such areas as the vicinity of Formosa, and the Ryukyu Islands and that the areas other than those immediately adjacent to the home islands are essentially no longer available to the skipjack fishery which uses live bait. The loss of the Mandated Islands' fishery in terms of the skipjack's percentage of production was partly compensated for by the entrance of Peru in the skipjack fishery in postwar years. It is important to note that among the Japanese tuna fisheries in the Pacific, the skipjack fishery ranks first in both prewar and postwar years. The average landings of this fishery in the period 1954 to 1957 were 189,000 tons per year. Because it is known that there are several modest local fisheries for skipjack in the Western Pacific, it follows that the actual catches are somewhat in excess of those indicated in figure 17.

Yellowfin tuna are primarily landed by Japan, the United States and Peru. Yellowfin landings rank second to skipjack, in both the prewar and postwar period. The yellowfin landings increased by 98 percent in the postwar years as compared to the prewar years shown. Japan's landings, which accounted for less than 10 percent of the Pacific yellowfin landings in prewar years (1937 through 1940) now amount to about 32 percent. The United States is by far the leading producer of this species in the Pacific. The increase in yellowfin landings in Japan is a result of the expansion of fishing grounds and increased fishing effort, especially in the tropical Pacific Ocean.

In the Pacific Ocean albacore are taken primarily by Japan and the United States with a number of other countries, including Canada, making relatively minor contributions to the catch. Annual albacore landings have more than doubled from 32,000 to 68,000 tons, an increase of 112 percent. The increase in Japanese albacore landings over the years has resulted from the expansion of fishing grounds in tropical waters. In addition to their summer live bait and winter long-line fisheries in the North Pacific, considerable albacore landings are made in tropical waters by mothership expeditions, foreign-based vessels and independent long liners.

While bigeye are taken by fishermen of a number of countries bordering the Pacific, the only substantial amounts of this species are caught by the Japanese. The bigeye catch is not generally identified in United States statistics but is included with yellowfin. For the prewar and postwar periods, the catches of bigeye averaged 10,000 and 36,000 tons per year respectively, an increase of more than 300 percent, this resulted largely from increased effort on the bigeye fishing grounds north of Hawaii.

Bluefin tuna landings in the Pacific increased approximately 42 percent from 26,000 to 37,000 tons per year for the periods compared. At least part of the increase in bluefin landings is associated with the development of fisheries in the South Pacific near Australia but the general expansion of the Japanese fisheries has had its effects.

These data point out the dominance of the United States in Pacific yellowfin production and Japan's dominance in the production of all other tuna species. The other striking feature is that Japan's landings are continuing to rise, whereas those of the United States are not.

Since Japan does play a dominant role in world tuna production and since only for the Pacific can an ocean-wide catch be approximated, it is worthwhile to turn back to Japanese information to briefly examine their Pacific catches and then focus carefully on the catches made by Japanese nationals in the Indian and Atlantic Oceans.

The data for figure 18 were obtained from the Kanagawa Prefectual Fisheries Experimental Station in Kanagawa, Japan, through the courtesy of Mr. Jun Nakagome. Minor adjustments were made to include Japanese mothership and foreign-based landings. Total landings, rather than long-line landings alone, are shown.

Figure 18 shows rather small landings of each of the major species in the 1950 period. Thereafter, the landings fluctuated. In 1957 the Pacific landings were large for all species. Landings of albacore include those made in the summer live-bait fishery off the coast of Japan proper. Another major portion is made up of landings made in the mid-ocean winter long-line fishery in the North Pacific between Japan and Midway Islands. A relatively small part of the Pacific albacore landings is therefore made up of fish taken in tropical waters, and it is largely accounted for by the mothership expeditions, and vessels based in Samoa and New Hebrides. Considering the large numbers of independent longliners which exploit distant waters, it is apparent that most of their effort is in the Indian Ocean rather than in the Pacific. This is more clearly seen when we examine the catches of yellowfin in the Pacific and the Indian Ocean. The Indian Ocean landings, wholly made by independent longliners, are generally greater than the Pacific landings; the latter includes mothership as well as foreign-based landings.

Japanese catch in Indian Ocean and Atlantic Ocean

Following the opening of the Indian Ocean grounds by the large independent longliners in 1952, landings of each species increased. This increase was accompanied by the exploitation of more and more grounds.

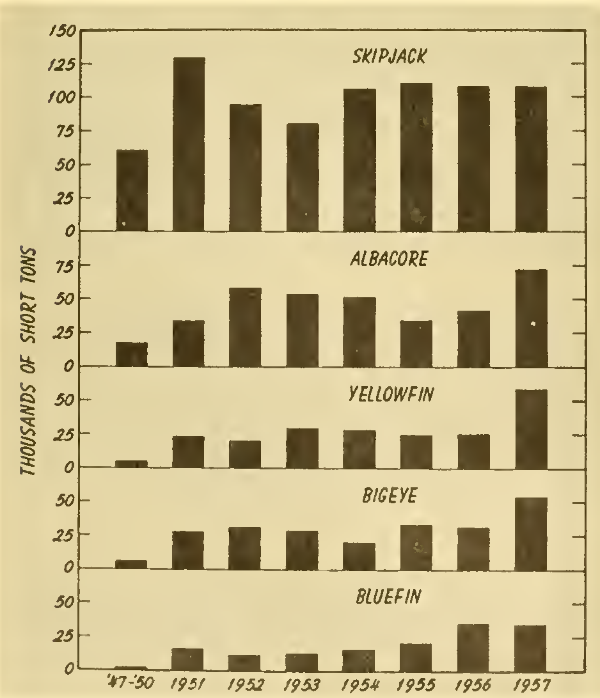

Figure 18.--Japanese catch trends in the Pacific (1947-50 and 1951-57).

If the catch records for any small area are examined in detail, it is seen that catch rates are high when a ground is first exploited and the catch rates decline as exploitation continues. To compensate for this Japan has been exploiting new grounds. The fishing operations of this nation extend over the entire tropical Indian Ocean. Due to this steady expansion and the lack of catch-location information the general declining catch rates for specific areas are not revealed by the over-all landings (fig. 19). The catches increased until 1956 but declined in 1957. During latter years greater effort was expended in the Pacific, and the Atlantic was also exploited for the first time.

CATCH AND AMOUNT OF FISHING

Except for the information concerning the yellowfin and skipjack of the eastern tropical Pacific, adequate biological data to indicate the condition of the various tuna stocks in the world are lacking. Nevertheless, it is important to examine such information as is available in order to evaluate what these data portend.

It is necessary to remind ourselves of some general well known phenomena associated with unexploited fisheries. By and large, unfished populations will have a significant proportion of large, old fish

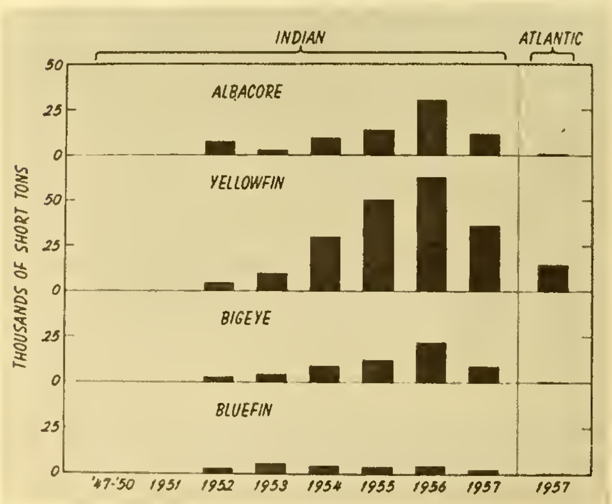

Figure 19.--Japanese catch trends in the Indian and Atlantic by species (1947-50 and 1951-57).

and they will be at the maximum density the environment can support. When a fishery is initiated, fishing will be relatively good. As time passes, the proportion of large, old fish will drop and the catch per amount of fishing per unit of time will also drop. At some point in this trend, added fishing effort will not produce a greater total catch, and biologists generally consider that when this happens, the fish population has been depressed below the maximum sustainable yield.

Since detailed data covering the tuna fisheries of the Eastern Pacific are readily available, I wish to address myself primarily --although briefly--to the evidence available from the far-flung Japanese operations. As we have stated, the Japanese have now circumnavigated the world in search of tuna. Except for their home island fishery, these operations essentially involve the use of long-lines. Long-line gear is rather selective to large, old tuna, particularly yellowfin and bigeye and this fact must be kept in mind in evaluating, even in a limited sense, the catch rate of the Japanese fisheries. The large sub-surface tuna involved in long-line operations are relatively scarce, and fishing of these old fish - while affecting the subsequent harvest of these particular size groups and therefore the future success of long-line operations - will not necessarily have a pronounced impact on the total tuna population being exploited.

Before proceeding, it is well to consider briefly why the Japanese use long-lines in distant waters. The Japanese have shown themselves to be generally skillful in a variety of fishing operations including the large home island live-bait fisheries. Their use of long-lines in distant fisheries would appear to be clearly a function of the logistics of that type of operations as compared with such methods as live-bait fishing. Obviously, the Japanese are well aware that their long-line gear is tapping only a part of the population of yellowfin, bigeye and perhaps other species, but they have thus far not found it feasible to extend significantly their live-bait operations. With this in mind, let us consider what is happening to the catch per 100 hooks in some of the Japanese fisheries.

In order to closely examine certain catch rates, those for yellowfin in the Indian Ocean were studied by dividing the area into increments of longitude and the average catch rates for each such north-south strip (5 degrees N to 13 degrees S) considered separately. Deviations from these several average catch rates were plotted for each month of the years for which data were available (fig. 22). Portions of the chart above the respective average lines represent above-average catches and portions below these lines indicate below-average catches. In virtually every instance, initial catches were

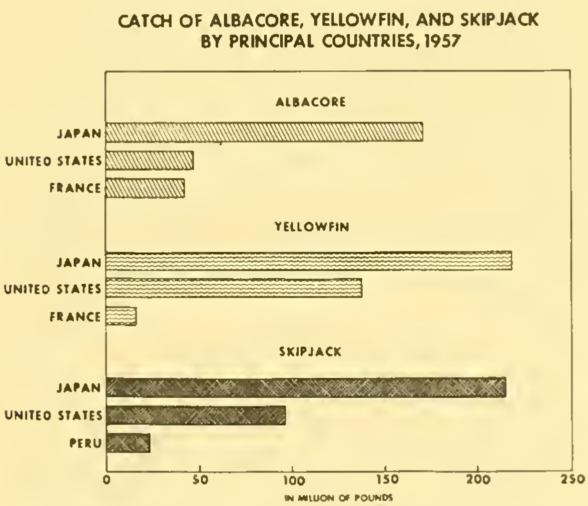

Figure 20.--Catch by principal countries (1957) of albacore, yellowfin and skipjack.

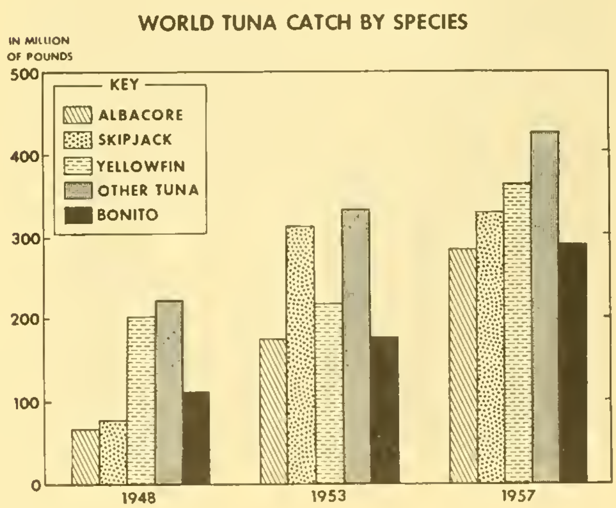

Figure 21.--World tuna catch by species (1948, 1953, 1957).

significantly above average and tended to be below average in succeeding months and years. Clearly this examination of the data demonstrates the initial high availability of at least a portion of the yellowfin tuna population to the long-line gear followed by a consistent reduction in such availability. Figure 22 demonstrates the progressive westward movement of the Japanese fishery across the Indian Ocean in the early 1950s.

In the Lesser Sundas and Timor area the yellowfin catch rate of 1952-53 to 1956 to 1957 was progressively 7.1, 3.6, 310, 3.3, 2.0 (Mimura 1958). In the Banda-Flores Sea, beginning with the same winter season, the yellowfin catch was 4.0, 2.8, 2.5 and 2.6 (no data on hand for 1956-57). There are yet insufficient data for the Japanese

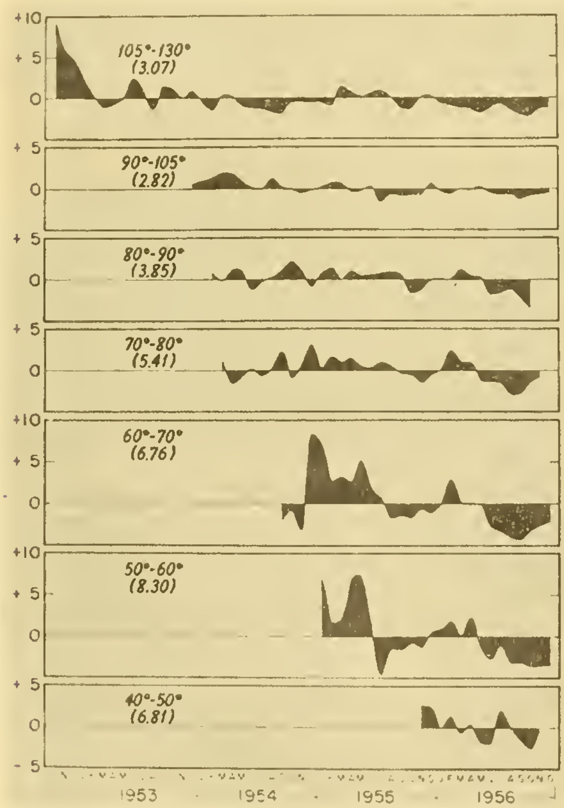

Figure 22.--Catch rates of Indian Ocean yellowfin shown as deviations from the area mean.

Atlantic fishery to show trends. We can however, refer to a news article which stated in part, (Commercial Fisheries Review, February, 1959, page 61), "when Japanese boats began fishing there (Atlantic grounds) in the spring of 1957, catches ran around 13 tons a day, but late in that year they were down to 7-9 tons, and at present they are only 5-7 tons."

In general, the literature is replete with indications of the drop in catch rate in Japanese yellowfin longline fisheries. Although the trends cited are not necessarily indicative of every series of operations, the pattern of a drop in return per unit of effort is common.

The catch rate for bigeye has occasionally been similar to that for yellowfin, but in general it does not follow the yellowfin pattern of decline from initial high catch rates. The rather consistent decline in yellowfin catch rates is not true of albacore either. Otsu in his article entitled, "A survey of the American and Japanese Albacore Tuna Fisheries in the Pacific through Examination of Catch Statistics," comments briefly on the albacore catch rate data. He said in part, "the fact that their (Japanese) present landings are triple those of prewar years attest to this (increase of catch with increased effort). 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." He says further, "their two North Pacific (albacore) fisheries appear to be quite stable"...and "the present status of the Samoa-based fisheries... is encouraging as far as albacore catch is concerned."

SIZE OF FISH IN CATCH

As stated, there is a general tendency for the large, old fish in a virgin fish population to be harvested rather rapidly because fishing mortality of such fish often exceeds recruitment. This phenomenon has occurred in the longline fisheries we are considering. Mimura (1958) noted that there was a decrease of large fish, the percentage of fish of 140-150cm. for a sequence of years beginning 1952-53 in the Lesser Sundas and Timor being 47 percent, 36 percent, 13 percent, 11 percent, and 13 percent respectively. For the Banda - Flores Sea the percentages of these large fish are respectively 39 percent, 21 percent, 11 percent, and 3 percent beginning 1952-53. Indian Ocean trends are shown in figure 23 and illustrate the decline in large-sized yellowfin. With respect to the Atlantic, the previously mentioned news article in the Commercial Fisheries Review noted that the average size of the longline yellowfin was 125 - 139 pounds but that it appeared to be declining.

OUTLOOK

Various opinions can be obtained from Japanese literature for the future outlook. For example, in the "State of Tuna Fisheries," obtained by the author in the form of a manuscript credited to the Japanese Fishery Agency, it is stated, "In October 1952 tuna fishing operations in the Indian Ocean was started, but this hit a brick wall three years later with the tuna resource in this area all but gone...The Nation's (Japanese) skipjack and tuna fishing industry faces a grave issue which is the withering of the tuna resource..."

Other comments worthy of note are in "State of Japan tuna fisheries." "There can be no further increase in the amount of tuna that can be caught by fisheries based in Japan." With tuna fishing at its near end in the Indian and Western Pacific Ocean, tuna fisheries have begun to operate in the Eastern Pacific and the Atlantic Oceans".

Little has been said to this point as to outlook for increasing Japanese skipjack production. While the home island skipjack fishery is enormous, distant skipjack fisheries lie undeveloped. "The (Japanese) Government considers that it is not wise to encourage further development of the skipjack fishing industry." Elsewhere in this article we find the comment, "the fishing grounds for skipjack have thus far been in waters near Japan, but after 1956 some fisheries have been sent to operate 1500 miles from Japan."

The Inter-American Tropical Tuna Commission has published information which indicates that the Eastern-Pacific yellowfin catch approached the maximum sustainable yield during the periods of highest production, it has indicated that the skipjack catch is no where near its maximum sustainable yield. The research of the California Department of Fish and Game has indicated that the albacore fishery of the Eastern Pacific is almost certainly part of a much larger albacore population that, at least in part, has trans-Pacific migrations.

With respect to Japanese fisheries, the home island skipjack fishery appears to be somewhat near its maximum and under heavy exploitation. Based on Japanese comments, there is no particular reason to believe that significant increases in any tuna catches can be expected near Japan. In regard to mid-Pacific albacore, it has been doubted that significant increases in production can be expected; on the other hand,

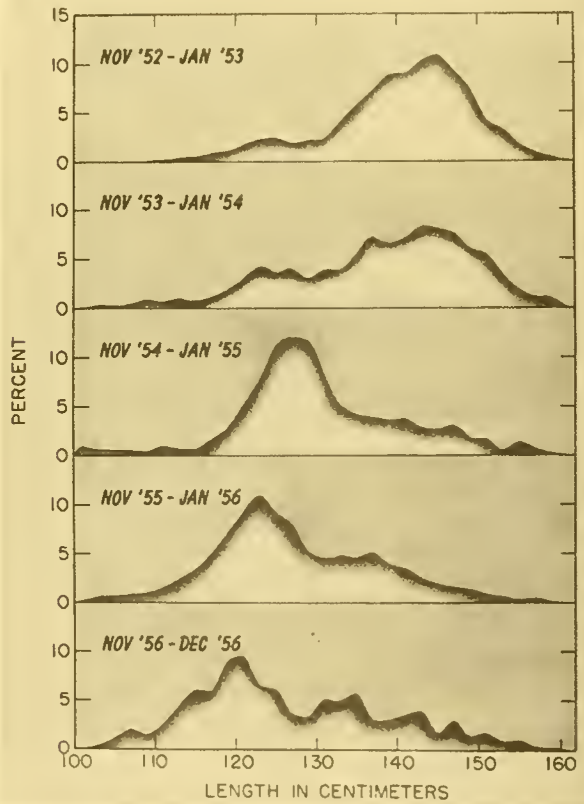

Figure 23.--Indian Ocean yellowfin size frequencies, 10°-130° East, by time periods (Nov. 1952 - Dec. 1956).

I am unaware of any specific reasons why this fishery cannot be expected to produce more.

With respect to various other areas and species, longline yellowfin in the Western Pacific are decreasing somewhat and are likewise decreasing in the Central Pacific. However, there is no evidence of decline in the albacore taken by longline fisheries in the South Pacific. In the Indian Ocean, longline yellowfin have decreased markedly as to catch per hundred hooks. Albacore production has become more important than it was during the initial exploitation of this ocean; reports indicate that there have been some important catches of bluefin. The Atlantic Ocean is just coming into heavy production and there is some limited evidence that a decrease in catch per hundred hooks is occurring.

Based on the various historic trends, longline yellowfin can be expected to be reduced to roughly three fish per hundred hooks in most of the world within a few short years. Bigeye, albacore and bluefin have not declined nor has skipjack.

CONCLUSIONS

The world tuna fishery was enormously stimulated in the years after World War II and almost every tuna producing country in the world has significantly increased its catch in the past decade, by far the dominant tuna-producing country in the world is Japan, and the most important factor in Japanese production is the expansion of her longline fisheries. In turn, the Japanese longline fisheries have depended heavily on yellowfin tuna and catch rates for this species have had a tendency to decline sharply after the initial exploitation of virgin grounds. The decline in yellowfin catch rate is still being offset by development of new fishing areas. While the decline in catch rate may ultimately be a problem to the Japanese it emphasized that their fishing depends on a number of species of tuna and on other fishes as well. The continued importance of Japan as a competitor for American fishermen and supplier of tuna for world markets is likely. The Japanese overseas operations appear to be an important hedge on operational cost trends and doubtless contribute to the strength of the Japanese fisheries. The various tuna populations (except yellowfin in the Eastern Pacific) appear to be capable of producing more heavily. In general, the tuna-producing countries of the world can be expected to continue to increase their fisheries and tuna harvest as long as their fisheries are profitable.

ACKNOWLEDGEMENT

This report was developed with major assistance from the Bureau's Biological Laboratory, Honolulu and Branch of Special Reports, Washington, D. C. The statistical data by country, which was assembled by the latter unit arose from a variety of sources as follows:

Japan. Data for 1953 and 1957 from the Japanese Government's Annual Reports on Fishery and Agriculture, 1954 and 1957. Data for 1948 were obtained from the Statistical Abstract of the Ministry of Agriculture and Forestry, 1957.

United States. The primary source of information was Fishery Statistics of the United States, 1948, 1953, and 1957.

Peru. Data for 1957 were derived from the Annual Statistical Fishery Report, Peru, 1957. This was received as Dispatch No. 436 of the U. S. Embassy, Lima, dated October 30, 1958.

Taiwan. Data for 1948 were obtained from the Taiwan Agricultural Yearbook, 1950 edition. All other information was taken from the United Nations, Food and Agriculture Organization Yearbook of Fishery Statistics, Vol. VII, 1957, Rome.

The Honolulu Biological Laboratory received assistance from Japanese scientists, which is mentioned in the text and is gratefully acknowledged.

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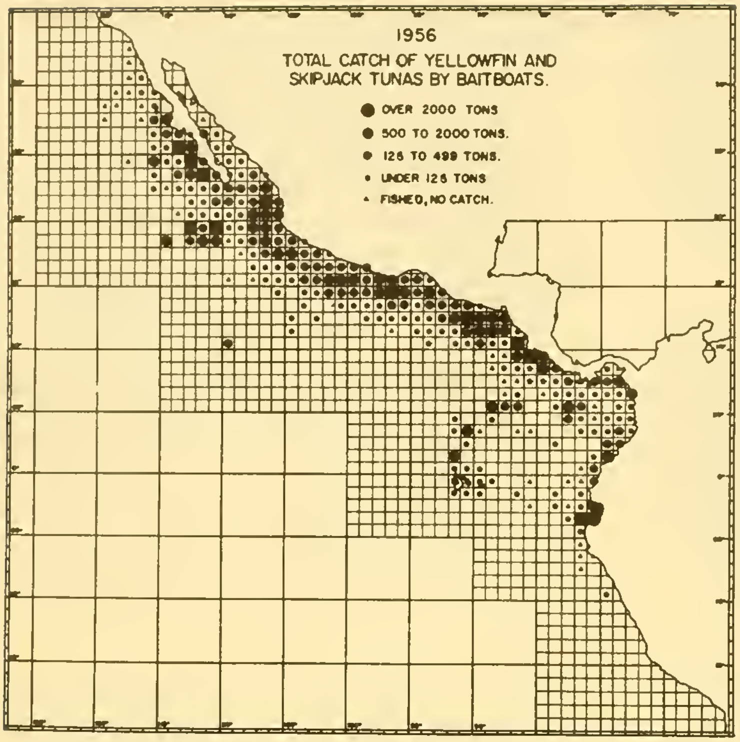

Figure 1.--Total catch of yellowfin and skipjack tunas by baitboats, 1956.

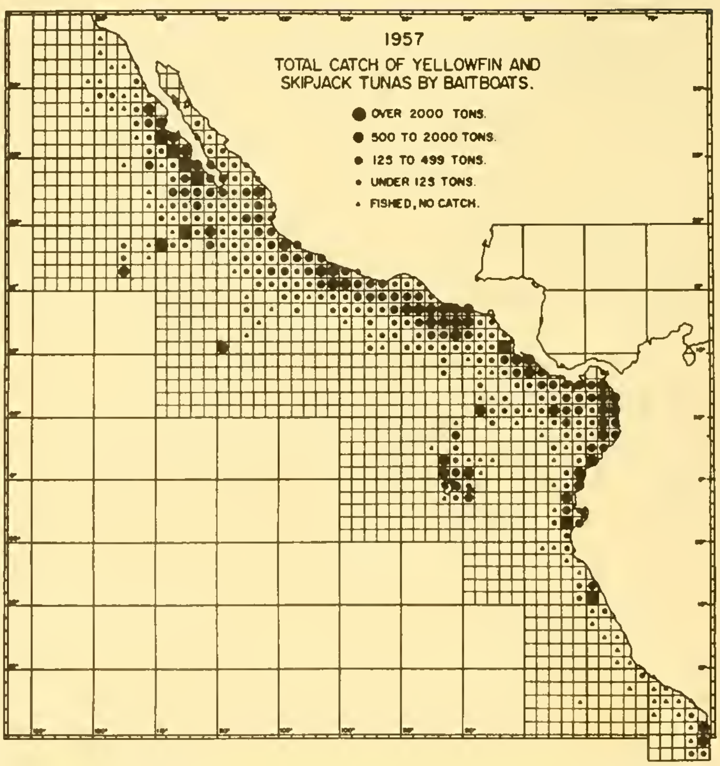

Figure 2.--Total catch of yellowfin and skipjack tunas by baitboats, 1957.

STATUS OF THE FISHERY FOR TUNAS OF TROPICAL WATERS OF THE EASTERN PACIFIC

by

Milner B. Schaefer [1]

GEOGRAPHICAL EXTENT OF THE FISHERY

The fishery for the yellowfin and skipjack tunas of the Eastern Pacific extends from California to Peru and Chile, and offshore for several hundred miles, encompassing also the outlying islands--Revilla Gigedos, Clipperton, and Galapagos. The areas of fishing and the relative yields obtained from them are illustrated in figures 1 and 2, which show the catches logged by baitboats by 1° squares for the years 1956 and 1957. The chart for 1956 represents a "normal" year when the fish are found in commercial concentrations from about Cedros Islands (Baja California) to northern Peru. These are approximately the limits of the water of suitable temperature for the tropical tunas at the northern and southern extremes of their range. The fish apparently move away from the equator during the summer and toward it during the winter, corresponding to the migration of the isotherms. The chart for 1957, which was a warmer than normal year throughout the Eastern Pacific indicates that in such a year the fish are found further to the north and south at the extremes of their range.

It appears that the fishery, at the present time, encompasses the entire range of these species along the coast of the Americas. However, the tunas probably occur further offshore than the present range of the fishery, this being especially true of skipjack.

Although the purse-seine fleet operates over roughly the same area as the baitboats, the fishing by this gear tends to be more concentrated in certain localities, including the local banks off Baja California, the Gulf of California, the Revilla Gigedo Islands, and the region off the Gulf of Guayaquil, and along the coast of Peru.

CHANGES IN THE FISHING FLEETS

Table 1 (page 38) shows the numbers of baitboats in the California fleet, by size categories, for the years 1932-58, inclusive. It may be seen that the fleet reached its peak in 1951 and has declined steadily since that year. At the same time, there has been a shift from small vessels to vessels of larger capacity, particularly during the years since the end of World War II.

Number of vessels of the purse-seine fleet, for the years 1931-58, by size categories, are shown in table 2 (page 39). A notable feature of this table is the sharp increase in numbers of purse-seine vessels in 1945, 1946, and 1947, which was the result of the diversion to the tuna fishery of vessels which formerly had not fished these species, in consequence of the failure of the sardine fishery. It may be seen that the purse-seine fleet reached a peak in 1948 and declined subsequently through the year 1958. Part of the decline was due to losses of vessels and transfer to foreign countries, but a substantial share is also due to the fact that some of the vessels which had shifted from the sardine fishery were not successful in the tuna fishery and, therefore, abandoned attempts to fish tuna.

In late 1958 and 1959, as a consequence of very good success of fishing by purse seiners during 1957 and 1958, several large

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Table 1.--Number of California baitboats by size category, based on capacity tonnage, 1932-58.

Year	0-50 tons cap.	51-100 tons cap.	101-200 tons cap.	201-300 tons cap.	301-400 tons cap.	Over 400 tons cap.	Total
1932	18	14	38	11	-	-	81
1933	16	10	33	11	-	-	70
1934	11	8	30	12	-	-	61
1935	19	6	31	15	1	-	72
1936	22	7	32	13	1	-	75
1937	26	11	35	13	4	-	89
1938	25	14	38	12	4	2	95
1939	22	18	36	15	4	2	97
1940	26	18	38	14	6	2	104
1941	26	19	33	15	6	2	101
1942	35	21	31	10	3	2	102
1943	26	26	25	3	-	-	80
1944	23	27	29	7	-	-	86
1945	30	35	37	13	3	1	119
1946	27	36	44	20	16	6	149
1947	23	38	53	37	19	6	176
1948	21	33	62	58	18	6	198
1949	19	28	64	67	20	7	205
1950	14	26	69	70	18	7	204
1951	15	25	77	78	20	10	225
1952	9	19	67	77	22	8	202
1953	7	17	57	74	23	12	190
1954	11	13	55	68	24	11	182
1955	12	12	45	63	28	11	172
1956**	12	11	43	66	32	11	175
1957**	11	11	43	60	35	10	170
1958**	12	8	35	57	36	11	159

** Includes Puerto Rico Fleet

baitboats have been and are being converted to purse-seiners.

We have attempted to combine the data of numbers of vessels of both types, and of the various sizes, by computing an index of potential fishing power of the fleet in terms of the equivalent number of Class 4 tuna clippers. The methods of computing this index are outlined in the 1957 Annual Report of the Commission. The potential fishing power of the U. S. fleet for the years 1932-58 is shown in figure 3. It may be seen that after a rapid rise, following the end of World War II, to a peak in 1951, there has been a fairly steady decline in the fishing power through 1958.

EFFECTS OF FISHING ON THE STOCK AND YIELD

One of the essential tasks of the Commission is the measurement of the changes in abundance of each of the tropical tuna species, as reflected by catch-per-day's fishing corrected to a vessel of standard size, and the study of the relationships of changes in abundance to changes in fishing effort and other factors. Methods of compiling and computing the pertinent statistics are given in detail in the Annual Reports of the Commission and various research papers of our Bulletin series.

In figure 4, are shown, for the years 1934-57, the total catch of skipjack from the Eastern Tropical Pacific, together with the catch-per-day's fishing, computed from the logbook records of tuna clippers, and also the calculated fishing intensity in terms of thousands of days fishing by a Class 3 tuna clipper. It may be seen from this figure that the catch-per-day's fishing, which measures the abundance of this species as the fishermen see it, fluctuates rather widely from year to year. Part of this variation reflects real changes in the abundance of the stock, but a large proportion is believed to be due to variations in availability of the fish to the fishermen, in response to variations in environmental factors.

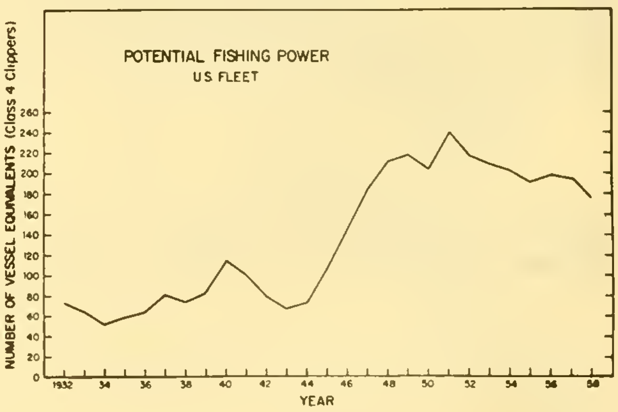

Figure 3.--Potential fishing power, U. S. fleet (vessels fishing tropical tunas).

It is noteworthy that, although in the post-war years the fishing intensity and the total catch rose substantially, the apparent abundance has remained, on the average, as high as in the early days of the fishery. From this it may be concluded that the skipjack are being very much underfished, since the effects of increased fishing intensity on the stock, if any, are so small that they cannot be detected against the background variations. It would appear, therefore, that it is biologically possible to obtain a much greater yield from the Eastern Tropical Pacific than is presently being obtained. Since the effect of fishing on the stock is, so far, not capable of measurement, we cannot determine the level of maximum yield, but we may be quite confident that it is very much greater than the present harvest.

For the yellowfin the situation is rather different. It may be seen from figure 5 (page 40) that changes in abundance over the series of years 1934-57, bear a measurable relationship to changes in intensity of fishing and harvest. It may be noted that as the intensity of fishing increased prior to World War II, there was a corresponding decline in the catch-per-day's fishing, although the total landings continued to rise. With the decrease of intensity of fishing during the war, the harvest decreased, but the catch-per-day's fishing recovered substantially. With the rapid increase in fishing intensity in post-war years, there was a corresponding rapid increase in catch, but a fairly steady decline in catch-per-day's fishing. Following about 1951, the fishing intensity has tended to fluctuate with corresponding inverse fluctuation in the apparent abundance, and with related variations in total catch.

It is possible from these data of the yellowfin fishery to arrive at an estimate of the average relationship between fishing

Table 2.--Number of California tuna purse-seiners by size category, based on capacity tonnage, 1931-58.

Year	0-50 tons cap.	51-100 tons cap.	101-200 tons cap.	201-300 tons cap.	Over 300 tons cap.	Total
1931	1	10	1	-	-	12
1932	5	22	1	-	-	28
1933	4	21	1	-	-	26
1934	-	7	2	-	-	9
1935	-	7	2	-	-	9
1936	-	18	2	-	-	20
1937	-	23	8	1	-	32
1938	-	6	1	-	-	7
1939	-	17	3	-	-	20
1940	3	50	21	1	-	75
1941	2	33	16	1	-	52
1942	1	15	5	-	-	21
1943	2	27	7	-	-	36
1944	2	23	9	-	-	34
1945	5	28	17	-	-	50
1946	3	37	27	-	-	67
1947	3	43	38	-	-	84
1948	-	41	45	2	1	89
1949	-	35	40	3	1	79
1950	1	28	35	3	-	67
1951	-	32	43	3	-	78
1952	-	23	39	2	-	64
1953	-	23	39	2	-	64
1954	-	19	49	1	-	69
1955	-	14	47	2	-	63
1956	-	12	50	2	-	64
1957	-	9	39	2	-	50
1958	-	8	34	2	-	44

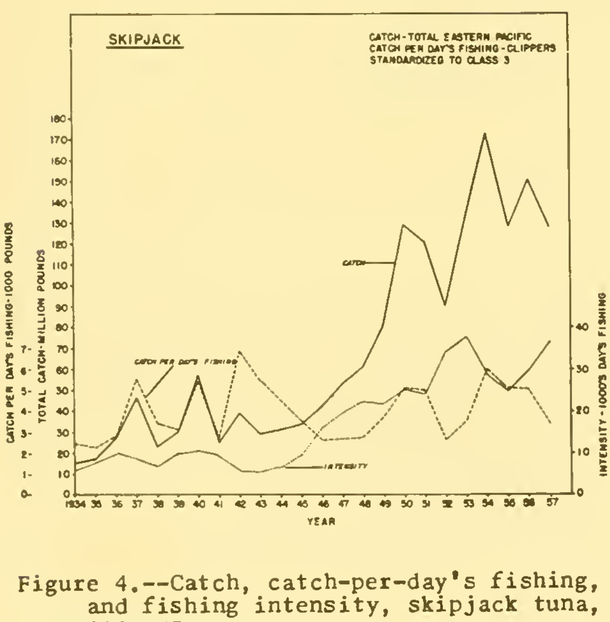

Figure 4.--Catch, catch-per-day's fishing, and fishing intensity, skipjack tuna, 1934-57.

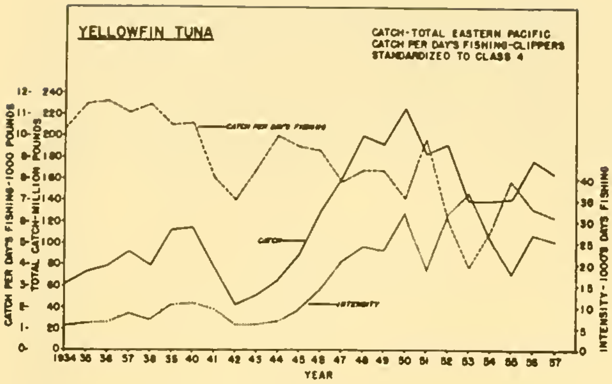

Figure 5.--Catch, catch-per-day's fishing, and fishing intensity, yellowfin tuna, 1934-57.

effort, apparent abundance, and total catch, with the aid of some mathematical theory which is outlined in detail in the research papers published in our Bulletin series. In figure 6, the data for the yellowfin fishery are presented in a form somewhat more complicated than in figure 5, but more suitable for illustrating these relationships. In this figure we show, along the axis of the abscissae, fishing intensity, and, along the axis of ordinates, catch-per-day's fishing. The product of the two is, of course, the total catch, isopleths of which are the equilateral hyperbolae on the figure. In this figure are shown the actual values for the years 1934-57. Also shown on the figure, by the dotted line, labelled "Estimated line of equilibrium," is our best estimate from these data of the average relationship among the three variables. From this it may be seen that, as the fishing intensity increases, the average catch-per-unit-of-effort continuously decreases, but that the average total catch continues to increase up to about 36,000 standard days' fishing, (Class 4 clipper units) with a total catch in the neighborhood of 195 million pounds per year. As fishing effort increases beyond this level, it is anticipated that the total catch will also decrease. We require, however, more data at high levels of fishing intensity to substantiate this estimate. The preliminary data for 1958 indicate that there was a considerable increase in fishing intensity over 1957, due to full operation of the fishing fleets during the later year, and due to extraordinarily high availability to the purse-seine fleet. The total intensity did not, however, reach 36,000 standard days.

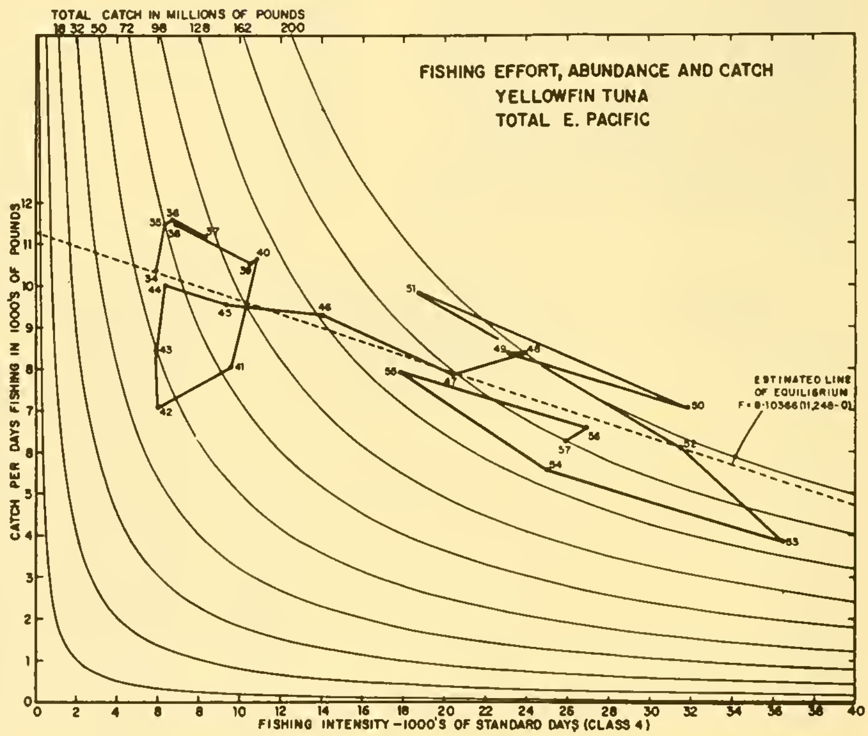

Figure 6.--Fishing effort, abundance, and catch, yellowfin tuna.

STATUS OF THE FISHERY FOR TUNAS OF THE TEMPERATE WATERS OF THE EASTERN NORTH PACIFIC (ABSTRACT)

by

Harold B. Clemens 1/

PACIFIC ALBACORE

The albacore fishery in the northeastern Pacific is a seasonal one, and ranges from southern Baja California to Alaska within 400 miles of the coast. On the average, however, a majority of the albacore are landed in California.

The dominant feature of the California landings is large year-to-year fluctuations. For example, landings dropped from 44 million pounds in 1957 to 27 million in 1958. These fluctuations are caused by changes in abundance of fish, availability, fishing intensity, and environmental conditions. California's data show that for the past several years the abundance of albacore has remained high, availability has varied greatly, and fishing intensity has declined steadily.

In 1958, the albacore run occurred much farther to the north than it had since 1951 when we first started analyzing log records kept by fishermen. The run swept through the San Juan Seamount area (over 100 miles west of San Clemente Is.) and the Baja California fishing grounds, which usually produce heavy catches, failed.

The California Department of Fish and Game predicted this failure on the basis of changing sea surface temperatures. There are many other things that affect the distribution and catch of fish, and until we are equipped to measure and take into account all of these variables, our predictions will not be perfect. Meanwhile, we will continue to do what we can with the data at hand, to help fishermen locate good fishing areas.

We are also studying the albacore population structure, migration routes, and rates of growth by means of tagging. Recoveries of tagged albacore within the west coast fishery reveal a northward migration as the season advances. Our tags also have been recovered in the central Pacific and in the western Pacific off the Japanese coast. If we omit all tags recovered in the west coast fishery during any one fishing season, we find that of the remainder, 7 percent were recaptured in the central Pacific, 21 percent off Japan, 62 percent in our coastal fishery the second season, and 10 percent in our fishery the third season.

A comparison of sizes of albacore caught in the three major north Pacific fisheries shows that on the average our coastal fishery depends to a large extent on 13-pound fish, the Japanese coastal fishery on 28 pounders, and the central Pacific longline fishery on 20-pound fish.

Our conclusions are:

1. We have found no measurable evidence of overfishing.
2. Our west coast fishery depends on the survival of young albacore in any one year, and their availability when they move inshore along the coast.
3. Major shifts in location of a season's albacore run have been predicted on the basis of sea surface temperatures.

1/ Associate Marine Biologist, California Department of Fish and Game, Terminal Island, California.

4. Our tagging data indicate that there is an exchange of albacore between the three major north Pacific fisheries. This may mean that we are dealing with one population in the North Pacific.

CALIFORNIA BLUEFIN TUNA

The bluefin tuna fishery is a seasonal one, and occurs between southern Baja California and Point Conception. Practically the entire catch is landed in southern California. The bluefin catch, like the albacore, is subject to tremendous fluctuations, the largest of which are caused by varying market conditions. Our data indicate that the abundance of bluefin tuna has remained high while availability, and fishing intensity have varied greatly.

In general, the smaller 12- to 25-pound bluefin are taken off southern California throughout the season while all sizes are found farther south. During the past warm water year (1958), however, larger bluefin have moved northward, as evidenced by the size composition of the catch.

Our conclusions are:

1. We have found no measurable evidence of overfishing.

2. Our fishery is influenced primarily by market conditions.

3. Changing sea surface temperatures affect the movements of bluefin tuna, especially the larger fish.

SOME OBSERVATIONS ON PRESENT AND FUTURE JAPANESE TUNA FISHERIES

by

Wilvan G. Van Campen 1/

In the brief time available, I cannot expect to present many factual data. I will try only to express some generalities about the present and future of the Japanese tuna fisheries, based on opinions I have heard from persons close to the Japanese industry.

Of the various speakers you will hear at this meeting, I am the only one who does not represent the Bureau of Commercial Fisheries or some other organization devoted to the welfare of the American fishing industry. I work for the Department of State. I therefore consider it appropriate for me to take on to some extent the role of the Devil's Advocate, if not to defend the Japanese fisherman, at least to show you some of his strong points and his point of view.

First, how do the tuna fisheries look in Japan today?

The ancient live-bait fishery for skipjack and albacore is not growing. New vessels are being built, it is true, but no one expects any spectacular expansion. Rather they foresee a decline in the size of the fleet. This fishery is a rather passive one; it simply waits for the skipjack and albacore to migrate into its operating range, which is limited by the distance that the vessels can move from their livebait supply. In years when the schools do not become available, the catch goes down. The applicable fishing power, assuming no drastic change in price levels, remains about the same from year-to-year. Last year the skipjack catch increased strongly from 97 thousand tons to 147 thousand tons -- but the albacore catch fell off badly. This season again, the skipjack catch is shaping up well, and the albacore season looks, if anything, worse than last year.

The catch of the livebait fishery last year was only about twice that of 1940, the last prewar year of full operation. The fishery is thus in a pretty bad way, as Japanese tuna fisheries go. But given operating bases near bait supplies in the Trust Territory or in Southeast Asia, there is little doubt that production could be greatly increased.

One of the reasons this fishery is losing popularity is that a large 150-300 ton boat, which can follow the full range of migration of the skipjack and albacore through the fishing grounds during the season, must, to make ends meet, go tuna longlining during the winter. This necessitates cutting the crew down to half, from about 50 to 25 men. In Japan the obligations of employer to employee are not easily thrown off, and fishing boat crews tend to have strong local and family ties, the boat being in a sense an instrument of social welfare in addition to being a production unit, and as a result this seasonal reduction of the crew is difficult and painful, and the boats are often overmanned.

What about the longline fishery?

By 1957 its production had increased 6-fold over 1940. How is it regarded in Japan? It is the show-piece, the glamor star of the Japanese fisheries. In the past few years almost an entire new fleet of beautiful modern vessels has been created. They are equipped with the finest navigational aids and with refrigeration machinery, with conveyors for handling the skates of gear -- why some, I understand, even provide each fisherman with a bunk

1/ Fishery Attaché, American Embassy, Tokyo, Japan.

of his own! These boats fish the warm seas of the whole world -- the Indian Ocean, the Galapagos area, the Arabian Sea, the Atlantic. Their fishermen can walk with a swagger through the streets of tuna ports like Misaki, on the rare occasions when they get to spend a day in a home port, and they can compare notes on the girls of Venice and Recife, Haifa and Cristobal. There has been no worldwide fishery like this one, I think, since the American sperm whale fishery of the last century. I wonder if that fishery too was not built and sustained not only by economics but by pride and guts. The Coffins and the Starbucks built their mansions in Nantucket; the new nabobs of the longline fleet are building theirs, I am told, on the bluff above Misaki. I should like to invite you to put aside your fear of these people for a moment and admire the audacity and initiative that has taken these fishermen around the Earth.

It seems to me that fishing, to continue, has got to be more than a matter of dollars and cents alone, it must be a way of life. The American fisheries were carried along for years, to a considerable extent, by fishermen who immigrated from fishing villages in the Old Country. When they are gone, who is left to carry on? Would it be too unkind to say a pack of potential factory hands, temporarily lured to sea by the promise of extraordinary pay?

In Japan there are still genuine fisherfolk. There are still many boys reared in narrow coves backed by cliffs, with hardly a square yard of land to till. Compared with scratching out a bare living in the inshore fisheries, a berth on a fine modern longliner, a chance to see foreign lands, the prospect of earning 70 or 80, even 100 dollars a month while enjoying four square meals a day of rice and high-grade tuna is a glamorous and attractive picture of success.

You have heard of falling catch rates and rising costs. It is true that in general the catch per day's absence for the large longliners dropped in 1956 and 1957. For example, a sample of 500-gross-ton boats averaged 84 days per trip in 1955, 94 days in 1956, and 113 days in 1957. Meanwhile the average catch per day of fishing fell from $8\frac{1}{2}$ tons to less than 6 tons. This trend is blamed largely on the slump in Indian Ocean catch rates of which you have heard, but in any case 6 tons per day is not bad longlining, and the Indian Ocean fishing, they say, is picking up again.

Some persons, encouraged by such reports, have thought that American fishermen, with their vaunted efficiency, can run the Japanese out of business. I would not be too optimistic on this score. If Americans are willing to pull in their belts and be fishermen do or die, eat tuna and rice if need be, it may be that they can do it. It may be that they will not see any use in trying.

In Japan they have resigned themselves to the fact that apparently the spectacular catch rates on virgin fishing grounds do not last long. There are few virgin grounds left anyway, except in the far eastern Pacific. But they are stubbornly convinced that the longlines of the present fleet, working over such great expanses of the world's oceans, cannot fish the tuna populations down below an economic level. What happened when the Indian Ocean temporarily went bad? The boats moved back into the tropical Pacific, where catch rates, though not spectacularly high, are remarkably dependable. They believe that catch rates on the newer grounds will settle down to a liveable level and that by rotating grounds they can continue to make satisfactory catches indefinitely.

There is a minor tuna boat-building boom in Japan now, they say. That, I suppose, we may take as an indication of confidence in the future. Although the Government has discouraged expansion of the fleet since 1955, in theory granting no new licenses and requiring the scrapping of equivalent tonnage as a condition of authorizing new construction, there has been an increase year by year in the total tonnage of the fleet and the average tonnage of the boats. Last year 94 new tuna boats were launched. To May of this year construction permits were granted for 35 new bait boats and 28 new longliners. One yard in Shimizu is said to have 10 boats of over 250 tons gross scheduled for launching by October.

This year the Japanese Fisheries Agency, the Bureau of Commercial Fisheries of Japan, announced a tuna mothership fishery catch limit of 13,600 tons. Already they have applications for licenses for operations totaling over 25,000 tons. Some of these operations are planned primarily to catch bigeye tuna for sausage material.

In the Atlantic too, the Government is trying to hold the lid down, against considerable pressure for expansion. Operations began there in 1956, with only 1 or 2 boats working at a time. In 1957 the number of boats operating in any one month rose to a maximum of 20, and in 1958 to 31. There are said to be about that many fishing the Atlantic now, and more would like to go. Plans for this year call for a total of about 60 boats making 2 landings each for the U.S. market. It was earlier reported that a vessel, to fish the Atlantic profitably, had to plan on 2 landings for transshipment to the U.S., one in a European or South American port, and a fourth trip to be landed at home. I have it on good authority that many owners now are ready to undertake an Atlantic operation for only the two landings for the U.S. and the final trip for landing in Japan.

What sort of competition is the American fisherman up against in the Japanese longline fishery? It is an operation of extraordinary flexibility and resiliency. California fishermen, by and large, catch yellowfin and skipjack and try to sell them to canneries. They cannot, because of the methods they use, fish far from land. The Japanese carry frozen bait and they can fish literally anywhere. They catch albacore, yellowfin, bigeye, several species of "bluefin", marlins, and broadbill, many of these species in a rather wide range of sizes. If they bring in frozen or iced small yellowfin and albacore, canners and freezers will bid against each other to get them for export. If they bring in frozen bigeye, large yellowfin, or marlin, the sausage makers are hungry for raw material. If it is iced bigeye, yellowfin, bluefin, or marlin, the fresh-fish trade takes it as high-grade merchandise. Do not let the limited scope of your own operations make you think of these odd fish as unimportant elements in the catch. Remember, black marlin often brings a better price than yellowfin, striped marlin sells higher than albacore, and bluefin can be more expensive than any of them. The Japanese fisherman actually mistrusts a one-species fishing ground -- he prefers to spread his risks, in view of the wide fluctuations from day to day in the prices of the several species. The Japanese operator is approaching a stage where he can gauge his market, select his ground for the time of year, and plan his production with a good degree of certainty. For example, if this summer's bait-boat albacore season turns out to be a failure, and the demand is strong, the situation can be remedied to some extent by sending out additional mothership fleets to fish for tropical albacore in the South Pacific and southern Indian Ocean.

The Japanese can apparently build their boats for a third to a fourth less than the American fisherman, and can man them mostly with young fellows who have few responsibilities ashore and few prospects of getting a good job on the beach. The Japanese fisherman can eat for less than 50 cents a day, and the older crew members will sail for a guarantee of around $30 a month, for that is enough to keep their families alive back in the native village. This makes tough competition for American fishermen.

I do not mean to imply that the Japanese tuna fisheries do not have their problems. As listed in a recent Japanese Government report, these problems include worries over the extension of jurisdiction by coastal states, the setting up of bomb and missile testing ranges in the middle of the fishing grounds, the threat of competition posed by Korean boats entering the Samoan fishery and the appearance of a Soviet tuna boat in the Caroline Islands, the appearance of signs of overproduction of skipjack, and the prospect of excess salmon boats entering the tuna fisheries. They also fear that their expansion into Eastern Pacific fishing grounds may bring on trouble with American fishermen, perhaps giving added stimulus to boycott, embargo, and tariff-raising movements, which are, of course, what they fear most of all. Their worries, as listed in this report, do not appear to include a fear that American fishermen will produce tuna so cheaply as to drive them out of business.

I should like to mention another minor advantage that the Japanese tuna fisherman has. His national and local governments operate over 40 research, guidance, and training vessels which fish tuna. They explore new grounds, report intelligence of value to the fishery, and train a steady supply of competent tunaboat officers. Last year, for example, a training vessel of the national government made a cruise around the world, training cadets in tuna fishing, canning tuna aboard, and doing simple public relations work for canned tuna in its ports of call. In the past, the operations of many of these government vessels have not been well coordinated and they have often fished more to make money than to obtain and disseminate new knowledge, but the Japanese Fisheries Agency is now making a determined effort to get them all working at their proper functions on a unified research plan. It certainly does not seem that our government agencies are doing as much along these lines for our tuna fishermen.

To sum up, the Government of Japan, fearing overproduction and the disruption of export markets, is holding down the lid on expansion of the tuna fleet, against considerable pressure. Unless the pressure blows it sky high, the lid will be eased off gradually, as increased demand for tuna seems to warrant it. No one can say anything very meaningful about the eventual maximum sustainable yield of the world's tuna resources at this time, when we know so very little about the tuna populations. People close to the fishery in Japan are in agreement that tuna production is likely to increase steadily in the near future, as more efficient and versatile boats replace old ones and as the vast, newly won fishing grounds are consolidated in terms of detailed knowledge of seasons and fish movements.

I should like to be permitted to conclude on a personal note. I have sailed a bit with Japanese tuna fishermen on their boats. I found them to be good men, good fishermen, and good shipmates. You might think them willing to accept an unreasonable degree of discomfort and hardship, but they have mostly never known anything else. You might think them inordinately fond of fish and rice, but that is the normal Japanese diet ashore too. They do not go tuna fishing just to annoy you or to threaten your livelihood. They fish tuna because they know no other trade and because someone is ready to buy the fish which they produce. Most of them have only the vaguest notion that American tuna fishermen exist or of what use Americans make of the tuna that they buy from Japan. I should be most unhappy to think that the economic difficulties in which you find yourselves might lead you to harbor feelings of animosity or bitterness against the Japanese fisherman.

PART 2

THE DOMESTIC TUNA-FISHING INDUSTRY

HARVESTING THE TUNA RESOURCE

by

Gerald V. Howard 1/

Purpose of the domestic tuna fishing industry, like any other industry, is to make a profit in order to stay in business and to expand. For several years, the tuna fishing industry has been in an unhealthy condition. There has been no expansion since 1951 and, since 1953 at least, the average tuna boat owner has experienced either marginal profits or losses on his investment. Capacity of the three fleets, the large clippers, the purse seiners and the albacore craft, has dwindled every year since 1951 when it was at a maximum. The clipper fleet has been reduced in number from 210 to about 125. Eighty large seiners fished tuna in 1951; less than 50 fish today. More than 3,000 craft participated in the albacore fishery in 1951; less than half that number fished in 1958. Fishermen manning these vessels have seen their earnings slump and employment opportunities have dropped drastically. It is not a pretty picture.

The unhappy situation results from the steady decline in the price of tuna and restrictions on fishing operations - fishermen are unable to sell at an acceptable price as much fish as they can catch. Inflation has aggravated the situation.

Those who have seen catch data in terms of man days at sea are aware that American tuna fishermen are much more efficient than most foreign fishermen. If this were not true, American tuna fishermen would long since have been essentially wiped out. It is only superior efficiency that keeps them in business at all.

For years, fishermen have advocated tariffs or quotes on tuna imports as the immediate and most effective solution of their difficulty. Any other means or circumstances that will contribute to their solution will take time. Since the control of imports is outside the province of the Bureau of Commercial Fisheries, it is the longer range solutions that we must explore.

I believe that we can perhaps obtain some comfort from Mr. D. R. Johnson's observation that the Japanese may not be able to continue to increase their tuna production indefinitely without appreciably adding to their cost of production. So far, they have been able to keep cost down by continually moving into virgin areas. If the cost of Japanese tuna production does eventually approach that of the United States' operators, and if the United States market continues to expand, prices for tuna will rise and our fleets will again be economically competitive. However, discussion of these possibilities is academic

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because they are beyond the control of the fishermen and the Bureau.

PRODUCTION COSTS

Over the years, boat owners and fishermen have constantly considered how to reduce costs of production. The events of the past seven or eight years have made such efforts increasingly urgent. Under existing circumstances, reducing the cost of catching tuna appears to be the best, if not the only, means of improving our fishermen's competitive position and thereby obtaining for them a larger share of the American market. At any rate, the cost of catching tuna is the central problem, and it will be defined in terms of 1) net income of tuna boat operation, and 2) cost factors in boat operation.

Profit and Loss Experience

The tuna boat owners expenses conveniently fall into four categories:

1. Fixed expenses which include depreciation and property taxes;
2. Semifixed expenses which include insurance and repairs;
3. Crew's share which is subject to negotiation;
4. Variable expenses which for the most part cover the trip expenses for fuel, provisions, licenses, gear, etc.

Depreciation and property taxes are fixed because there is little that can be done to reduce them. Insurance and repairs are considered semifixed because the owner is able to minimize them and they vary with the amount of time spent at sea and other factors. The crew's share is subject to negotiation and agreement with the fishermen's unions, at least for the large vessels. The truly variable expenses are the trip expenses for fuel, provisions, licenses, gear, and so forth, which in some segments of the fleet are shared by owner and crew. Trip expenses are directly related to the time spent at sea - the longer the trip the heavier the expenses and the greater the cost of catching a load of tuna.

The United States Tariff Commission report (1958) on tuna fish provides data on income and expenses for recent years. They were obtained by circulating questionnaires to boat owners. Included is information for over 100 large bait boats, about 20 purse seiners, and over 200 albacore boats, which operated in 1953 through 1956. Similar material for 35 clippers fishing in 1957 is also provided.

Figure 1 and table 1 show, for the large clippers and seiners, expenses as

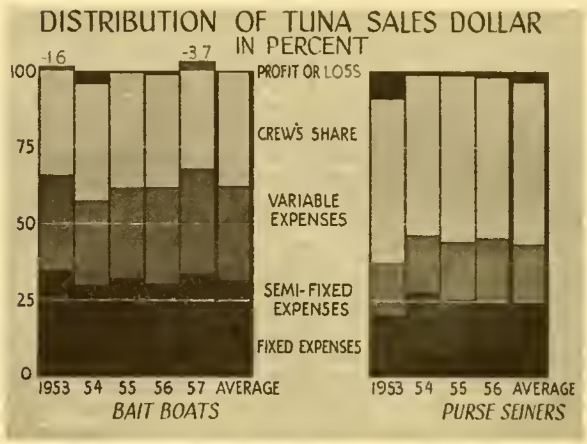

Figure 1. --Average expenses and profit or loss experience of large bait boats and purse seiners responding to U.S. Tariff Commission questionnaires. Expenses and profit or loss are given as a percent of net sales.

percentages of average annual sales according to the four categories mentioned. Over the period, sales averaged $183,000 annually for the bait boats and $111,000 for the purse seiners. From profits or losses as shown, it is apparent that the average owner continues to operate by depreciating his capital investment. The fisherman is not doing much better; the average bait boat crew's share of 35.8 percent of sales in 1957 represents less than $5000 per fisherman which is less

Table 1.--Landings, sales, expenses and profit or loss experience of large bait boats and purse seiners responding to U. S. Tariff Commission questionnaires.

	1953	1954	1955	1956	1957	Mean
Large bait boats[1/]						
No. of vessels	115	121	126	131	35	
Net landings - tons	69203	81061	76541	93791	23115	
Net sales - thousands of dollars	21036	25416	21746	23836	5875	
Average landing - tons	602	670	607	716	660	
Average sales - dollars	182922	210050	172587	181954	167857	
Average price per ton - dollars	304	313	284	254	254	
		Percent of sales				
Fixed expenses	12.5	10.7	12.4	11.7	12.3	11.9
Semi-fixed expenses	20.9	19 0	19.9	18.7	21.4	20.0
Variable expenses	31.3	27.7	29.4	30.8	34.2	30.7
Crew's share	36.9	38.6	38.2	37.7	35.8	37.4
Net profit or loss (before taxes)	-1.6	/4.0	/0.1	/1.1	-3.7	0.0
Large purse seiners[1/]						
No. of vessels	16	21	21	20		
Net landings - tons	--	--	--	--		
Net sales - thousands of dollars	2206	2210	2188	2065		
Average landing - tons	--	--	--	--		
Average sales - dollars	137848	105238	99424	103237		
		Percent of sales - all fish				
Fixed expenses	4.5	6.1	6.1	6.3		5.8
Semi-fixed expenses	15.4	21.6	18.9	17.6		18.4
Varisble expenses	17.4	18.6	19.0	21.3		19.1
Crew's share	53.9	52.6	54.5	53.0		53.5
Net profit or loss (before taxes)	/8.8	/1.1	/1.5	/1.8		/3.2

1/ Bait bost sales are entirely tuna; purse seiner sales include tuna and other fish - tuna in value varied as follows:

1953 - 97%; 1954 - 87%; 1955 - 85%; 1956 - 92%

Source: United States Tariff Commission, Tuna Fish Report, May 1958.

Table 2.--Landings, sales, expenses and profit of albacore vessels responding to U. S. Tariff Commission questionnaire.

	1953	1954	1955	1956	1957
No. of vessels	212	238	238	280	248
Net albacore landings - tons	5065	5118	7729	9766	9047
Net albacore sales - dollars	2015834	2056331	2504271	3339932	2623642
Net sales - all fish - dollars	2494442	2546955	3054867	3986554	3065682
Net sales - percent albacore by vessel	80.8	80.7	81.9	83.8	85.6
Average landings - albacore - tons	23.9	21.5	32.5	34.9	36.5
Average sales - albacore - dollars	9509	8640	10522	11928	10579
Average price per ton - albacore - dollars	398	402	324	342	290
	Percent of net sales - all fish				
Fixed expenses	14.5	15.8	13.5	12.2	12.8
Semi-fixed expenses	15.4	14.8	13.3	13.2	14.6
Variable expenses[1/]	27.2	30.2	29.0	25.6	27.8
Crew's share	21.2	20.2	18.6	19.6	18.9
Net profit-average per craft including owner's earnings as crew member	21.7	19.2	25.5	29.2	25.9
Net profit and earnings in dollars	2553	2053	3273	4157	3202

1/ Insurance included here and not with semi-fixed expenses.

Source: United States Tariff Commission, Tuna Fish Report, May 1958.

than that earned by a typical factory worker in southern California in the same year.

Owners of albacore vessels, in general, fish for other species besides albacore. Those answering the Tariff Commission's questionnaire obtained about 80 percent of their income from the sale of this tuna species, which is usually caught during the six months or less of the year when it is available (table 2). The situation of these owners is similar to that of the owners of the larger tuna boats. Even when average profit on sales was at a maximum of 30 percent in 1956, it only amounted to $4200 and included was the owner's earnings as a crew member.

Examination of figure 1 and table 1 indicates that for the large bait boats, the variable expenses greatly exceed those in the other categories, and for the seiners they are, on the average, somewhat larger, although semifixed expenses approach the same level. Albacore boat owners find that their variable expenses far exceed those in the other categories. Since boat owners have little possibility of reducing expenses in other categories, it is the variable or trip expenses which must be minimized if the cost of catching tuna is to be reduced appreciably. It is in this area that the Bureau can assist the industry.

Cost Factors

Fishing operations are essentially the same for all types of tuna boats. They include time spent running to and from the fishing grounds and the time spent scouting and fishing. Bait boats have one more operation than seiners and jig boats - scouting for and catching bait. These are the operations which determine the length of a fishing trip. Before imports became a problem, these operations also determined the number of trips made. "Turn about time", which is the time spent in port between trips, was controlled primarily by the owner and his crew. In recent years, "turn about time" has increased markedly and has been controlled, for the most part, by how long the owner has had to wait to sell his fish. It also can be increased, of course, by prolonged negotiations between owners and fishermen. The only tie-up of any real consequence from this cause in recent years, however, was in 1951.

Through the courtesy of the Inter-American Tropical Tuna Commission and its director, Dr. M. B. Schaefer, it is possible to examine typical fishing trips of the large clippers and seiners (figs. 2 and 3 and table 3). The data are for clippers of 201 to 300 tons capacity (Class 4) and purse seiners of 101 to 200 tons (Class 3). Vessels of these capacities are typical of the long range clippers and seiners.

The average trip of a bait boat lasted 70 days over the years 1950 through 1958 and of this 21 days were spent running, 37 days were used to scout and fish, and 12 days were spent baiting. Shortest average trips were made in 1951. Fifty-seven days were spent at sea - 21 days running, 28 days scouting and fishing and 8 days baiting. Longest average trips were made in 1952 and 1953 with 82 and 81 days at sea - 24 days running, 45 days scouting and fishing, and 13 days baiting. The important thing to note is that the time spent running and baiting is quite constant from year to year. The big variable is time spent scouting and fishing.

The large purse seiners have spent an average of 38 days at sea on tuna trips since 1952; of this time, 16 days were devoted to running and 22 days to scouting and fishing. Shortest average trips were made in 1958 - 29 days with 12 running and 17 scouting and fishing. Longest average trips were made in 1954 - 52 days of which 23 were used running and 29 scouting and fishing. In 1954, unlike any of the other years, the seiners did much of their fishing in waters off South America. If the 1954 trips are disregarded, we find that running time for the seiners averaged between 12 and 19 days per trip. Nevertheless, running time is more variable for the seiners than it is for the bait boats. However, like the bait boats, the seiners spend more time fishing and scouting than running, but running takes up a greater proportion of their time (42 percent) than it does for clippers (30 percent).

Comparable data on running and fishing times are not available for albacore craft but it is known that they spend more time fishing than running and that the length of average trip varies from year to year.

For the bait boats, 1957 was a "normal"

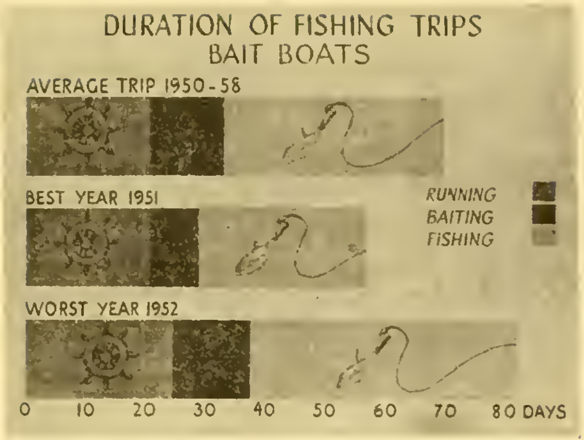

Figure 2.--Average duration of fishing trips of Class 4 (201-300 tons capacity) bait boats showing time spent running, baiting and fishing.

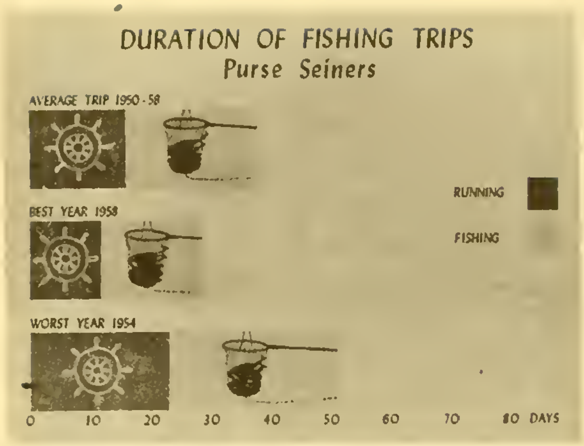

Figure 3.--Average duration of fishing trips of Class 3 (101-200 tons capacity) purse seiners showing time spent running and fishing.

Table 3.--Fishing operations of Class 4 bait boats and Class 3 purse seiners 1950-58 and 1952-58 respectively.

Year	No. boats	No. trips used	Days out	Days fishing	Days baiting	Av. trip days out	Av. trip days fishing	Av. trip days baiting	Av. trip days running
Bait boats - Class 4 (201-300 tons)									
1950	35	126	7422	3806.5	1098.5	59	30	9	20
1951	72	168	9648	4667.5	1383.5	57	28	8	21
1952	72	212	17410	9438.5	2785.5	82	45	13	24
1953	70	203	16505	8904.5	2546.5	81	44	12	25
1954	67	222	15506	7553.0	2444.0	70	34	11	25
1955	63	151	10043	5202.0	1785.0	66	34	12	20
1956	60	198	12269	6550.5	2403.5	62	33	12	17
1957	54	156	10849	6205.0	2154.0	70	40	14	16
1958	53	157	11718	6113.0	2475.0	75	39	16	20
	Total	1593	111370	58440.5	19075.5	Av. 70	37	12	21
Purse seiner - Class 3 (101-200 tons)									
1952	33	102	4415	2542.0		43	25		18
1953	31	95	3604	2418.5		38	25		13
1954	49	102	5341	2949.0		52	29		23
1955	47	92	3892	2123.0		42	23		19
1956	50	151	5124	2901.0		34	19		15
1957	37	109	3808	2403.0		35	22		13
1958	36	147	4236	2446.0		29	17		12
	Total	798	30420	17782.5		Av. 38	22		16

Source: Inter-American Tropical Tuna Commission.

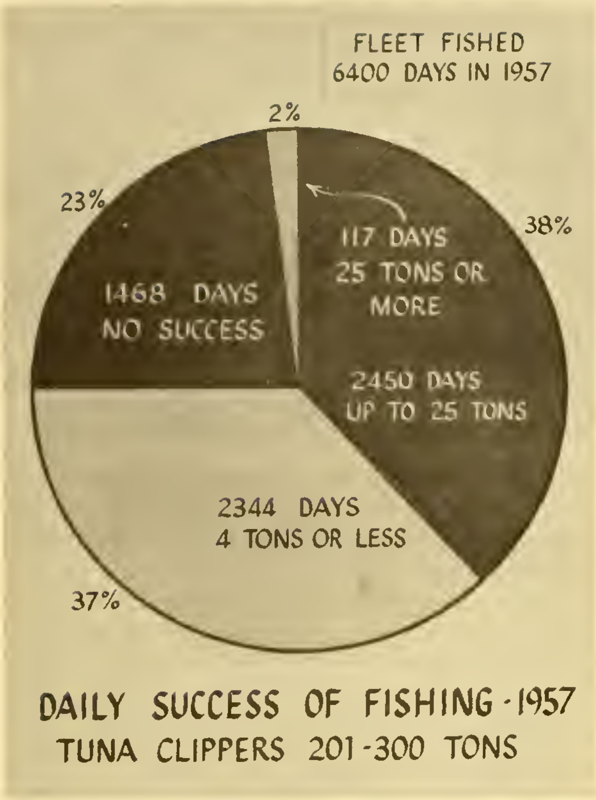

Figure 4. --Daily success of fishing of Class 4 (201-300 tons capacity) bait boats in 1957. Time spent running has been eliminated.

year. A typical vessel spent 70 days at sea per trip and used 40 days scouting and fishing. The more than 50 boats of 201 to 300 tons capacity spent more than 6,000 of over 11,000 days at sea scouting and fishing. What kind of daily catches did they make? They are shown as a frequency distribution in table 4 and are illustrated in figure 4. No catches were made on 23 percent of the "days spent fishing" which means that on an average trip of about 40 days fishing, 9 were spent without landing fish. About 37 percent or nearly 15 days per trip yielded 4 tons or less. Few days yielded catches greater than 15 tons. Comparable data for the purse seiners and albacore vessels have not yet been processed. While we have no information concerning the average daily catches of the albacore, the California Department of Fish and Game probably has.

The number of fishing trips a boat is able to make each year depends on the daily success of fishing experienced and on the "turn about time" between trips used for maintenance and repairs. Since 1951, "turn about time" has, on the average, been much greater than necessary because, as mentioned, it has not always been possible to dispose of the fish immediately on arrival in port. Extension of "turn about time" has adversely affected the cost of catching fish for all owners and their crews. It

Table 4.--Success of fishing of Class 4 (201-300 tons) bait boats in 1957 showing tons caught daily as frequency distributions. Time fishing has been separated from time running and baiting.

Catch in tons	January -March	April -June	July- September	October- December	All year	Percent of total time	Average for one vessel - days
0	383	423	429	233	1468	23.0	9.2
4 or less	758	611	557	418	2344	36.8	14.7
5-9	348	420	389	268	1425	22.3	8.9
10-14	155	235	144	113	647	10.1	4.0
15-19	64	113	42	56	275	4.3	1.7
20-24	21	46	15	20	102	1.6	0.7
25-29	12	17	11	10	50	0.8	0.3
30-34	7	24	1	6	38	0.6	0.3
35 and over	6	10	4	9	29	0.5	0.2
Total	1754	1899	1592	1133	6378		40

Source: Inter-American Tropical Tuna Commission.

has tended to cancel much of the advantage obtained by having a superior vessel and crew.

The typical bait boat (201-300 tons) has averaged just under 60 percent of the year at sea since 1951. Minimum sea time was 45 percent in 1955. About 66 percent of the year, or 240 days, were spent at sea in 1958. (See table 5 for data on time at sea, number of trips, length of trip, catch per day of fishing). Certainly time at sea could be increased appreciably if this were the only consideration. Any way of decreasing "turn about time" would contribute to solving the problem of reducing the cost of catching tuna. It has been variously estimated that each day of waiting to unload adds about two dollars per ton to cost of catching tuna.

REDUCTION OF FISHING TIME

Effects of Knowledge and Skill

Boat owners and fishermen are continuously seeking ways to shorten time taken to catch loads of fish so that they can reduce cost of production and increase sales. Time reduction is effected by information available to the skipper and his crew and through technological advances.

The information available to the skipper, which contributes to his fishing success, is his and his crew's empirical knowledge or accumulated experience, current shore reports on fishing conditions obtained before sailing, and information received at sea from other boats. Skippers of purse seiners and albacore vessels tend to exchange information more freely among them than do masters of the bait boats who frequently prefer to operate through small code groups. The purse seine skippers initiated an additional way of getting information in 1958 by employing the scouting service of land based aircraft operating from bases in California and Mexico. The pilots of these planes receive a share of the schools that they find for the boat. The fact that the vessels continue to use this free-lance service attests to its effectiveness.

There is no question that the empirical knowledge of the skipper and the current information he receives both contribute substantially to minimizing the duration of fishing trips. That some skippers have more knowledge than others and that their superior knowledge permits them to make consistently shorter trips is undeniable. We have plotted in figure 5 the average number of days spent on a fishing trip annually (1951-58) for eight of the more successful Class 4 bait boats (201-300 ton capacity), each of which maintained the same skipper from 1951 through 1958, and the same average statistic for the fleet of Class 4 bait boats (more complete details are given in table 6). Over these years, the skippers with superior knowledge made consistently shorter trips - a savings of time in

Table 5.--Average number of days at sea, length of trip, number of trips and catch per days fishing for a typical Class 4 (201-300 tons) bait.

Year	Days at sea	Length of trip	Number of trips	Catch per day--lbs.
1951	165	57	2.9	--
1952	254	82	3.1	9207
1953	259	81	3.2	8581
1954	238	70	3.4	13613
1955	165	66	2.5	13910
1956	204	62	3.3	13606
1957	203	70	2.9	10489
1958	240	75	3.2	10137

Source: Inter-American Tropical Tuna Commission.

the order of 15 percent per trip. As a consequence, although they spent no more time at sea, they completed greater number of trips.

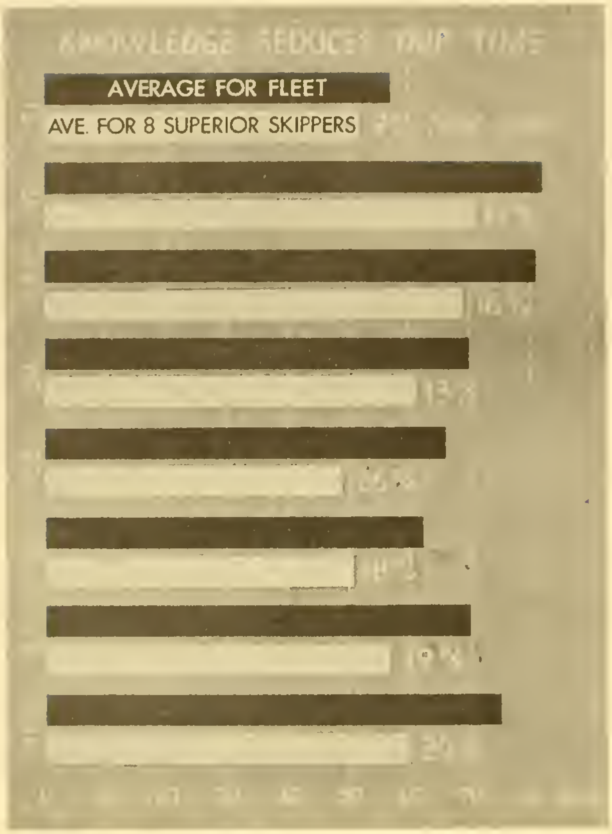

Figure 5.--Average operational record for eight Class 4 bait boats (201-300 tons capacity) each having same skipper over period 1951-1958 compared with average record of all bait boats of this capacity.

Effects of Improved Equipment

Vessel and gear improvements and other auxiliary aids, like knowledge, are effective in minimizing the duration of fishing trips. The record of vessels launched by the National Steel and Shipbuilding Corporation during the last four years points out the increased efficienty gained by operating modern vessels. While it is true that the owners and crews of these particular vessels have enjoyed other advantages, no one will question that these vessels are superior to older craft of the same capacity.

I have, for the most part, used examples from the bait boat fleet to illustrate the effective contribution of information and knowledge to shorter fishing trips and we have also referred to bait boats in speaking of the contribution made by modern vessels. Since technological advancements have been particularly noteworthy in the purse seine fleet during the past three years, this seems a good place to emphasize the contributions that can be made by gear improvements and auxiliary aids. In this discussion, we will draw heavily on an article to be published in the June 1959 issue of Pacific Fisherman

Table 6.--Average operational record for eight Class 4 bait boats (201-300 tons capacity) compared with the average for all bait boats of this capacity 1951-1958.

	1951	1952	1953	1954	1955	1956	1957	1958
Average record of eight boats								
Days at sea	142	257	257	259	147	205	212	253
Number of trips	2.8	3.6	3.8	4.3	3.0	4.0	3.8	3.7
Percent of time at sea	39	70	70	71	40	56	60	61
Average trip in days	52	71	71	61	49	51	57	60
Average record of all boats								
Number of boats	73	77	74	68	63	60	54	52
Days at sea	165	254	259	238	165	204	203	240
Number of trips	2.9	3.1	3.2	3.4	2.5	3.3	2.9	3.2
Percent of time at sea	45	69	71	65	45	56	56	66
Average trip in days	57	82	81	70	66	62	70	75

Source: Inter-American Tropical Tuna Commission by Craig J. Orange and Gordon C. Broadhead of the Inter-American Tropical Tuna Commission.

Three developments have contributed greatly to reducing fishing time of purse seiners - the power-operated block for recovering the tuna seine first introduced in 1955 aboard Anthony M, the all-nylon net which was introduced by Anthony M at about the same time, and brine-spray circulation first installed on Jo Ann in 1957.

The power-operated block was used by six seiners in 1958 and at the beginning of this year about half the 44 odd large seiners were so equipped. The advantage of handling the net mechanically is the time saved on the many unsuccessful sets and those with small catches. About half of the sets made in 1959 were unsuccessful and they averaged close to 110 minutes to complete. The vessels with power-operated blocks completed unsuccessful sets in 58 minutes - about half the average time. They also made about 40 percent more sets each day than did vessels without the powered blocks. However, since these particular vessels did about 10 percent better than the remainder of the fleet in years previous to the installation of this equipment, perhaps no more than a 30 percent increase in the number of sets can be attributed to it. In 1958, about half the sets of both groups, those with and those without power blocks, were successful. If the power-operated block reduced fishing time by about 30 percent, it probably reduced trips by 15 percent or more because running is not affected.

It is claimed that the nylon net outlasts cotton and that the stronger material permits capture and retention of larger schools. Tuna Commission logbook data do not bear this out. In 1958, there was no measurable difference in the average amount of fish taken in successful sets of nets made of more than half nylon and nets made of less than half nylon. The advantage of nylon nets is that they can be handled more quickly and need less care.

Development of brine-spray circulation has proved a major time saving device for purse seiners and has been widely adopted. It retains the advantage of the brine immersion method of refrigeration without increasing weight. Without it, purse seiners could not convert entirely to brine refrigeration. Orange and Broadhead (loc. cit.) show that the all-brine boats can stow 15-ton sets in 2 hours compared with $2\frac{1}{2}$ hours for boats using part ice - a saving of 30 minutes. Time saved is proportionally greater for larger sets. Sets of 30 tons are handled in about 4 hours and 10 minutes on vessels using part ice stowage and 2 hours and 20 minutes on all-brine boats - a saving of $1\frac{1}{2}$ hours.

That recent technological advances have greatly aided the purse seine fleet in reducing their fishing time is unquestionable. Their success during the past two years has been remarkable. It should be born in mind, however, that technological advances have not been entirely responsible. The unusual oceanic climate during this period has apparently shifted yellow fin and skipjack tuna distrubition and increased their availability in the areas fished by the purse seine fleet, a fact often overlooked by proponents of this gear and bait boat owners considering conversion. Also, bluefin has been more available during the last two years. Certainly the sharp increase in the number of sets-per-day-of-fishing in 1958 was primarily related to high abundance of schools rather than to use of the power-operated block, since only 6 of 44 vessels were so equipped.

One of the large tuna clippers has recently introduced a method that may reduce the time required to catch live bait. The clipper Lois Sievers used a newly designed speed boat on her maiden voyage early this year. It is equipped with power to haul the net. It is reported that the net is set and recovered from the speed boat with less men and in less time than it takes with the usual net skiff.

Further Possibilities through Knowledge of Oceanography and Biology

The tuna fleet's reputation of being progressive ensures that fishing methods will continue to improve through the ingenuity of the boat operators. However, it is improbable that improvements, whatever they may be, will appreciably reduce the considerable time spent scouting for fish or help in catching fish that refuse to bite or schools that are not suitable for netting. That these situations make up a good part of the vast majority of trips points to the need for more knowledge about the fish and their ocean environment. Such information can come from studies of oceanography and biology.

Study of the geographic distribution of tuna catches from logbook records of fishing vessels shows that tunas are not evenly distributed over the Eastern Pacific but tend to concentrate in certain general areas. The tropical tunas congregate off Baja California, the Revillagigedo Islands, the Gulf of Tehuantepec, Central America, northern South America, and the Galapagos Islands. The concentration of the fish in these general regions is remarkedly consistent. However, notable variations do occur from year to year and season to season in the location of the center of good fishing within these general regions, and wide variations also occur in the relative abundance of the tunas within these localities. This also occurs in the broad area of the albacore and bluefin fishery. These variations are responsible for the time the fishermen waste scouting.

Oceanographic studies by Scripps Institution of Oceanography, the Inter-American Tropical Tuna Commission and the Bureau of Commercial Fisheries during the past several years have provided a rather good understanding of the general circulation of the Eastern Pacific Ocean and the reason for the concentration of tunas in the particular regions mentioned. It is in these general areas, as might be expected, that the tunas encounter the best feeding conditions. The regions include features of the ocean circulation which bring nutrient-rich deeper waters into the euphotic zone or layer of light penetration where production of phytoplankton is stimulated. This in turn leads to large crops of forage organisms and finally to concentrations of tuna.

Basic productivity is highest and is accompanied by tuna concentrations where upwelling occurs, as off Baja California and Peru, in the vicinity of thermal anticlines (regions where a strongly developed thermocline rises close to the surface) as off Costa Rica and Panama Bight, along transitions between water masses, and where vertical mixing is particularly strong. However, we have also noted that towards the extreme ranges of the tropical tuna fishery, aggregations are more seasonal, less persistent throughout the year, and appear to be related in a general way to the distribution of temperature more than food. The distribution of albacore is likewise affected by temperature, although there are probably other properties controlling or affecting its distribution.

As yet oceanography has not demonstrated anything new to the fishermen about the distribution of tuna and scientists are not yet able to predict where fish will be most available at any particular time. The tasks of research, therefore, are: (1) to determine what features stimulate organic production, (2) to elucidate the processes by which marine life is supported, (3) to discover the causes of temporal variations in these features and processes, and (4) to relate the latter variations to the tuna's distribution and abundance. When the causes and mechanisms of changes in tuna availability are better understood, scientists will better be able to assist fishermen by predicting areas of tuna concentration.

An investigation with such a goal is now underway at Scripps Institution of Oceanography. It is devoted to the area of the tropical tuna fishery and is financed by contract with the Bureau of Commercial Fisheries. It is being augmented by allied research programs at Scripps Institution and by the oceanographic studies of the Inter-American Tropical Tuna Commission. Its ultimate objective - accurately forecasting changes in tuna availability - will not be attained for some years. However, it should not be long before this program provides useful information which will assist fishermen in locating fish more rapidly than is now possible on the basis of their own knowledge and information.

What benefits are the albacore fishermen receiving from oceanographic research? The California Cooperative Oceanic Fishery Investigation (CCOFI) has made a tremendous number of observations in the area of the albacore fishery during the course of its studies of the California sardine, anchovy and mackerels. Mr. Clemens utilized data collected by CCOFI in his study of albacore distribution as it relates to temperature and for predicting occurrence. It is reasonable to assume that much of the material collected in the past and now being taken could be profitably used to gain some understanding of the variations that occur in the seasonal distribution and availability of the albacore.

Little is known about tuna behavior. Personnel at the Bureau's Honolulu laboratory, under the direction of Vernon E. Brock and his distinguished predecessors, has recognized the need for such knowledge and considers it one of the basic requirements for increasing fishing efficiency. Scientists have embarked on a program to learn about the behavior of tuna in Hawaiian waters. They believe that the elucidation of patterns of behavior can help make existing fishing methods more efficient and may also help in suggesting more effective means of harvesting. There is need for similar studies in the Eastern Pacific. Live bait fishermen encounter all types of schools; so do albacore jig-boat fishermen, and so do purse seine fishermen. Some schools bite well, others bite poorly, and still others do not bite at all. Schools are often too scattered or too fast to catch with either a purse seine or live bait. Purse seiners find some schools are accompanied by too many porpoise. Since fishermen have to stop fishing at nightfall, schools they are working then are often lost by morning. Do these schools maintain themselves during the night? Can they be followed if they do? If fish are biting well at night, can they be expected to bite the next morning? When can nonbiting schools be expected to become biting schools? When are scattered schools likely to become compact? These are only a few of the questions that fishermen would like answered. They point out that studies of tuna behavior would be useful to the fishermen.

More knowledge of the behavior of the bait species while in captivity aboard tuna boats might well contribute to reducing time spent on fishing trips. Fishermen have varied success in keeping bait fishes alive, and since a considerable amount of time is used to catch these fishes and to run to and from baiting and tuna fishing areas, studies of optimum crowding, whether and what bait fishes should be fed, temperature requirements, and other features could contribute to minimizing the duration of fishing trips.

THE ROLE OF THE BUREAU IN REDUCING FISHING TIME

Our present thinking leads us to believe that the Bureau can make its maximum contribution to the fishing industry through studies of oceanography, biology, fishing strategy, and by collecting and disseminating current information considered useful to the fishing industry. Let us examine some of the more promising possibilities.

Oceanography

The Scripps Institution of Oceanography of the University of California is, under a three year contract with the Bureau, studying the relationship between ocean features and tuna availability. This work began in late 1957 and the contract will expire in June 1960. The University, under Dr. Maurice Blackburn's guidance, is making good progress in these studies. We have pointed out the contribution that oceanography is potentially capable of making and believe that this type of investigation should continue.

The Bureau's Stanford Biological Laboratory is engaged in a study to determine on an ocean-wide scale the relationship of medium and long term (more than one month) changes in environmental conditions to medium and long term fluctuations of fish stocks in the Pacific Ocean. Dr. O. E. Sette, veteran Bureau scientist, has a small but select team examining air circulation indices, sea level variations and mean sea surface distribution for the past 30 years. We believe the results of these investigations will be most useful to the scientists studying oceanography in relation to tuna availability and that they will eventually contribute materially to tuna forecasting.

The Bureau recently assumed responsibility for a project initiated by the American Tuna Boat Association to analyze and plot existing data on soundings in the Eastern Pacific which have been made over the years from research craft of Scripps Institution and other vessels. It is known that yellowfin tuna are frequently found to be abundant around sea mounts. The recent accidental discovery of Shimada or Hurricane Bank and the ensuing large catches made on it point to the usefulness of determining what other unknown sea mounts may be buried in unanalyzed sounding data now on hand. It would seem worthwhile to continue this project for at least another year if we are able to persuade the U. S. Navy to declassify the material.

We mentioned that the CCOFI oceanographic data have never been examined, except for Mr. Clemen's study of temperatures, in relation to seasonal occurrence. availability, and distribution of albacore. We consider that this is a prerequisite to planning research in the area of the albacore fishery. This should be done before exploring the possibility of extending the albacore season through work at sea. The state agencies, the California Department of Fish and Game in particular, have rather good records of fishing in these areas over the last several years. If we undertake an albacore investigation, it could be best done jointly or in cooperation with the states and the Pacific Marine Fisheries Commission.

It is our understanding that both scientists and fishermen, particularly albacore fishermen, consider useful the charts distributed monthly by the Bureau's Honolulu Biological Laboratory. They show sea surface temperature averages over the Pacific, east of 180°, for the middle ten days of each month. Temperatures are contoured from 55°N to 20°N and available readings are tabulated in one-degree squares to the south of 20°N because they are insufficient to permit contouring. At the present time the readings are those taken by merchant ships for the U.S. Weather Bureau. They are made available at the latter's central office in Honolulu via the San Francisco Central. Coverage could be increased by obtaining the data directly from San Francisco because this office does not forward all readings to Honolulu. Also, it might be profitable to include data for the entire month in order to give better coverage to the area of the tropical fishery and to make possible contouring of this region. We should like to have your reaction to our extending this service.

If all the available Weather Bureau sea-surface temperature readings did not prove adequate, we could explore the possibility of obtaining more readings from other sources. Some tuna boats collect temperature data for the Weather Bureau; possibly others could be persuaded to do so. Dr. Schaefer, as a member of the National Academy of Sciences Committee on Oceanography, recently inquired, without apparent success so far, into the possibility of interesting the U.S. Air Force in making regular aerial surveys of a part of the Eastern Pacific to obtain synoptic sea-surface temperature data which would be useful not only to fishermen but also to the Weather Bureau and weather researchers. The instrumentation to do this is available. A bolometer developed at Woods Hole Oceanographic Institution will measure back radiation from the sea-surface while the plane flies at about 1500 feet and these measurements can be converted to water temperature readings. It may be worthwhile for the Bureau, in cooperation with other interested parties, to follow-up Dr. Schaefer's initial inquiry.

Biology

We think that the time is ripe to begin studies of tuna and bait-fish behavior. It would seem logical to begin initially with an analysis of the Tuna Commission's logbook data, which the Commission's director has graciously agreed to make available, if this research is started, to determine whether observations recorded by the tuna boat skippers will permit us to learn anything about the behavior of the fish in relation to catches made; to "pick the brains" of skippers with superior fishing success in each of the fleets; and to have scientists make observations at sea aboard commercial vessels. A year from this summer, if funds are available, we could begin making observations at sea from chartered vessels, either research or commercial vessels. We could, of course, draw heavily on the results of the work and experience of our Honolulu laboratory which is now engaged in behavior studies.

The Inter-American Tropical Tuna Commission keeps detailed records of catch and fishing effort for the tropical tunas. The Commission uses these data primarily to determine how the stocks respond to changes in fishing intensity. Some of this material was used in discussing the time taken in various fishing operations, how some boats make shorter trips than others, and to show how recent technological improvements have assisted the purse seine fishermen. The

Commission's director, Dr. Schaefer, has suggested that the Commission might make these data available to the Bureau if required for studies of optimum fishing strategy. We believe the data could provide information useful to the fleet for planning fishing trips.

Those are the areas of study in oceanography and biology which we believe can make substantial contributions to the fishermen in their search for knowledge that will reduce costs of catching tuna. They are areas in which the Bureau is well equipped to operate.

Gear Research

Assistance will come, as we have pointed out, from improved vessel and gear design and from the development of auxiliary aids. The impact of new materials, new instrumentation, new power plants, and new refrigeration techniques has the industry thinking of new vessel design. Numerous technological advances are being made which must have application in the fishing industry to reduce manpower and to catch fish faster. Automation may even have its place in some operations aboard fishing vessels. These may be fields in which the Bureau can assist the industry; they may be areas which the industry can best handle itself. Let us list a few of the things that might be done and which might contribute to catching fish more quickly.

1. Echo ranging equipment for the detection of fish schools as now manufactured is unsatisfactory for detecting and following schools of tuna. It does not have sufficient range and we are told that equipment now used in other fisheries will have to be completely redesigned to be useful to tuna fishermen. Suitable echo sounding devices would aid tuna fishermen and are essential to scientists studying tuna behavior.

2. Experiments in electrical fishing are underway on the east coast and are already assisting menhaden fishermen to brail their catches more rapidly. Some of our colleagues in the Bureau think that electrical fishing may have possibilities for the tuna fishermen.

3. Ways to integrate the bait and purse-seine fishing methods on the same vessel. Bait boats run onto schools they cannot catch but which would be productive for purse seiners and vice versa.

4. Methods of minimizing or avoiding shark damage to nets.

CONCLUSION

Our discussion of the problems of harvesting which are faced by the domestic tuna fishermen clearly points out two things: (1) Under terms of its authority, whatever the Bureau of Commercial Fisheries can do to assist tuna fishermen in solving their present economic difficulties must of necessity be long-range and will, therefore, take time before becoming effective. (2) Because reducing the time required to catch full loads of fish is the key to reducing production costs and increasing sales, we must concentrate our efforts on research and services which will contribute to this end. We believe that the Bureau can make its maximum contribution through studies of oceanography, fish behavior, and improved fishing strategy, and by collecting and disseminating current information which will assist fishermen to make their operations more efficient.

These are the areas of endeavor which appear to be the most promising. The Bureau will assist the industry in every way possible within its authority and available resources. It is well to point out, however, that scientific work can proceed no faster than data are accumulated, men are trained to interpret them, and funds are made available for research.

HANDLING AND TRANSPORTING TO THE CANNERY

Part A

by

Clarence J. Carlson 1/

For many years the handling and preservation of tuna at sea has been recognized as a problem by all segments of the tuna industry. Through variations in handling, the quality of domestic tuna landed has not been always up to its highest potential. When the quality of the fish is slightly below the average, it must be packed as a lower grade or other than a name-brand product and such products command lower prices than the top-grade name brands. For the fisherman to receive the maximum return on each load of fish landed, the fish must be suitable for processing into a top-grade product. We plan to discuss briefly problem areas in the handling and transporting of domestic tuna to the cannery which can affect the quality of the tuna landed.

About 1954-55 the tuna industry recognized a need for improvement in the quality of domestic frozen tuna landed. Deciding that something must be done, they made plans to inaugurate an educational program. The skippers reported to the canners concerning the catching and preserving of each load of tuna and, in turn, the canner evaluated the quality of the load and reported this information to the fishing vessels skippers.

To supplement the program started by the industry, the United States Fish and Wildlife Service, in 1955, negotiated a one year Saltonstall-Kennedy contract with California Department of Fish and Game to carry out research on the handling of tuna. The technological work directed by Dr. Lionel Farber was conducted under subcontract by the Hooper Foundation of the University of California. On the expiration of the contract in 1956, a second contract was negotiated with the Philip R. Park Research Foundation in San Pedro to continue the studies. This contract is still active under the direction of Dr. Sven Lassen who will review the work of his group following my discussion.

The emphasis of the contract research has been on the bait boat fishery because, at the time, this fishery accounted for a large majority of the tuna landed. Since the amount of funds available was limited it was decided that the most good could be accomplished by working on bait-boat fish.

In the previous discussion, Mr. Howard pointed out the complex problem of harvesting tuna from the sea. While this is undoubtedly the most important problem that the fisherman faces, it certainly is not his only problem. After capturing the fish, he must handle and preserve his catch in such a manner that the fish can be delivered to shoreside installations in the best possible condition. Due to many factors, the quality of fish delivered to the cannery sometimes is not considered as being suitable for canning and, as a result, part of the delivered catch is rejected - a problem common to all segments of the fishing fleet. In turn, each segment of the fleet has its own special problems in regard to quality of fish landed. Through discussions and observations we have learned that, in general, the reasons for change in quality of fish aboard the brine freezing vessel can be attributed to four important general factors. These factors include physical damage, bacterial and autolytic spoilage, oxidative deterioration, and salt penetration.

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Physical damage may occur at almost any step in the handling of fish. Aboard the fishing vessel the most likely areas are during the initial handling, during the chilling and freezing processes and while unloading.

Further change in the quality of tuna may be due to bacterial and autolytic spoilage. Bacteria are always present and as soon as an organism dies, they multiply and start their work of destruction. The same is true for autolytic or enzyme spoilage. As soon as the organism dies, self-digestion or autolytic spoilage starts. Aboard the fishing vessel the most likely times for spoilage to occur are during the initial handling, during the chilling process, and during the thawing and unloading.

A sidelight on bacterial spoilage is of interest. Canadian research workers have done considerable work on the spoilage of fish, and have evolved a heat-unit concept of spoilage. They conclude that the rate of bacterial spoilage at 37°F. is double the rate at 32°F. or, in general, that the rate of spoilage doubles for every 5° rise in temperature above 32°F.

The third factor, oxidative deterioration, may affect the quality of the tuna during the frozen dry storage period. During this period, oxygen reacts with certain chemicals in the fish flesh, the most noticeable reaction being the development of rancid odors and flavors in the fatty flesh.

The last important factor is salt penetration, which can affect the quality of tuna at any time during chilling, freezing, and thawing. Changes in quality due to salt penetration can be compounded during these periods, due to variations in these processes.

Not only the bait-boats but also the purse seiners and trollers have some difficulty in maintaining the quality of their fish. An important problem occurs in seine fish while they are in the net. As the net is being brought in, the area in which the fish can swim about is restricted and physical damage may be inflicted by one fish upon another in his death struggle. By the time the net is in a condition to be brailed, most of the tuna have died from being confined. Since the water temperature is relatively high and because it takes considerable time to brail a net, some autolytic or self-digestion deterioration may take place. Recent improvements in fishing gear have cut down the time necessary to purse the seine and to load the fish into the hold of the vessel. This saving in time will undoubtedly have good effect on the quality of seine-caught tuna. During 1957, another innovation, the brine spray system of refrigeration, was adopted by a member of the San Pedro seine-boat fleet. Since that time several other boats have installed similar systems, and the percentage of reject fish is reported to be low at the present time.

The tuna trollers are primarily short-range fishing vessels. If the fishing is good, there is the possibility that the tuna will be on deck too long at high temperatures. In such cases, the fish lose quality due to autolytic and bacterial decomposition. These boats use ice to refrigerate their fish. Because of this, there is a possibility that some physical damage can occur through the use of too large and sharp pieces of ice. Also troll caught tuna held in ice, can suffer from bacterial and autolytic spoilage and from oxidative deterioration, if the boat remains out too long.

In collaboration with the California Fish Canners Association, a man with experience, both as a fisherman and as a research worker, was detailed to a tuna clipper for two trips to study some of the variables in the handling and freezing of tuna at sea. Aboard the vessel, samples of tuna were tagged and records were kept of the temperature and handling conditions. Logs were maintained for each brine well in order to indicate the variables encountered commercially in handling, loading chilling, and freezing the fish. In addition, samples of tuna were taken at various intervals and were frozen in still air in the meat locker for later studies of oxidation, salt content of the fresh flesh, and on salt absorption during storage in refrigerated brine ashore.

Several observations made aboard the vessel during the two trips are of interest in relation to the time and temperature delays which may occur in the handling, chilling and freezing of tuna. The following are examples of some of these observations:

1. The body temperature of skipjack and yellowfin tuna immediately after landing, varied from 4° to 8°F. higher than the seawater temperature (range 74° to 83°F.).

2. Skipjack tuna ranging from 8 to 10 pounds each were chilled from 84°F. to 32°F. in 6 to 9 hours when placed in sea water prechilled to 31°F. When placed in warm sea water at an initial temperature of 85°, skipjack required about 20 hours to cool to 32°, at which time the sea water temperature was down to 31°F.

3. The condition of skipjack held in air on deck was influenced more by initial condition of the fish and environmental factors (temperature, piling of fish, handling, etc.) than by time on deck. For example, in one case skipjack held on deck for 10 hours were still in rigor mortis and in excellent condition whereas another lot from a different catch had passed through rigor and appeared soft and in poor condition after only 2½ hours on deck. This difference was attributed partly to the greater exposure and physical damage to the latter fish.

4. Fish located in the center of a large brine well required an excessively long period to come to the equilibrium temperature of the well.

5. During loading of a brine well over a period of several days, the temperature of the chilled fish already in the well rose proportionately with the temperature increase of the brine when warm fish were added to the well.

6. Shrinkage or loss of weight of skipjack and yellowfin tuna from the time they were placed in the well until time of unloading was not of great significance under the conditions aboard the vessel used in the study. The average loss in weight for 52 individual fish in 4 different wells was 2 to 3 percent of the initial weight. Loss of blood and minor physical damage appeared to account for this shrinkage.

While these observations are of limited value inasmuch as they apply only to the conditions and practices aboard one vessel for two trips, they do provide some indication as to the importance of various factors in handling, chilling, freezing, and thawing tuna. This preliminary work indicated, also, that while it was difficult to follow a preconceived plan of research at sea, due to conditions beyond the control of the researcher, much could be learned through observation of at-sea working conditions.

HANDLING AND TRANSPORTING TO THE CANNERY

Part B

by

Sven Lassen [1]

The technological problems which I shall discuss are some which I have had a chance to study as a result of my contract with the Bureau of Commercial Fisheries. The title of the contract is: "A Study of Methods of Handling, Freezing and Thawing of Tuna at Sea, and the Resulting Effect on Quality and Yield of the Canned Product." To do justice to a project like this, it is, of course, necessary for the investigator to have a fairly clear picture of what happens to a tuna from the moment it hits the deck of the tuna clipper until it ends its usefulness in the form of a tasty dish on the consumer's table. Of course the part of the overall processing of tuna which takes place at the shoreside cannery may more readily be subjected to a study and analysis, and that is why more is known about the influence upon quality and yield of handling during the shoreside processing of tuna. While we have studied some important aspects of this last phase of tuna processing, it is what happens to the quality and yield of tuna during the transit period from the fishing area to the home port of the tuna clipper that I should like to say something about.

To learn more about the procedure followed by the tuna clipper for the preservation of tuna while in transit, a survey covering 103 tuna clippers was made by Mr. Van Atta of the California State Board of Health, and paid for by the Bureau of Commercial Fisheries. I had the privilege of analyzing and summarizing the results of this survey. While much useful knowledge was gained of the various steps involved in the treatment of tuna on board ship, it became evident from this survey that the methods of preservation, while similar in outline, varied enough in essential detail that a picture of a uniform procedure could not be obtained. This explains in part why some boats bring in better fish than others. To clarify this situation and at the same time try to unify preservative methods on board the tuna clippers, an attempt was made to write a set of general recommendations which, if followed, would give a uniform, improved, high quality tuna product delivered at the dockside. These recommendations were embodied in a manual. The recommendations were based upon the valuable advice and help by many people with whom Mr. John Rawlings, my collaborator in this effort, and I came into contact.

As a part of the effort to learn more about what happens to the tuna on board ship, Mr. Rawlings made observations and measurements at sea on the treatment of tuna in transit. The results from the two cruises of Mr. Rawlings have been reported in various communications from the Bureau of Commercial Fisheries, and will not be delt with here to any extent. Mention shall only be made of the temperature measurements of the freshly-caught tuna on deck and in the filled wells of the tuna clipper which contributed much to a better understanding of the problem.

One might ask what is the nature of the changes which freshly-caught tuna undergo when stowed in the wells of a tuna clipper and kept under refrigeration while being transported to the cannery. These changes apparently begin the moment the tuna hits the deck and continue at varioua

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rates until the tuna can is opened.

These changes are, of course, much slower after canning. The changes in quality which occur at the cannery prior to actual canning have also been investigated, particularly the changes which occur during butchering, precooking and cooling. These results will be reported elsewhere and will, therefore, not be subject to comment here except to state that the changes at the cannery are easier to recognize and identify and may be followed experimentally without much difficulty.

The situation is different when it comes to an investigation of the quality changes in tuna while in transit. It is evident that a thorough knowledge of the general method of handling of tuna at sea is indispensable for an inquiry into the nature of quality changes of tuna. Furthermore, it is important to use methods of analysis which will permit the measurement of such changes. But until we know what the nature of these changes is, it is difficult to select the proper analytical procedure. In the past and to a certain extent at present, the organoleptic test has been predominantly used. The subjectivity of this test, however, always leaves room for difference of interpretation and such a method does not reveal very well the cause of the changes observed. Several chemical tests have been used by various investigators in connection with quality evaluation of tuna, and as used by us, they have thrown light on the changes which occur during one stage or another of the several steps into which the preservation of tuna on board the vessel may be divided. By simulating in our San Pedro experimental freezing plant, the freezing procedure which takes place on board, we have acquired a deeper insight into the relative influence that each step of the refrigeration process has on the overall change in quality.

Many chemical analyses have been made of samples of tuna taken from returning clippers, and have been compared with analytical results obtained from fresh tuna which has undergone similar treatment in our experimental freezing plant. The analytical work has covered investigations of oxidative changes in the fatty matter contained in the tuna muscle, oxidative changes in the protein substance of the tuna, bacteriological examinations of skin, muscle and viscera of tuna, and the determination of volatile substances released in the tuna muscle tissues as a result of incipient spoilage. Finally, the problem of salt penetration into the tuna muscle has been investigated, and we have established that the thawing of the tuna often causes more salt penetration and spoilage than does the cooling, chilling and freezing.

These studies, which by no means have been completed, have led us to differentiate between quality changes caused by spoilage factors and quality changes caused by denaturation.

By denaturation, we mean the undesirable quality changes which may occur when tuna is refrigerated in brine. As a result of refrigeration in brine, certain changes in the muscle tissue of the tuna take place which might affect the texture, the taste and the yield of the end product. The process of denaturation is a complicated one, and involves a partial change of state of the muscle protein such as dehydration, reduced solubility in certain electrolytes, and a change in its colloidal properties. Much work has been done by others on the denaturation of protein by heat, but less on denaturation of protein by freezing.

Little is known about protein denaturation in fish in general and practically nothing is known about the denaturation which takes place when tuna is frozen in a brine solution under conditions such as prevail in a clipper ship. Some efforts to relate degree of denaturation of fish protein to its solubility in sodium chloride solutions, of given strength, have been made by the British. Their method has seemingly been successful in its application to muscle protein from cod, and we are trying to apply this method to tuna. Some work has recently been done in our laboratory which aims at relating the electrode potential of a tuna-muscle homogenate to degree of denaturation. It is too early to express any opinion about the success of the method.

While this distinction between denaturation and spoilage as a cause of quality change, which we have just made, is not a sharp one, it is our belief that denaturation of tuna plays a greater role in quality of landed tuna than does spoilage.

When in the thirties the percentage of

rejects of tuna because of spoilage became alarmingly large, the boat owners faced a critical situation. The progressively longer distances that the ice boats travelled created this situation and forced boat owners to adopt a new refrigeration system. Land and Farber recommended the adoption of the brine freezing system, and since then the rejects, from all causes, have declined drastically. On the whole this system of preservation has worked well and the type of quality deterioration which we find today is different from what it used to be in ice boats.

Many of the tuna clippers now bring in tuna with little evidence of spoilage or even of incipient spoilage in the fish as measured by the organoleptic test or by the use of conventional chemical spoilage tests. In spite of this, it is evident that the tuna has undergone certain physical and other changes which are undesirable. These changes are, in our view, due to changes which occur when the freshly caught tuna either is not frozen soon enough after capture, or not fast enough, or not kept at a low enough temperature while in transit. If these assumptions are valid, any study of means for the improvement in quality of tuna while in transit should be focused on the chemical engineering aspects of the problem rather than primarily on the chemical aspects. In view of this, we have in our recent work laid more emphasis on the chemical engineering aspects of the problem.

The rate at which freshly caught tuna in a well may be cooled and frozen depends upon several factors. One is adequacy of refrigeration capacity on board ship; another is the rate at which the refrigerant removes the natural heat from the tuna. In a sense the well of a vessel may be considered a heat exchanger where exchange of heat takes place between a fluid and a solid. In such an exchange the interstitial volume and surface of the packed tuna play predominant roles. The interstitial volume is also of interest to the practical question of how many pounds of tuna can be stored in a well per cubic foot of well space. Should it be 60 pounds or 50 pounds or 40 pounds per cubic foot? If considerations of quality were unimportant, it should be about 60 pounds. Under such conditions, however, there would be little interstitial volume and interstitial area and, therefore, no internal heat exchange between the solid block of tuna and the circulating brine. The result would be slow cooling and freezing and the development of "hot spots" in the tuna and consequent damage to quality. Furthermore, when the tuna finally has been slowly frozen and thawing starts in port, it will proceed at a very slow rate leaving possible "cold spots" in the tuna and causing excessive salt penetration, and warped and mutilated fish will also result. Some tests carried out in our laboratory on the interstitial volume of tuna and other fish in a state of aggregation similar to that which obtains in a well, varied from 40 percent to 14 percent. The interstitial area will, of course, vary with the interstitial volume, but this relationship has not been measured yet. It should be done.

The importance of finding a value for interstitial volume which will permit a fast rate of cooling and freezing of tuna, so long as that is being done exclusively in the wells, will also apply to the subsequent thawing process. Inasmuch as heat exchange in thawing is the opposite of freezing, the physical laws governing freezing will apply but the flow of heat if reversed. The present method of thawing is not, it seems to me, taking full advantage of that principle and could, therefore, likely be much improved, thereby avoiding unpleasant salt penetration and other effects which contribute to quality deterioration. A cut in thawing time resulting from such improvements should also cut the time the vessel stays in port and improve the general economy of the clipper boat. It is hoped that an opportunity will soon present itself so that a guided and speeded up thawing procedure, which we have in mind, may be tested.

A study of the chemical engineering features involved in the preservation of tuna while in transit on the clipper, has revealed the desirability of collecting more data on the physical properties of tuna in the frozen as well as the unfrozen state. Such data are being collected now, data such as specific heat of tuna, specific gravity and the change of volume of tuna with temperature change, etc. A paper on the importance of interstitial volume and area in heat exchange problems is under preparation.

It is my hope that there will be

opportunity for further studies on the best way of preserving tuna while in transit to the canner. Such studies should not be content with an investigation of the relationship of tuna quality to method of preservation but should include a critical examination of whether present refrigeration capacity of tuna clippers might not be used more efficiently without resorting to unrealistic changes of present equipment. It is my belief that such a study might prove to be rewarding.

FISHERIES LOAN AND MORTGAGE PROGRAMS

by

Lester T. Bradbury 1/

My talk today primarily concerns the Fisheries Loan Fund and the Mortgage Insurance Program for fishing vessels, both of which are the responsibility of the Bureau of Commercial Fisheries.

The financing of new fishing vessels for the tuna fleet--albacore, bait boats, and purse seine types--to replace vessels that have been lost at sea, damaged, and worn out, or have become obsolete or inefficient is considered to be one of the major problems facing the tuna industry. A large proportion of the present fishing fleet is becoming obsolete and as time goes on more and more of the existing fleets will have to be replaced with modern vessels if this country is to maintain its position in the worldwide tuna industry. I might make that statement much stronger by saying that we will have to rebuild our fleets relatively soon if we are going to continue to have a domestic tuna industry.

It has been emphasized for several years that the industry's inability to secure sufficient venture capital to construct new vessels and to modernize or convert some of the existing fleet is a problem of major proportions that must soon be resolved. Vessel owners have little or no incentive either to replace old or lost vessels with new ones, or to make additions to the fleet. This is particularly true today of the tuna bait-boat fleet. Generally speaking, investment money to build new vessels is lacking because of the poor financial experience of vessel operators during the past several years. Unquestionably, one of the principal reasons that sufficient venture capital is not readily available is because of the decline in world tuna prices and the resultant unprofitable operation of the fishing vessels. It seems reasonable to expect that to be able to entice sufficient venture capital into the industry to eventually rebuild the fleet, the investors must be given reasonable assurance of something more than just a very modest return on their investment. Otherwise there would be no incentive for them to take the additional risks involving hundreds of thousands of dollars or even a million dollars for only one modern tuna fishing vessel and its gear.

At the present time we have, in the Bureau, two programs that are of assistance to the tuna industry in the financing of fishing vessels and operations. The Fisheries Loan Program was established by the Fish and Wildlife Act of 1956 and the Fishing Vessel Mortgage Insurance Program was transferred from the Maritime Administration under provisions of this Act.

FISHERIES LOAN FUND PROGRAM

The Fish and Wildlife Act of 1956 established a ten million dollar revolving loan fund, which in 1958 was increased to twenty million dollars. To date, thirteen million dollars have been appropriated to the fund. This Fisheries Loan Fund is used by the Secretary of the Interior to make loans for financing and refinancing of operation, maintenance, replacement, repair, and equipment of fishing gear and vessels, and for research into the basic problems of fisheries.

The broad objective of this fund is to provide financial assistance which will aid the commercial fishing industry to

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bring about a general upgrading of the condition of both fishing vessels and fishing gear thereby contributing to more efficient and profitable fishing operations.

This loan fund program was put into operation in the fall of 1956 and as of April 30, 1959 we have received 565 applications for loans totaling $18,424,000. Of these 303 were approved for loans in the amount of $7,480,000 and 142 applications requesting $4,134,000 were denied. Thirty applications were pending, 49 were found ineligible and 41 were withdrawn by the applicants.

In the California territory 42 loans have been authorized in the amount of $1,860,000 for the benefit of tuna vessels. These include loans made to vessels of the albacore fleet as well as loans authorized on the larger tuna vessels. In the northwest there were 27 loans authorized in the amount of $307,000 to vessels that devote a fair share of their fishing effort to the tuna fishery, especially for albacore. This makes a total of $2,140,000 that has been authorized for the aid of tuna fishing vessels, or approximately 1/3 in dollar value of the total loans authorized under the program.

MORTGAGE INSURANCE PROGRAM

The second program, which we expect to place into operation shortly, is the Fishing Vessel Mortgage Insurance Program. This program will, in our opinion, be of considerable assistance to the industry in the financing of the construction of new fishing vessels and the reconstruction of older vessels.

Title XI of the Merchant Marine Act of 1936 established the Federal Ship Mortgage and Loan Insurance Program under the Maritime Administration in the Department of Commerce. This title was drafted in language that not only expressed the intent of Congress but spelled out in broad detail exact procedures to be followed. Discretionary power of the Secretary, however, permitted some latitude in issuing regulations. The merchant marine fleet presented problems which are mostly different from those of fishing vessels. Regulations issued by the Secretary of Commerce were designed for the larger vessels and, of necessity, had requirements which fishing vessels could not meet.

When authority under this title to insure mortgages and loans on fishing vessels was transferred to the Department of the Interior, we found it necessary to begin from scratch and draft regulations which will permit the most effective use of the funds. We believe we now have a workable set of regulations for administering the program. This is a straight business program with bank standards, except that the mortgage may be for 15 years instead of the 3 - 5 years which banks usually allow. A mortgage may be given for a maximum of 75 percent of the cost of the new vessel, where banks generally advance only 50 percent. As stated, the credit requirements are to be equal to normal banking requirements, except for the length of time allowed for repayment. Guaranties may be required of shareholders of a corporate applicant. In determining the economic soundness of the proposed vessel operation, the condition and intensity of the fishery will be considered. The operation of the vessel must be in a fishery approved by the Secretary of the Interior.

Probably a simple way of describing the operation of this mortgage insurance program for the construction and reconstruction of fishing vessels is to say that it will operate in a manner similar to FHA financing on a home. It will be up to the borrower to find a lender who is willing to lend him the money providing the United States Government is willing to insure the mortgage. Borrowers under this program must have demonstrated ability to manage profitably, the vessel to be constructed.

As for lending agencies, any bank, insurance company, or other commercial lending institution may be approved as a lender or mortgagee, unless there is evidence that it is not capable of handling loans or mortgages of this type. Marine supply houses or others may be approved if they can show that they have the experience and facilities necessary to properly administer the proposed loan or mortgage. Someone who has ample funds, but shows no evidence of being able to properly service the mortgage, would not be considered a suitable lender. Both the borrower and the lender must be approved by the Secretary of the Interior.

I have mentioned both loans and mortgages and I might explain here that a loan is used during the period of construction of the vessel, and a mortgage after the launching of the vessel. The word loan as used in this discussion of mortgage insurance has no connection with the Fisheries Loan Fund program. Loans under this Mortgage Insurance Program are simply used to cover the period of construction. A commitment to insure means that the Secretary agrees to insure the loan or mortgage on the performance of certain conditions. A commitment to insure must be approved by the Secretary prior to the launching of the vessel. It will include a copy of the proposed mortgage and other pertinent papers. Applications for mortgage insurance will be filed on a form to be completed jointly by the borrower and the lender.

To initiate a loan, the borrower must have plans and specifications of the vessel to be constructed and he must secure competitive bids for its construction. The applicant and lending agency then will have to work out an agreement, subject to obtaining the insurance. The applications will be filed with the Director, Bureau of Commercial Fisheries, United States Department of the Interior, Washington, D. C. rather than through the local field offices.

We anticipate that this fishing vessel mortgage insurance program will be implemented as soon as certain legal difficulties in connection with the funding of the revolving fund are straightened out. Although authority to provide mortgage insurance was transferred to the Department of the Interior, it is not possible to begin operating until we have either a fund to take care of any losses or we have the authority to borrow funds from the Treasury Department in case a claim caused by a default exceeds the amount in the revolving fund. The Maritime Administration was given this authority in 1958, but there is some question in the minds of the Government solicitors whether this authority also extends to the Department of the Interior. Legislation giving this authority to the Secretary of the Interior has passed the Senate and has been introduced into the House of Representatives. The program can be started as soon as these bills become law.

In conclusion, we feel that these two programs that I have discussed will be of benefit to the tuna industry in the following manner:

The Fisheries Loan Fund provides:

1. A source of financial assistance not otherwise available.

2. Assistance at a fairly low rate of interest with repayment over a period longer than banks would allow. This reduces regular payments.

The Mortgage Insurance Fund provides:

1. A means of financing the construction of new fishing vessels and major reconstruction of older vessels.

2. Repayment terms to a maximum of 15 years in contrast to a much shorter period required by commercial banks.

This mortgage insurance program, unlike the Fisheries Loan Fund, provides a means of rebuilding or expanding the domestic tuna fleet.

PUBLICATIONS OF THE BUREAU OF COMMERCIAL FISHERIES OF INTEREST TO THE TUNA INDUSTRY

by

Donald R. Johnson

While the publications of the Bureau of Commercial Fisheries have been previously outlined in certain reports of the Fish and Wildlife Service, this summation will emphasize the sources of information of special interest to the tuna fishing and canning industries.

The reports of the Bureau can be grouped in a variety of ways. The categories selected here are: (1) current events, (2) statistics, (3) specialized reports, (4) reports on research. It is emphasized that these categories are not the specific series of the Bureau. Insofar as pertinent, the various series are mentioned within these categories (certain series no longer in use or of interest to the tuna industry are purposely omitted).

CURRENT EVENTS

In the category of current events we include daily and monthly publications of a general nature covering such matters as landings, prices, imports, and timely reports of interest to the industry, including events in foreign countries. Publications include:

FISHERY PRODUCTS REPORT (daily)--mimeographed reports published in key cities in the United States covering the respective local fisheries in detail and also general matters of price, imports, current legislation, and developments of interest in this country and abroad.

COMMERCIAL FISHERIES REVIEW (monthly)--processed reports treating more completely but broadly with landing patterns, prices, etc. This journal covers some matters that are indicated in summary fashion in the daily fishery products reports and also usually includes pertinent reports on recent research by the Bureau. Foreign fishery matters are discussed, current legislation is set forth, and fishery publications are briefly reviewed. Individual articles from this publication can often be obtained as separates.

STATISTICS

With the cooperation of the states and industry the Bureau assembles and publishes regularly certain statistical information on landings, fishing effort, fish holdings, and various current uses. A number of different publications are issued as duplicated leaflets. An annual Statistical Digest covering all major United States fisheries is published. Statistical publications of most interest to the tuna industry include:

FISHERY STATISTICS OF THE UNITED STATES (annual). This Statistical Digest covers a large amount of pertinent factual information on all major fisheries. It consists of numerous statistical tables plus some explanatory text.

PACIFIC COAST STATES FISHERIES (annual)

CALIFORNIA LANDINGS (monthly and annual)

CANNED FISH AND BYPRODUCTS (annual)

MANUFACTURED FISHERY PRODUCTS (annual). This covers quantity and value of canned, cured, packaged fish and byproducts.

IMPORTS AND EXPORTS OF FISHERY PRODUCTS (annual)

FISH MEAL AND OIL (monthly and annual)

SPECIALIZED REPORTS

This category includes diverse matters, some of which are generally or specifically of interest to the tuna industries. They range from FISHERY LEAFLETS, which in some instances, might be specific to tuna (but in most cases not), to the outlook for fish marketing, and to cruise reports on vessel operations. Examples include:

CRUISE REPORTS, LaJolla Laboratory. These are mimeographed reports issued after the conclusion of each vessel cruise, which summarize the research work undertaken and the field observations made. Similar reports are issued by the Honolulu Laboratory, Seattle Office and elsewhere. Circulation is limited.

FISHERY LEAFLETS. These are correspondence aids, developed as needed. They are usually duplicated from typewritten text.

COMMERCIAL FISHERIES OUTLOOK (monthly). This Report reviews indications of supply and demand for fishery products.

News letters have been issued from time to time by various units of the Bureau to inform the industry as to current activities.

Temperature charts of the North Pacific are being issued monthly by the Biological Laboratory, Honolulu. These are given limited distribution.

COMMERCIAL FISHERIES ABSTRACTS (monthly) is a summary of important developments for the fishery industries, primarily in technology and allied fields.

REPORTS ON RESEARCH

The Bureau conducts a significant amount of biological and industrial research, the results of which are published in various series as follows:

FISHERY BULLETINS. This includes technical reports of scientific investigations of fishery biology.

RESEARCH REPORTS. These are technical papers reporting the results of scientific investigations.

SPECIAL SCIENTIFIC REPORTS. These include preliminary reports, progress reports, and reports on investigations, usually of restricted scope.

PART 3

PROCESSING AND MARKETING TUNA

SOURCES OF TUNA CONSUMED IN THE UNITED STATES

by

Victor J. Samson and Anthony D. Sokolich 1/

The consumption of tuna in the United States is increasing rapidly as has been the pattern for many years. For all practical purposes, consumption equals production plus imports because exports are relatively small. Consumption is confined to canned tuna, the use of fresh, frozen and cured products being insignificant. Figure 1 and table 1 show the rapid increase in consumption since 1948 - from 352 million pounds in 1948 to 669 million pounds in 1958. All amounts shown are on a round or landed weight basis. The figure indicates the quantities canned in the United States according to the source of raw material, i.e. as domestic landings or foreign imports, and indicates the quantity of the canned product imported as such.

Since 1950, imported fish has supplied the increasing consumption. Although the total supply of all species of tuna in the United States is increasing steadily, (table 1) domestic landings are providing both a smaller actual and proportionate share. Imports have risen from 6 percent of the United States supply in 1948 to 46 percent in 1957 and 54 percent in 1958. Domestic canners have been able to expand production; domestic fishermen have not.

Various factors motivate domestic cannery purchases of imported tuna. The principal one is the price differential. In addition imports are almost the only source of supply for some canners. For others, for example tuna processors in the Pacific Northwest, domestic albacore landings are inadequate. If the price differential did not exist, other advantages gained by importing fish would not be so important to those canners located near the source of domestic landings. The other advantages include better yield per ton from imported fish because it is

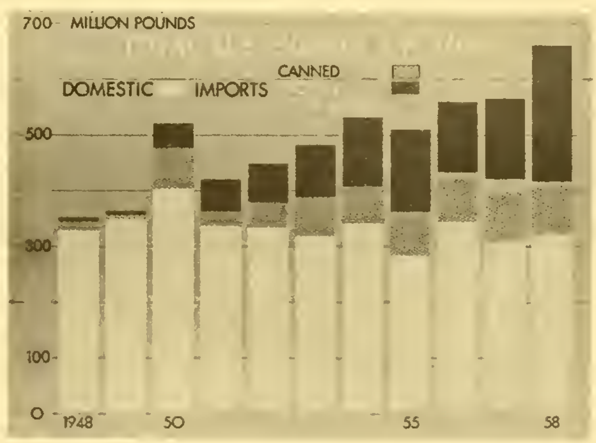

Figure 1.--Supply or consumption of tuna in the United States in recent years.

1/ Market News Reporters, Bureau of Commercial Fisheries, San Pedro, California

Table 1.--United States supply of canned tuna (1948-58) showing quantities received from domestic landings and imports (Round weight in millions of pounds)

Year	Domestic landings	Imports: Frozen	Imports: Loins and discs	Imports: Canned	Total
1948	329	5	--	17	352
1949	349	10	--	9	368
1950	403	44	--	73	320
1951	335	58	--	27	420
1952	333	70	--	46	450
1953	318	95	--	70	483
1954	341	124	2	66	532
1955	282	151	4	73	510
1956	343	127	10	79	560
1957	305	145	22	93	565
1958	332	235	5	97	669

NOTE: Factors used to convert to round weight

Gilled and gutted	x1.12
Dressed, headed and tailess	x1.25
Cooked loins and discs	x2.25
Canned (cases and factor equals round weight)	
Solid	x 42
Chunk	x 39
Flakes and grated	x 36

generally graded for quality and is more uniform in size, elimination of the need for costly investment in vessels to insure supply (the latter is especially true for the smaller canner), and a stable year-round supply without costly inventories.

Between 1948 and 1953, well over half of all imported tuna was albacore, which is packed as white meat tuna. Since that time, despite the increasing quantities of albacore being imported, the other tuna species, which are canned as light meat, have made up over half of the total amount imported annually. Table 2 illustrates the relative importance of albacore imports and those of other tuna species between 1948 and 1958.

Japan has always been the primary source of tuna imported into the United States except during the years of World War II. Figure 2 and table 3 show the relative importance of Japan as a supplier between 1948 and 1958. Only in 1949 and 1951 did Japan's contribution fall below 80 percent of the total amount imported. Peru has maintained its position as the second most important source of imports. A good part of the tuna shipped from there is caught by American flag vessels.

Table 4 shows where the United States tuna supply (canned in California) came from during the first quarter of 1959 as compared with the same period in the years since 1955.

Table 2.--Total imports of tuna into the United States, 1948-58 (Round weight in millions of pounds)

Year	Albacore: Frozen	Albacore: Canned	Albacore: Loins and discs	Albacore: Total	Other Species: Frozen	Other Species: Canned	Other Species: Loins and discs	Other Species: Total	Grand Total
1948	2	13	--	15	3	4	--	7	22
1949	3	6	--	9	7	3	--	10	19
1950	15	55	--	70	29	18	--	47	117
1951	31	20	--	51	27	7	--	34	85
1952	40	35	--	75	30	11	--	42	116
1953	63	35	--	98	32	35	--	67	165
1954	56	18	2	76	68	48	--	116	192
1955	69	26	4	99	82	47	--	129	228
1956	40	28	10	78	87	51	--	138	216
1957	65	27	22	114	80	66	--	146	260
1958	52	23	5	80	172	74	--	246	326

During the first quarter 102 million pounds were received in 1959, of which 42 million pounds were imported and 60 million pounds were domestic landings. Imports exceeded the five year average by 10 million pounds and were 14 million pounds greater than in 1958. The impact of Japanese shipments from the Atlantic is significant. Domestic landings during the first quarter amounted to 60 million pounds, 4 million pounds over 1958 and 6 million pounds more than the five year average. The increase in imports was substantially greater than the increase of domestic landings. Landings of the bait boat fleet dropped considerably but the purse seine fleet enjoyed excellent fishing during the first part of 1959.

Table 3.--Imports of tuna into the United States from Japan, Peru and other countries, 1948-58 (Round weight in millions of pounds)

Year	Japan	Peru	Other countries	Total
1948	19	3	--	22
1949	12	6	1	19
1950	95	18	4	117
1951	63	15	7	85
1952	95	15	6	116
1953	147	15	3	165
1954	165	22	5	192
1955	191	25	12	228
1956	185	18	13	216
1957	213	27	20	260
1958	285	30	22	337

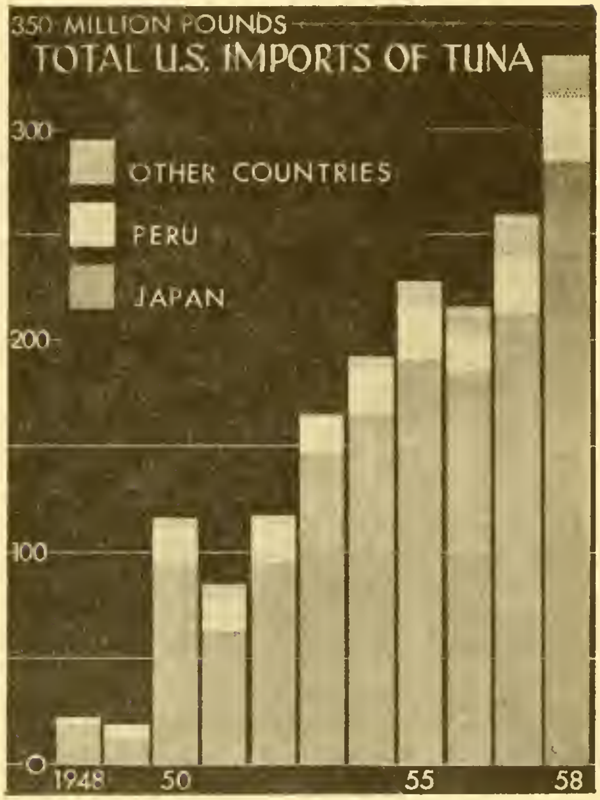

Figure 2.--Imports of tuna from Japan, Peru, and other countries in recent years.

Table 4.--California canner's supply of frozen tuna for the first quarter (January through March) (Round weight)

Year	Domestic Landings: Clippers	Domestic Landings: Seiners	Domestic Landings: Clippers and Seiners	Imports	Total	Domestic Landings: Clippers	Domestic Landings: Seiners	Domestic Landings: Clippers and Seiners	Imports
	Million pounds					Percent of total			
1955	30	8	38	32	70	44	11	55	45
1956	58	12	70	28	80	59	13	72	28
1957	48	8	56	32	86	55	9	64	36
1958	56	8	54	28	84	56	10	66	34
1959	38	22	60	42	102	38	21	59	41
Five year average									
	44	12	52	32	88				
1959 deviation from average									
	-6	-10	+8	+10	+14				
1959 deviation from 1958									
	-8	-14	+6	+14	+18				

THE PROCESSING OF TUNA

by

Maurice E. Stansby 1/

The purpose of this particular discussion is to review the principal technological problems of the tuna processing industry as I see them, and consider how these problems can best be solved by joint efforts of industry and Government. It may appear presumptuous for me to tell you in industry what your problems are. Surely you in industry are far more familiar with your own problems than anyone in Government can be. Yet I feel sure you can appreciate that those of us in the Bureau who are concerned with programs to help the tuna industry must, of necessity, obtain an understanding of the industry's problems. This I have tried to do in every way possible.

PROCESSING PROBLEMS

The canned tuna industry is in competition with other segments of the food industry which are continually improving their products. Concurrent improvement in existing tuna products must keep pace in order that canned tuna may continue in a competitive position. Such improvement as development of various flavor additives and the inclusion of color stabilizers to insure uniform color should be included. The use of additives for such purposes is going to be considerably more difficult in the future because of the recent passage of the new Food and Drug Law. This law will require considerable additional research on the safety of any new additives which may be considered in the future for improving a product.

Development of New Products

New types of tuna products must be considered by the industry for introduction as market demands warrant. While many of the so-called speciality products never develop into large volume items, occasionally such a product may become of importance and efforts to develop new products should not be relaxed. This is especially true in the field of frozen tuna products. Frozen foods are continuing to expand and fruits and vegetables are taking an ever-increasing proportion of the total production. With tuna, except for frozen tuna pie production, no extensive developments have yet taken place. Development of new and different frozen tuna products might well result in opening important new outlets.

Quality

Many problems of the tuna processing industry relate to the maintenance of quality, and some of these pertain to the need to meet specifications of one sort or another. Most tuna canners have brand specifications, and it is a problem to get as high a proportion of the pack under top brand labels as feasible. The Food and Drug specifications have added problems especially with respect to maintenance of fill of container. Often there are additional requirements laid down by state and local agencies which have to be met. These include, for example, requirements as to freshness of raw material, and meeting requirements for adequate processing time such as is specified by the State of California. Still another type of specification sometimes encountered is that required by Federal agencies for purchase of canned tuna for Government use.

Finally, there may be specifications to be met for special types of packs. The dietetic pack is such an example. Here

1/ Laboratory Director, Bureau of Commercial Fisheries Technological Laboratory, Seattle, Washington.

specifications for maximum sodium and fat content must be met. Problems, for example, in the penetration of excessive amounts of salt during brine freezing of tuna may make such a specification difficult to meet.

Maintaining quality becomes a problem in processing tuna at various stages of the canning process. The problem of keeping green tuna and other forms of rejects at a suitably low level has to be met. During the cooling of the precooked fish the fish is susceptible to oxidation or other deteriorative changes. During the heat processing and cooling of the cans, problems with respect to scorch may develop.

All these various types of quality problems have made necessary the use of careful quality control in the tuna industry. A few years ago it was unusual to find a food technologist in any but the largest tuna canneries. Today with mounting problems and new specifications which have to be met, even the smallest canneries are introducing quality control into their operations.

Efficiency

Another type of problem concerns the efficiency of operation of the cannery, of obtaining maximum yield from the fish, efficient utilization of manpower, and improvement in equipment to achieve greater mechanization. Possibilities exist for rather drastic alteration in operational methods. For example, changes in storing of tuna aboard the vessel might result in unloading the frozen fish either without any thawing or only partial thawing with transfer for intermediate holding in a cold storage warehouse for use as needed in the cannery.

Utilization of Byproducts

Finally, we come to problems concerning utilization of byproducts of the tuna industry. Perhaps the most important of these concern tuna meal and solubles on the one hand and tuna oil on the other. These byproducts are,of course, in competition with similar products produced not only by other fisheries, but from other sources as well. Since competitive products are constantly being improved, parallel improvement in tuna byproducts are required if their relative position in the markets is to be maintained.

Fish meals, in general, are a premium poultry feed which sell at prices somewhat above competing protein sources such as soybean meal. This is based upon the better balance of amino acids in the fish meals and the presence of other nutritional factors including some of the known vitamins as well as unidentified growth factors. Tuna meals, unlike most other fish meals, are of highly variable quality because of the practice of using different portions of the cannery waste for meal manufacture in different plants or at different times. Thus diversion of dark meat (which formerly all went into tuna meal) into pet food production has altered, perhaps lowered, the quality of tuna meal. Use in some instances of visceral portions for a homogenized tuna product again diverts raw material from tuna meal production and alters quality. This variation in tuna meal quality jeopardizes the premium position which fish meals in general possess. It means that efforts along other lines to maintain high quality and uniformity are needed. Similar considerations also apply to tuna solubles production.

Tuna oils likewise are not in the forefront of quality among fish oils. Condition of raw material tends to produce a somewhat lower quality oil for many purposes than other fish oils. This is reflected in the recent slow movement of tuna oil. One solution to this problem would be development of new uses for fish oils where the qualities of existing tuna oil are not a disadvantage. The other solution might be improvement in processing to produce a higher quality of oil.

Diversion of tuna waste into animal feed, particularly pet food has introduced nutritional problems such as, for example, the difficulties involving steatitis. A considerable amount of research is needed not only to solve this specific problem but also to get a better understanding of the problems involved in developing a better balanced pet food.

GOVERNMENT HELP IN SOLVING PROCESSING PROBLEMS

These, then, are some of the problems of the tuna processing industry. Just what is the Bureau doing to help the tuna industry solve these problems is my next topic for discussion.

One approach might have been to take each of the problems as I have outlined them and set up a series of Bureau projects to find solutions. This, however, we have felt is not the proper manner of giving Government assistance to the industry. Most of the problems I have outlined are ones for which, in the final analysis, industry must find solutions. We have felt that in most instances Government can best aid by carrying out basic research to provide a background of ideas which will be useful to the tuna processing industry in solving its own specific problems. In a few special instances we have been following up some of this basic research with very limited applied research before leaving the industry to work out specific applications of their interest, based on the results of our research.

Some of the basic research programs currently under way have been set up in a broad fashion to cover chemical reactions or other problems common to more than one species of fish. Thus, Bureau technological programs of value to the tuna processing industry are by no means limited to those which were set up to work exclusively upon this species. One such program was started eight years ago at the Seattle Fishery Technological Laboratory to learn more about the proximate composition of fish.

A better knowledge of the chemical composition of fish is important in order to know just what we are dealing with in solving technological problems. Especially, it will determine the nutritive value of the product. Information on composition relating to nutritive value can be used for advertising the fact that tuna is a well balanced food containing the various nutritive components in generous amounts and also as background information for use in devising such special products as dietetic, geriatric, or baby food packs.

The program on proximate composition at the Seattle laboratory which during the past several years has been concerned with fresh-water fish and certain species of the Pacific Northwest, such as halibut, has this year shifted its main emphasis to tuna, and extensive work on this species is planned for the next two years. Supplementing this program is work at the tuna field station at Terminal Island to determine certain analytical constants for tuna at different stages of processing. Certain tests are used for quality control purposes, such as the TBA test for rancidity or the volatile base test for freshness. The relationship between the values corresponding to different stages of freshness for raw, precooked, and canned tuna is being worked out in this program.

Tuna Oil

The most comprehensive basic Bureau program of importance to the tuna industry concerns the chemical composition and reactions of fish oils including tuna oils. This program was set up with the long-term objective of developing new industrial uses for such oils with the concurrent accumulation of basic information which will help in solving various other processing and preservation problems. This program is carried out partly at the Bureau's Seattle Technological Laboratory which coordinates all programs dealing with fish oils and partly on contract at laboratories of the Universities of California and Minnesota.

Historically, fish oils have been used for the manufacture of soap and paint and more recently have been exported to European markets for use in margarine. As a result of research in the chemical industry, markets for fish oils in soap and paint have dwindled to a point where these are no longer important. Thus, in the case of paints, research has developed substitutes for oils in the form of synthetic alkyd resins and rubber base materials. Similarly, the development of synthetic detergents has greatly reduced the demand for fish oils for use in soaps. This has left fish oils only one large outlet, the European margarine field.

A situation where there is only one important market for a raw material such as fish oils is a very bad one since it encourages wide fluctuations in price with the danger that should the one market condition change, the price might collapse completely. For this reason alternate important uses for fish oils are badly needed.

The same type of research which

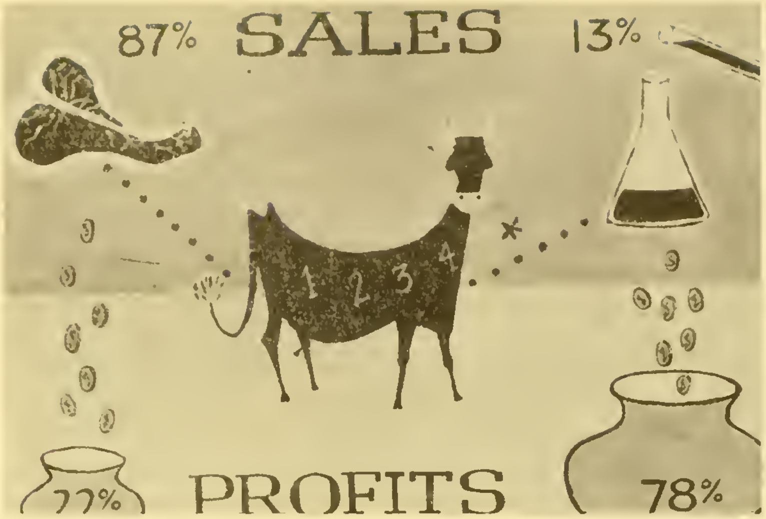

Figure 1.--As a result of chemical research on tallow, one of the largest United States meat processing plants derives most of its profits (78%) from the sale of chemical byproducts, although these amount to only 13% of total sales.

developed new raw materials for soap and paint manufacture (displacing fish oils) might well develop new profitable uses for fish oils. The example of what recent chemical research has done for the meat byproducts field should be noted. Research was started 20 years ago by the U. S. Department of Agriculture to develop new uses for tallow and other fat waste products of the meat industry. As a result of this work and parallel research by the meat industry itself, the entire profit pattern in the meat industry within the past several years has changed. Figure 1 shows the current situation in one of the two largest American meat packing concerns. Although sales of meat itself account for 87 percent of the total sales, the small 13 percent sales corresponding to byproducts--mostly chemical derivatives from tallow--make up 78 percent of profits with only 22 percent coming from the sale of the meats!

Just think for a moment what this might mean for the tuna industry if a similar situation could be achieved. Even if price from the sale of canned tuna were to only equal costs, profits from the sale of chemical byproducts would be sufficient to make the operation attractive. In effect you would be handling tuna primarily for the chance to get the oil as the lucrative raw material from which most of the profits could be derived.

It is from some of these considerations that the Bureau has made its decision to embark on an extensive research program on fish oils.

Since fish oils are not simple chemical compounds but rather mixtures of a large number of chemical substances, the first step in this program has been to separate the numerous compounds present in order to identify what is present and determine which ones represented important materials having unique properties that would possess potential industrial value. It is known that the fatty acids making up fish oils in part differ from those in animal and vegetable oils in several ways including possession of higher degrees of unsaturation. Such compounds, however, are mixed in the fish oils with the more usual fatty acids such as occur in animal and vegetable oils. The first task, therefore, which our chemists had to undertake was to devise means to sort out and separate these various components of the fish oil. At the Seattle laboratory such a separation is carried out with a special still consisting of a "spinning band column" which effectively fractionates the components. This is only one

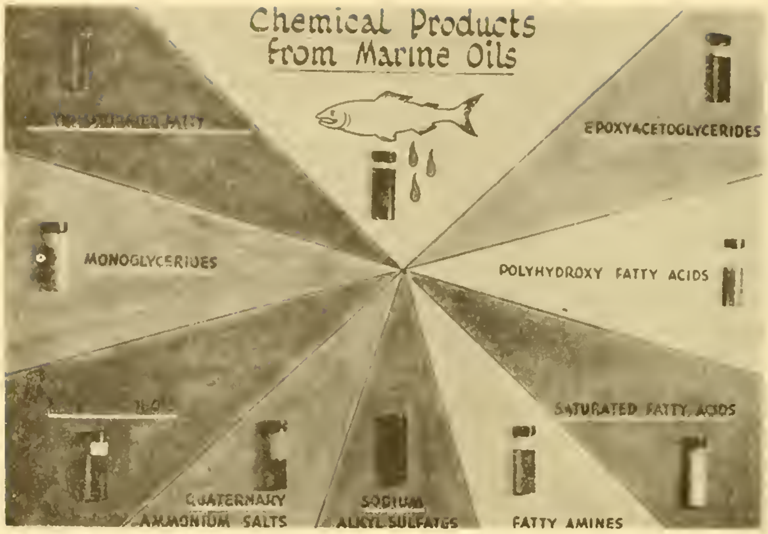

Figure 2.--Fish oils can be used to produce many chemical derivatives such as fatty alcohols and fatty amines.

of several techniques which have been found for separating the component fatty acids in fish oils.

The next step is to convert the separated fatty acid to some other compound having potential industrial value. After the reaction is completed the new compound must be separated from the reaction mixture and purified. Finally, it is necessary for the chemist to identify the final product and see whether he has accomplished what he set out to do. This may be done by a combination of techniques, such as by a simple titration, or by means of more complex procedures such as measurement of such physical properties as ultraviolet light absorption. Such properties vary with the different compounds and serve as means for identification.

Many chemical derivatives have been prepared from fish oils at the Seattle Laboratory and at the University of Minnesota's Hormel Institute which is carrying out contract research in this field for the Bureau. Figure 2 shows some of these compounds which have been prepared at Seattle.

The work on development of new uses for fish oils is not the only phase of basic research under way in the Bureau. Another aspect under investigation is research on the nutritive value of fish oils. Particular attention is being paid to the relationship between fish oils in the diet and atherosclerosis. Atherosclerosis is today the leading cause of death in the United States, being the basic cause for coronary failures or heart attacks and for cerebral hemorrhages or strokes.

A connection between atherosclerosis and the level of certain fatty materials, especially cholesterol in the blood, has been established. Deposition of cholesterol in the arteries may clog them to the point where such heart failures or strokes result. The level of cholesterol in the blood has been found to be affected by the type of fat in the diet. When the fat or oil contains unsaturated fatty acids, the blood level of cholesterol is diminished, which should then decrease the likelihood of deposition in the arteries.

Most of the research to date using unsaturated fatty acids derive these from vegetable oils such as corn oil. Although fish oils contain even more highly unsaturated fatty acids than do the vegetable oils, an erroneous conception led most medical researchers to the belief that fish-oil fatty acids would be relatively ineffective for this purpose. Preliminary results in research in Bureau programs is beginning to indicate that this belief is false and that tuna and other fish oils may be even more effective in lowering blood cholesterol than are the vegetable oils. These findings when definitely confirmed should be useful in advertising the nutritive value of tuna and other fish. They might eventually also result in a new use for fish oils in the pharmaceutical field. Before this can be achieved, however, means for producing such oils without the objectionable fishy flavor will have to be developed.

In this connection, the experience in testing fish oils for their blood-cholesterol-lowering properties on human patients is interesting. At Rockefeller Institute, volunteer patients were used to assess the effectiveness of different oils in this regard. The patients were given an emulsion of oil with water or orange juice. When the test series reached fish oils, owing to the fishy flavors the number of volunteers dropped nearly to zero and it was a great problem to obtain enough data on the effectiveness of fish oils to give conclusive results. Thus even though fish oils may well prove to be much more efficient than corn oil for this purpose, it is doubtful if fish oils will find therapeutic application until it is possible to reduce or eliminate the fishy flavor.

Another of the Bureau's basic research programs deals with the chemical cause of fishy odors and flavors in fish and fish oils and means for diminishing it. This is a very fundamental problem of great importance to all phases of the fish preservation industry since preservation is undertaken very largely to prevent development of undesirable fishy flavors and odors. Only last March the Bureau held a one-day conference which some of you attended at Davis to discuss research in this important field. Suffice it to say here that cooperative research is under way among the laboratories of the University of California, University of Minnesota, and the Bureau to get at the chemical basis for this type of degradation and to develop remedies.

Fish Protein

Protein is perhaps a more important constituent of fish than oil, and much basic research is needed to learn more about how fish proteins behave during canning, freezing, and other processing steps, to find out more about the nutritive value of fish proteins, and to find new uses for fish proteins. So far, our Bureau programs on protein have delt largely with the nutritive value, particularly with reference to fish meal.

Our basic research in this field which has been carried out at the Poultry Husbandry Departments of the Universities of California and Wisconsin on a cooperative basis, have been aimed at showing just how tuna meals may differ in nutritive value in relation to the type of waste going into the meal or other processing factors. Older research classed fish meals as good or poor depending upon how they behaved when used as the sole protein source in a check feed diet. We have been finding out the reasons some tuna meals were apparently less effective than others. These cases are often related to the meals containing less than optimum amounts of some of the essential amino acids. There is now hope that even some of these poorer meals can be efficiently utilized, now that we know in what way they are deficient, by proper supplementation with feeds containing more of the missing amino acids.

Other Components

There are other components of fish which require basic research besides oil and protein. For example, pigments are important since changes during processing will affect color considerably. Bureau research, carried out by Dr. Tappel and Dr. Brown at the University of California at Davis, has been completed on the chemistry of the normal pigments in tuna and those responsible for green tuna. Our research has not only revealed the chemistry of the normal and abnormal pigments but also has developed means for at least partially controlling these pigment changes and reversing the developed green color back to the normal pink. Although we now understand the chemistry of what is going on to change the normal pink color during cooking to the off "green" shades, we still do not know why some tuna are more prone to develop the greening than others. This is a matter for further research.

APPLIED RESEARCH

Applied research consists of solving specific problems of the fishing industry --in our case of the tuna industry. In many instances it is the Bureau's position that such specific problems can best be solved by industry itself. There are some special cases, however, where Government can help.

If it is not completely clear how the results of basic research can be applied or if the research results are not well known to the industry, then the Bureau often goes a step further. Work on the causes of green tuna is an example. This work, most of which had been done at Davis, was not widely known in the tuna plants nor was it clear just how the chemical treatment might work out in practice. As an extension of the basic research, Clarence Carlson of our Terminal Island Station carried out some additional tests by putting up some experimental packs employing the new chemical treatment for retaining maximum normal color. At the same time, at Seattle, we discussed results with manufacturers of some of the chemical materials involved. As a result, the applied research is currently being carried out jointly by one of the pharmaceutical concerns who manufacture the chemicals involved, in cooperation with the tuna industry.

Applications of basic technological research to problems of the fisheries are not necessarily restricted to basic programs of the Bureau. Any such results of basic research of any laboratories are considered for application. For example, much research in the past had shown the possibility of utilizing atomic radiation for preservation of food. Recent experiments at the Seattle laboratory have been looking into application of such means of preservation to fish. At present, radiation is carried out at a very few Atomic Energy Commission sites. In our program at Seattle, radiation was conducted at such a site in Idaho. After radiation treatment the samples are returned to Seattle to determine the effect on storage life. Our studies have shown that very adverse flavor changes are brought about if a sufficient level of irradiation is used to sterilize the fish, killing all the bacteria and insuring an indefinite keeping for the fish. Use of lower radiation levels do not seriously alter the flavor, but the fish are merely pasteurized which destroys some but not all of the bacteria. When such fish are refrigerated, their keeping time, which might have been ten days in ice without radiation treatment, can be increased to about 6 weeks.

The next stage in this applied research program can be undertaken as soon as the Army Quartermaster Corps completes its large-scale irradiation facilities near Stockton. Industry will then be asked to participate in larger scale operations.

In some cases, applied research programs are undertaken by the Bureau to solve directly some problems of the tuna processing industry. The contract research program of Philip R. Park Research Foundation, although concerned to the major extent with problems of freezing and thawing of fish aboard the vessel, touches also upon processing problems. Since Dr. Lassen has already discussed this program I will not dwell further upon it.

Finally, applied research must be made in the byproducts field. I discussed at some length Bureau programs on fish oils. After new chemical derivatives have been prepared by our organic chemists, industrial uses have to be found. Some of the potential industrial uses for several chemical derivatives prepared from fish oils (in some cases from tuna oils) are shown in Figure 3. These potential applications, as you can see, include such fields as chemical intermediates, plasticizers and ore flotation agents. But these are only potential uses and must be tested to determine whether these fish-oil derivatives possess any advantages over substances currently being used by industry.

One of our first efforts was to apply certain of the derivatives for agricultural insecticides and fungicides. Most of this work was done in laboratories in Florida but a portion was carried out at the University of California's Riverside Citrus Experiment Station. Results showed that while the compounds did possess fungicidal and insecticidal activity, the extent was not great enough to make these fish-oil derivatives attractive

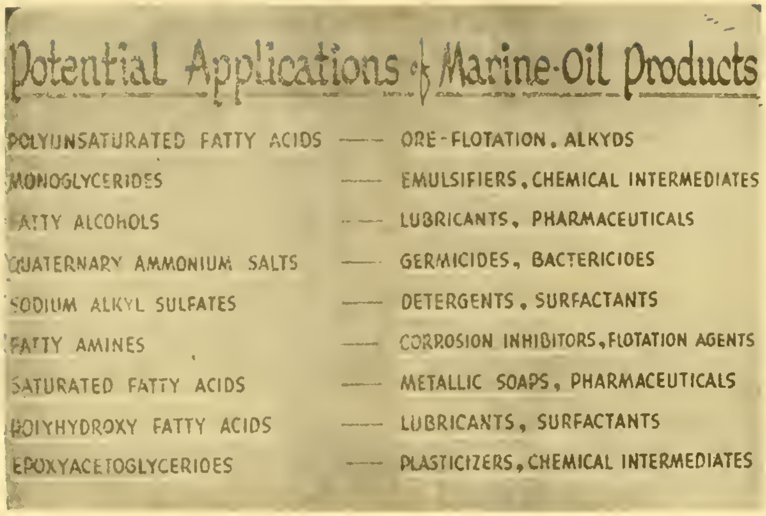

Figure 3.--Chemical derivatives of fish oils have many potential industrial uses which have to be appraised before industry will be interested in using fish-oil products.

enough to displace existing products already in use.

A second effort, to use fish oils as ore flotation agents, is appearing much more promising. Ore flotation consists of preparing a froth with fatty acids or other chemicals to which a portion of the ore clings and then floating away the froth and adhering material from the rest of the ore. Flotation has been used for many years. At one time fish oils were used but, due to chemical research on competing oils, fish oils are no longer employed. In recent years a new need for flotation processes has arisen which may cause a huge demand for new flotation agents. The rich iron ores which have been mined from deposits in northern Minnesota and Michigan are nearly depleted, leaving, however, vast quantities of lower grade ores. These ores are currently being partially concentrated by a magnetic process. This process can not be made quite efficient enough to do the job. It will reduce the impurities down to about 8 percent. In order for these ores to compete with foreign imports, the impurities must be reduced to 6 percent or less, something impossible to achieve by the magnetic process. Research the Bureau has been carrying out at the University of Minnesota's School of Mines and Metallurgy, has recently been successful using fish-oil derivatives as flotation agents in reducing the impurities to less than 2 percent. Iron ore concentration plants have shown great interest in this development which gives promise of eventual adaptation. If fish oils could become the principal source for flotation in the iron-ore flotation field, up to one-third of all fish oils produced in the United States would be required.

The fish oil-iron ore flotation research is carried out in a cooperative program at the School of Mines and Metallurgy. The ore to be concentrated is first finely ground in a laboratory jar mill. It is then mixed with water in a flotation cell to which the fish-oil derivative is added and air bubbled through. This forms a foam to which the silica impurities selectively adher and the foam is floated off. There results the residue which is concentrated iron ore and which is left behind in the flotation cell while the silica impurities are floated away. The commercial process is carried out in a very similar way, but, of course, using much larger scale equipment.

As I pointed out earlier, fish oils are not pure chemicals but rather mixtures of many compounds which must be fractionated before adopting them for commercial use. Only a portion of the fish oils are of the right chemical make-up to be useful for ore flotation agents. Before fish oils can be used commercially as ore flotation agents we must next find uses for the remaining fractions of the fish oils. Otherwise, the entire burden of cost would fall on the ore flotation fraction if the other portions of the oil had no use and had to be discarded. The entire success of the program, therefore, depends on continuing research to find additional uses for the various fractions.

This oil research program should be very timely for the tuna industry. Since tuna oils are of inferior color and are usually not of high enough quality for edible use, they are often the first to be affected by falling prices. As you are all aware, such a situation now prevails making marketing of tuna oils difficult. The fish-oil program when finally successfully applied, should greatly relieve this situation.

Application of other basic research findings in the byproducts field should also aid the tuna industry. For example, in the Bureau's program on nutrition of fish oils at Hormel Institute, recent findings have shown that tuna oils contain some, though not great quantities, of essential fatty acids. It is quite possible that lack of adequate amounts of these essential fatty acids is related to incidence of steatitis (a nutritional disease causing deposits of subcutaneous yellow fat) in cats fed red-meat tuna pet food. The beneficial effect of addition of vitamin E then would be due, in part at least, to its protective action on these essential fatty acids which occur in marginal quantities in tuna. This research may offer aid in solving this current difficulty for the tuna industry.

It has been suggested by some that our basic research should be set up on a species basis to investigate, for example, the chemistry of tuna pigments or tuna oil rather than fish in general. Actually such an approach would cause enormous overlapping and duplication of effort since differences in the chemistry of various species of fish are minor. There is so much specialization in the fields to be investigated that it is much better to set up projects on the basis of, for example, the organic chemistry of fish oils or the biochemistry of fish proteins. We in technology, use organic chemists, analytical chemists, biochemists, or chemical engineers to study the basic problems of fish-oil utilization. This requires a large number of specialists in each of several fields. If we were limited to only a few scientists that could be afforded from our limited technology budget for work on tuna, each man would have to work in several specialized fields.

We are, in effect, in competition with research on technology of other food products. In our oil research program, for example, the meat industry is trying to develop products from tallow competitive with products we might produce from fish oils. The U. S. Department of Agriculture has 40 scientists working on the chemistry of tallow. They do not arbitrarily break down their research according to mutton tallow and beef tallow despite the fact that there is a greater chemical difference between these than between any two fish oils. We in the Bureau have only 3 organic chemists at Seattle, plus half a dozen or so other scientists in cooperating and contract laboratories to work on all species of fish oils. Under a species breakdown of projects tuna oil could not fairly expect more than one man to be assigned for tuna oil work. This man would have to carry out biochemical, organic chemical, and chemical engineering investigations on tuna oils. This would clearly be a wasteful and inefficient means of operating and would insure our competitors in the meat industry in pushing their products ahead of fish oils with little or no chance of success on our part.

A similar situation prevails with all basic technological research projects. When we come to the more applied work such as that being carried out by Dr. Lassen (Philip R. Park Foundation), the situation is entirely different. Here it is proper, and quite necessary, that the applications be studied on the species where the problem exists. Dr. Lassen's program, while still at a quite basic level is concerned with applications to specific problems of the tuna industry.

When we come to the still more applied problems of the tuna processors such as studies on plant efficiencies, it is our feeling that for this type of research the tuna processing industry will want to carry out the work in its own plants and that no Government assistance is desirable.

In conclusion, I have outlined the technological problems of the tuna processing industry as I see them. I have described to you current Bureau programs which should help to solve some of these problems. I have indicated how our approach has been largely one of carrying out broad basic research, leaving, in most instances, the specific solution of the problem for application by industry.

MARKETING TUNA IN THE UNITED STATES

by

Donald Y. Aska 1/

Certainly no discussion of the domestic tuna processing industry would be complete without including marketing - the final link in the chain from fisherman to consumer. Marketing any strongly competitive commodity is attended by a number of problems and we certainly do not claim to have a knowledge of all these problems confronting the domestic tuna canning industry. Moreover, I know that we, as a Government agency, do not have any responsibility in connection with many of these problems. Accordingly, I am going to dismiss almost entirely those marketing factors which in our opinion are the responsibility of the tuna producing and processing industry as a segment of American private enterprise and confine my comments to those wherein the industry and the Government have related interests.

Our staff has been giving a lot of thought to the marketing problems facing the industry; what distinguishes them from other canner's problems, such as canners of fruits, vegetables and meats; what is the present merchandising situation; what is the Government doing and what could it do; and, finally, what is the trade doing and what are some of the recommendations that might be appropriate, coming from a Government agency, for the trade to consider.

What are the problems of the tuna canners and why are they different from those of other food canners? As we see it, each of the canners, whether canners of tuna, fruit, vegetable or meats, is faced with the problems of the bigs and the smalls; advertised and private labels; the cost of raw materials, labor, processing and distribution etc.; moving inventories and keeping the pipe lines filled; getting maximum distribution through broker representation; internal rivalry with others in the same business; increasing competition from other protein foods; the constant fight at the retail level for additional shelf space; cost of field warehousing; floor stock guarantees; development of new products; the constant struggle to make better "silent salesmen" out of the labels; and the increasing costs of advertising. The country is strewn with bankrupt and cobwebbed fruit and vegetable canneries whose managements failed to meet these challenges. Our objective, of course, is to do whatever we can, in line with Government responsibility, to see that the same thing does not happen in the tuna canning industry.

What are the conditions which set the tuna canning industry apart from these other food canners? While canned tuna is probably as fortunate as any item in being nationally distributed and is probably consumed at a greater rate than any other canned fish, it still requires that continued uphill fight to command the place in the American diet of such canned foods as peas, corn, tomatoes, beans, peaches, citrus concentrates and other fruits and vegetables. So there is that constant struggle to develop and increase a clientel. There is the competition from imports; there is distance from centers of production, and competition for the raw material; there are frequently supply and delivery problems; the complexity of labor-management negotiations; and there is the fact that there is no profitable "back up" item in the tuna trade. You have mackerel, squid, anchovies and sardines, but these are not consistently profitable back-up items. In contrast, the typical California fruit canner has a schedule that starts with

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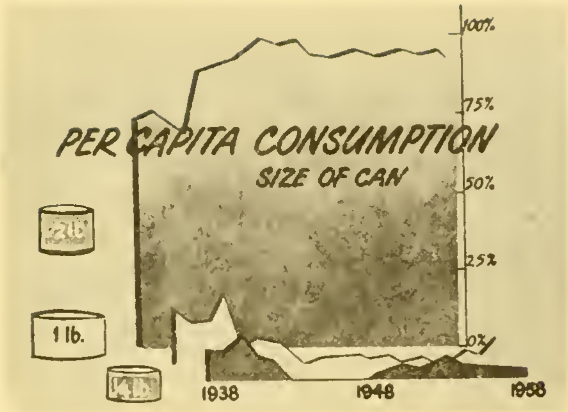

Figure 1.

cherries in June and then moves progressively through apricots, peaches, pears, tomatoes, and similar other profitable commodities. Also few tuna canneries are geared to pack the institutional size can and miss out on this part of the market.

What are the present marketing situations and practices? In discussing the marketing and merchandising of any consumer product, we must first establish what we are working with, who our present customers are, who our competitors are and what factors have led up to today's conditions.

MARKETABLE PRODUCTS

While the tuna industry produces a number of products that are different in style of pack, the domestic market is dominated by the canned product. This in turn is dominated by the 1/2 pound can, which is accepted as the standard in statistical reports. From figure 1 you will note that no reference is made to the family size or 3/4 size can which was introduced in 1958 or the institutional pack which represents only about one percent of the total pack. But, as the type of container varies, so does the style of pack. Tuna meats are packed as solid, chunk, or grated. Figure 2 shows the tremendous increase in the popularity of the chunk style pack in contrast to the decrease in the grated pack and the practically steady production of solid pack. Note that the graph is broken at 1952. Prior to that year, chunk and grated were combined in our statistics and it was not until after 1951 that the tremendous growth in the chunk pack justified its separation statistically. There are a number of other items, though not actually competitive, that are dwarfed by the previously mentioned packs. These include: tuna and noodles; strained tuna for baby food; the dietetic pack; tuna spreads, canned smoked tuna; creamed tuna; tuna frankfurters; and frozen tuna pies and casseroles. Tuna loins, processed by smoking and curing to simulate the taste and appeal of ham, have been experimented with and they may eventually find a market in this country.

There are also several byproducts of the tuna processing trade of considerable importance. One that has experienced tremendous growth in recent years is pet food. In 1957 this country produced about 7-1/4 million standard cases of fish-based pet foods with tuna accounting for about 9 percent. Other byproducts are fish meal, oil and solubles. While these industrial products are important, the mainstay of the industry is the sale of canned products for human consumption.

DISTRIBUTION

Although it is extremely difficult to get figures on the distribution of imported tuna, we were able to get some unofficial figures from one prominent eastern United States Japanese importer. These indicated that, of the white meat tuna brought into this country, approximately one-third was in the four pound or institutional size can and the remaining two-thirds was in the one-half and one pound cans. In the light meat, however, it was about 50-50. Also, on the basis of the first six months consumer panel data furnished under our contract with the Market Research Corporation of America, foreign produced tuna was distributed about as follows: New England, 70 percent; Central United States, 15 percent; Pacific Coast, 7 percent; and the balance spread throughout the country. This bears out our contention that the sale of domestic and imported tuna varies markedly by region. For instance, the Market Research Corporation of America average from October 1958 to March 1959, shows that in the New England region, the reported

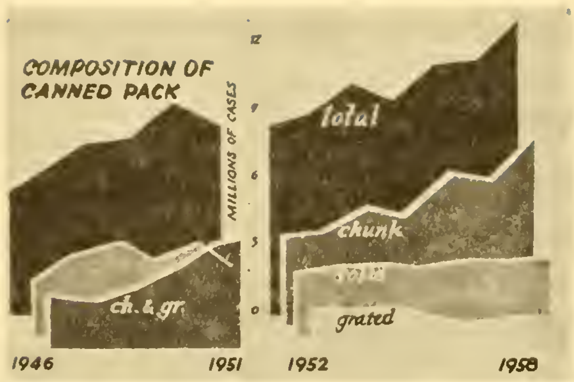

Figure 2.

consumer ratio is eight to one in favor of the domestic pack, while in the South the ratio is a whopping 86 to 1.

The distribution method for canned tuna is identical with that of most other canned food items and can be broken down into four basic subfunctions: distribution, warehousing, wholesaling and retailing. Normally, the first distributive step is the movement of the merchandise from the processor to the field warehouse. About 12 percent of the total California tuna production is transported by truck --primarily to the Pacific Coast and Mountain States; about 13 percent is moved by water -- primarily to the Atlantic Coast and important New England markets; and the remaining 75 percent is shipped by rail -- to the major markets throughout the country. Incidentally, the Bureau currently has a contract study under way with the Bureau of the Census which should give us some very good information on the distribution pattern of canned fish from the packer's warehouse to the point in the field where title first changes.

Of the three primary costs, distribution takes a smaller share of the consumer dollar than does production or processing. Warehousing is now done largely by the processor at his expense in field warehouses throughout the country. This method becomes necessary for quick shipments in volume to wholesalers as a result of the practice of reducing inventory by wholesalers and food chain warehouses. From the processor's field warehouse stock, and after sale by the broker, the goods come into possession of a wholesale distributor or some similar organization. The final sale in the process from raw material to the consumer is made by the retailer, and now, in theory at least, every one in production, processing and distribution, from the fisherman to the retail stock boy, can be paid for his services as Mrs. Housewife passes through the check-out counter.

USAGE PATTERNS

But, let us examine some of the conditions that determine the level of tuna usage. For instance -- the size of the household, family income and geographical location. These factors all have a direct effect upon the sales pattern. The Bureau is currently subscribing to the monthly Market Research Corporation of American Consumer Panel Service, and, on the basis of the first six months of study, we will soon have some very reliable and pertinent information with respect to such socioeconomic factors as city size, location of the consumer, family income, size of the family, employment status of the housewife, and presence of children by age group. In the meantime, however, and until this information becomes available, we have had to depend upon miscellaneous surveys conducted by the Bureau and by other government and industrial organizations to try to develop some type of a picture of who buys canned tuna.

Naturally, the number of persons in a household is an item of considerable importance. During a 1955 survey (Household Food Consumption Survey 1956) conducted for the United States Department of Agriculture by a nationally prominent market research organization, it was learned that households consisting of one person are normally poor tuna users, but in households of two or more persons the rate of use increases substantially. On a national basis only 9.4 percent of the households of one person used tuna, whereas in homes of two or more persons the percentage was 22.5 percent. This varied by region, of course. In the New England area 15.3 percent of one-person households and almost 30 percent of two or more used canned tuna, whereas in the West the numbers were 8.8 and 33.1 respectively.

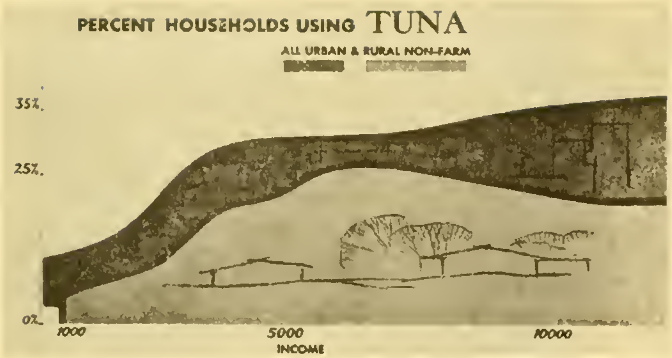

Figure 3.

Other items we have mentioned, such as income, degree of urbanization, etc., might all be applied to the number of persons or households we are considering and each item has an effect on the percentages. Figure 3 shows household groups by income. Note that in the urban areas as the income increases the use of tuna increases, whereas in the rural nonfarming area, after a peak of approximately 6,000 dollars annually, the use of tuna decreases as the income increases. Figure 4 represents some of the same material, but by geographical regions rather than by degree of urbanization. Quite noticeable is the lesser use of tuna in the Southern states, particularly in the low income bracket. In contrast, note the much heavier use of canned tuna in the West by all income brackets. Therefore, by consolidating the various data, we find that the ideal hypothetical tuna consuming household is one of two or more persons with an income of 10,000 dollars or more living in an urban area in one of the Western States. From a practical standpoint, however, there is no substitute for population density in selling any food product.

We have another clue as to who is buying tuna. In a 1956 survey (Household Consumer Preferences for Canned Fishery Products, 1956) conducted for the Department of the Interior, it was brought out that 48 percent of young married couples and 39 percent of the persons in the 30-40 year age group were tuna customers, whereas only 13 percent of the customers were in the older group. This is almost a direct reversal of the pattern for salmon and canned sardines and indicates a very bright future insofar as tuna sales are concerned.

Another item that should be considered is the seasonality of sales. This is brought out in a report of the National Canners Association (1956) known as the Philadelphia Project. Canned fish sales appear to be about equally divided among spring, summer, and winter, indicating its use as a menu supplement during Lent, a hot weather salad dish and as a substitute for a less available food during winter. Figure 5 shows the percentage of sales by month for the commonly encountered canned fish items. Such promotional efforts as Tuna Week have heretofore been directed toward the last three months of the year, and it would indicate that a promotion during that period featuring hot dishes is well aimed. From this particular study we can see that, in Philadelphia at least, tuna outsold all other canned fish items.

Of great concern to all segments of the industry is the long term outlook for tuna consumption. Upon this prognosis depend plans for future operations. There are several methods that we might use to arrive at a consumption figure for a given point in the future. Any approach assumes that the raw material will be available in relation to needs. Other assumptions naturally are necessary in order to make any kind of a projection of this type.

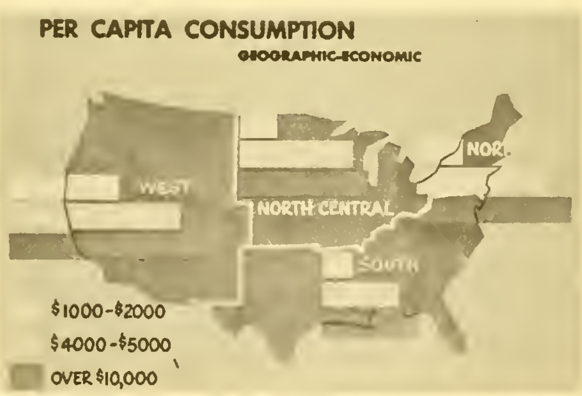

Figure 4.

You will recall that in the 1952 tuna report (Anderson, Stolting, et al 1952) -- a study which the Bureau conducted at the request of the Western Senators -- a projection was made of probable tuna consumption, based on estimated population increase and product popularity. Actually, consumer acceptance exeeded even the projected figures appearing in that report. According to the Bureau of Census (Zitter and Siegel, 1958), our population is expected to increase to 250 million by 1980. If tuna consumption continues at the same per capita rate and applying this against the anticipated population increase, we would have tuna requirements around 500 million pounds (figure 6). However, if we were to project consumption at the post World War II accelerated rate, and taking into consideration the anticipated population increase, we could get tuna requirements running as heavy as those shown on the upper line of figure 6. It is redundant to state that there are many variables which could have a very profound effect on the direction these lines take.

So far we have talked only about our household consumer, but I think it would be perfectly in order that we consider another customer of the tuna industry -- the military. Out of the 9 million pounds of canned fish purchased in 1958, canned tuna totaled almost 6 million pounds. As a matter of fact, from the period 1950 to 1958, the military subsistance centers purchased almost 58 million pounds of canned fish. Of this amount, tuna sales amounted to slightly more than 25 million pounds, or about 43 percent.

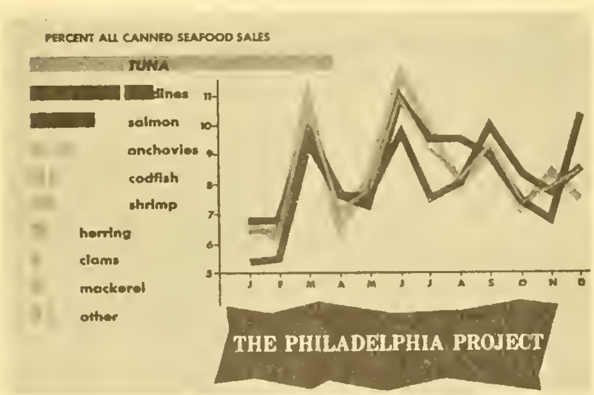

Figure 5.

Figure 6.

COMPETITIVE PRODUCTS

Of vital importance to the producer, distributor and the seller alike is an up-to-date appreciation of trends in consumer demand. This is particularly important when we consider the rate of consumption of related competitive items. Directly competitive with tuna are the other canned fish items in volume production, and particularly canned salmon. In that regard the use of canned tuna has shown a very dramatic increase (figure 7) whereas canned salmon, for a number of reasons, has shown a decrease.

Not only must tuna compete with other fishery products, but also with other forms of animal protein. Nutritionally, our different animal proteins are merely interchangeable with respect to their contribution of amino acids, vitamins and minerals to our diet. The competition then becomes one of price, convenience, availability, taste, appearance, or of motivation created by promotion pressure. Studies of the consumption of canned tuna as related to beef, poultry, eggs and cheese, from 1930 to 1957, show that the increase in per capita consumption of beef was 28.2 pounds during this period; poultry, 14.3 pounds; eggs, 6.2 pounds; cheese, 4.4 pounds, and tuna 1.4 pounds. The poultry and beef increases represent carcass rates, and as such should be reduced somewhat, but even so, it is apparent that there has been a tremendous increase. Encouragingly, the increase in canned tuna is far greater than for fishery products as a whole, which has

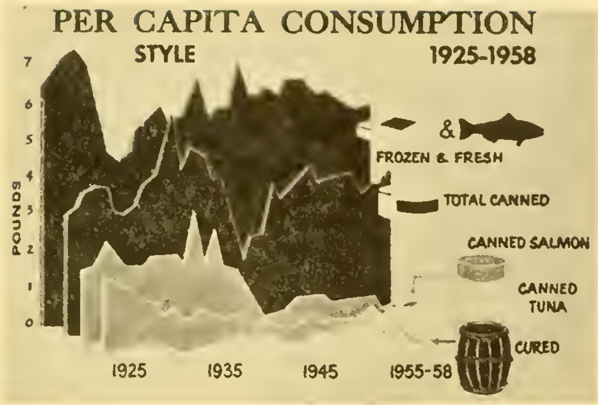

Figure 7.

remained almost static during the same period. The outlook is for plentiful supplies of meat, poultry, eggs and cheese, and there appears little likelihood for tuna consumption to make any marked increase as a result of shortages of other protein foods.

MARKET DEVELOPMENT PROGRAMS OF THE BUREAU

Now all of this is very interesting, but I know you are all wondering how we intend to shape our market development program so as to improve the position of the tuna processing and producing industry in today's tremendously competitive food market.

It seems to me that wider use could be made of market research facilities both on the part of the tuna producing and processing industry, and the Bureau. Today's selling calls for using all of the means of modern marketing. Marketing decisions can be made much better if the proper facts are available and we all ought to use them. With proper knowledge, marketing and distribution can be analyzed as effectively as production, but to do this we must know what actually is the market condition. We have charted the changes that have taken place in the past, and we have a fairly good picture of the situation that affects today's sales. Any programs, to be effective, should have the elasticity to meet these ever-changing conditions.

I mentioned earlier that we have conducted some surveys. These merely scratch the surface. A considerable amount of work remains to be done on such projects as consumer preference studies and consumer uses. Our funds to date could not support broad studies of this type. There are now available, from commercial sources, studies on the end use of various foods and it would seem that this type of material would have direct application to the industry in formulating its processing programs for the future as well as its sales promotion and advertising campaigns both individually and collectively. We have contracted with the Market Research Corporation of America for their monthly consumer diary panel study, and to date have received the reports for October 1958 through March 1959. I wish to emphasize that these figures are collected on a commodity basis and do not contain any information on individual brands, sales and movements. These figures indicate the sales of canned tuna, both domestic and imported, by the various types of pack on a United States projected basis, and by each of the five geographical regions. They also show nationally and geographically, the number of families buying tuna, the average prices paid for the types of pack and can size, and the average purchase transaction. This study also gives the same type of information with respect to sales through chain stores, independents and other outlets. An analysis of these figures indicates sales trends geographically, sales changes as correlated with price changes, seasonality of sales, and the position of the domestic production with respect to foreign products. This type of information can be particularly valuable in planning individual, collective and cooperative sales promotion. We can determine the most advantageous time of the year for promotion, the areas in which the program should be conducted, and the type of consumer to whom the material should be directed. As this study progresses, and the full 12 months figures are available, we will have a very good picture of the canned tuna sales pattern in the United States. We will know who is buying the product, where, and to feed whom.

After consultation with representative segments of the tuna industry, we also let a contract to the Bureau of Labor Statistics to collect monthly retail prices on canned tuna, in some 31 stratified cities throughout the United States. We have not yet had an opportunity to adequately analyze these figures, but they are available to any of you who wish to make such an analysis.

As mentioned earlier, we also have the contract with the Bureau of Census to study the ex-packer warehouse distribution patterns of canned tuna. No results are yet available.

There are also commercial market research facilities available which can provide very good information on retail shelf prices, shelf inches, retail inventory and rate of disappearance. In planning our market research program, the Bureau is giving considerable thought to all of these types of studies.

Another type of study that is being conducted by the Bureau, is consumer motivation research. There is currently a contract with a national market research firm to study the motivations or reasons why homemakers do or do not buy canned tuna, salmon and sardines. This study is being conducted in Boston, Detroit, Birmingham, and Orangeburg County, South Carolina. The interviewing involved in the study has now been completed and tabulation is underway. We expect to release the completed report late in 1959.

Another phase of our continuing market research and analysis involves the publication of Commercial Fisheries Outlook. This quarterly publication contains an analysis of the market, demand, and supply conditions expected to exist for the principal species. Tuna is one of the featured items. This publication has widespread distribution throughout the producing, processing and distributive trades, as well as through allied trades such as the banks, warehouses, trade associations, and others concerned with the marketing of fishery products.

One of our most productive programs has been in the field of home economics. To back up a great number of our other programs, and so that our home economists and fishery marketing specialists in the field may have the benefit of current, accurate, and useful data on the uses of

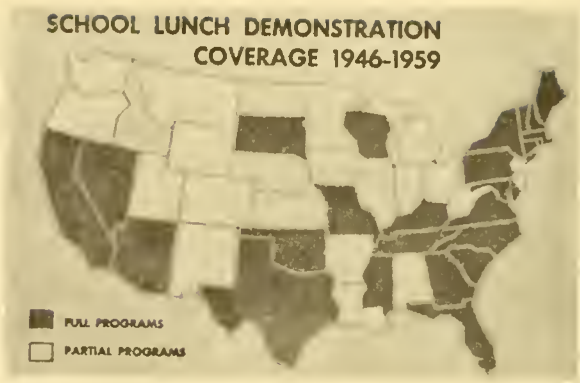

Figure 8.

fishery products, we operate three test kitchens in the country; one in Seattle, one in Pascagoula, and our main test kitchen in College Park. These are staffed by a group of professional home economists and dieticians who split their time between test-kitchen work and field demonstrations. Emphasis is placed on the development, publication and distribution of kitchen tested recipes because of the great need for this material on the part of home economists, dieticians, homemakers, institutional managers and the general food trade. Special recipes are developed, in homemaker and institutional quantities, for use in the special tuna and other promotional programs. The Service-produced fish cookery card files for use in the nation's school lunch rooms contain eleven recipes for using tuna, eight for California sardines and five for mackerel. Recipes are also developed for use of the Food Service Division of the Army and Air Force, and the Quartermaster Food and Container Institute for the Armed Forces. Another feature is the development of recipes which are released biweekly to the newspapers, and radio and television for distribution to the household consumers.

With respect to actual contact with the consumer, both household and institutional, we have found that fish cookery demonstrations by our home economists and marketing specialists are one of the most effective means of stimulating interest in all fishery products and for the purposes of this discussion, canned tuna.

Our demonstrations are conducted on

a systematic basis for institutional supervisory personnel. Our initial efforts were primarily directed at the schools, but we have more recently expanded our program to include inplant feeding establishments, restaurant associations, Agriculture extension groups, and other groups that are interested in mass feeding. To date about 2,500 demonstrations have been given throughout the country.

Figure 8 indicates the coverage through our school lunch fish cookery demonstration program. The black states are those that have been saturated; that is, where approximately 75 percent of the schools have been contacted by our representatives, and where, in many instances, there have been repeat surveys after an intervening period of 4 or 5 years. The white states are those where we have given 50 percent or less coverage. The one gray state is Idaho, in which we have given no demonstration.

Our entree into this field is based on public service -- we emphasize fishery commodities and make no mention of brands. The criticism has been made that most of the institutional requirements are met by imported tuna. Our feeling in this matter is that imported tuna is going to be sold and if it goes into the institutional market, it exerts a lesser impact at the retail level which is the backbone of the domestic industry. Also, if people eat well prepared tuna dishes in school, at the industrial cafeterias, and in the restaurants, a desire can be created for expanded household use where the domestic industry has the advantage.

One of the most effective consumer education portions of our program, is the regular release of publicity material to the various media, such as the radio, press and TV. Some 3,000 home economists, dieticians, extension demonstration agents, and food editors of newspapers, television, radio, and food trade organizations are on our regular mailing list. Press releases on food are prepared biweekly and contain recipes for consumer use. Fishery products, either in plentiful supply or particularly in season, are featured. Here again, our objective is to back up and give additional support to the industry's promotional programs.

In connection with the special marketing programs, such as Canned Foods Month, special recipes, fact sheets, and food photographs are prepared and distributed to food editors throughout the United States. For special campaigns, such as Tuna Week, the Bureau produces special one-page tuna marketing bulletins. On the front of each of these is a notice indicating that the United States Department of the Interior is cooperating with the domestic tuna industry in promoting the sales of canned tuna, and on the back, two recipes adapted to the individual recipients of the material. These market development materials go to the schools; restaurants; State, county and city institutions; inplant feeding establishments; and other similar institutional groups. These are produced in considerable volume and are aimed primarily at those outlets not readily accessible to industry promotions.

One of the factors that has made these programs particularly effective, has been the very enthusiastic response of the food trade organizations. The National Restaurant Association, National Association of Food Chains, Supermarket Institute, the Association of American Railroad Dining Car Officials, several State restaurant associations, the United States Department of Agriculture, and such private food chains as the A&P and others, for example, cooperated in one of the previous Tuna Week programs.

The best means of encouraging consumer acceptance of any product is through newspapers, radio and television. Black and white food photographs were distributed to the newspapers and TV stations throughout the United States. Incidentally, these were provided to us by the public relations agency representing the California Fish Canners Association and the Bureau paid for the prints which were nationally distributed. You recall earlier that we mentioned that one of the things we were emphasizing was to encourage the use of tuna in hot-prepared meals. Among these tuna dish photographs were a tuna cheese biscuit roll, a tuna pizza, and an open face tuna cheese sandwich. All are hot meals. We hope that tactics of this type will tend to increase consumer use of canned tuna during the colder months.

During the past few years an amazing amount of public service time on radio and television has been allotted to our marketing specialists and home economists and to Bureau material. Our home economists are frequent guests on television cooking shows and other similar home service programs. On two occasions we distributed recordings each of which contained 10 spot announcements, of 10, 20, 30 and 60 seconds, to practically every radio station in the country. One radio network in Texas has alone granted free public service radio time to the playing of these recordings, which, if paid for, would have cost more than preparing, producing and nationally distributing the some 3,000-odd records.

We find that frequently the television stations prefer to use drop cards to fulfill their public service requirements. For these stations we prepared a colored and plain version of an "Eat More Fish" dropcard. With these we sent a copy of the announcements that appeared on our recording. This enabled locally known television personalities to make the TV spot announcements.

I would like to reiterate that these radio and television times represent public service times and are in addition to industry activities.

Another feature of our Market Development program has been the sponsorship of educational and market promotional exhibits at major food conventions. We regularly sponsor such exhibits to stimulate consumer interest in fishery products. You may be assured that canned tuna receives a very prominent part in these exhibits. Consulting services and distribution of Service prepared publications have been included with the exhibits. It may be of interest to you to know some of the conventions at which we exhibit. They are as follows: National Restaurant Association, American Dietetic Association, American School Food Service Association, American Home Economics Association, National Canners Association, Regional restaurant, hotel and grocer conventions, and this year for the first time for any Government agency, the Supermarket Institute Convention.

Another facet of the Bureau's market promotion program, but one that has not had particularly direct application to the tuna industry, is that of educational motion pictures, which are produced under Bureau supervision using commercial motion picture production facilities. These films are designed to stimulate consumer interest and use of fishery products by showing methods of capture, processing and use in the home or institution. Distribution is made on a nationwide basis, through our own distribution center as well as through over 150 cooperating film libraries. In addition, public service TV showings provide for extensive distribution. Our records indicate that about 2 million persons see these pictures annually, exclusive of television. Most of these films are made possible through industry financing, since our funds for this purpose are limited. Currently, films are in use or in production describing a growing number of the major fisheries of the United States. For your information, one of the heaviest users of our films is the Los Angeles City School Department which has in its library copies of practically every film that the Bureau has produced and for many of the titles, has three or four copies which are constantly in use. Our two latest pictures are being financed by the salmon industry. These two salmon films will be supplemented by an industry-financed, Bureau-produced, full color recipe booklet.

There is another feature of our program that I would like to discuss, because it represents a potential outlet for a fair quantity of United States produced tuna. This is the foreign market. We know that many of the tuna-producing countries have strong export markets throughout the world. We know that Europe is becoming "refrigerated" and that they are developing the drug stores like those we have in this country. Thus, tuna conceivably could become a popular item over there, either as a hot item or as a salad or sandwich, and it certainly is worth investigating. At the moment, our foreign reporting program is very limited. However, when people on our staff make trips to foreign countries they normally take advantage of the opportunity to visit the United States Embassy officials and trade members and come back with useful marketing information.

We do feel, however, that this does represent a field of some promise for future years.

This, very briefly, has been a resume of the Bureau's market development program as it affects the tuna industry. We do not claim it to be the panacea for those marketing problems in which the Government has a stake, but, according to many of our industry contacts, it has been effective. We will certainly exert every effort to make it even more effective in the future.

RECOMMENDATIONS

Now we think that it is not improper for us to make certain suggestions with respect to programs that perhaps you might want to consider to further your own individual and mutual welfare. We certainly endorse a strong association among the canners, with a budget that permits active programs along the following lines: market research, public relations, tie-in advertising, the development of new products, work on multiple packaging, in-store demonstrations, exhibits at food fairs, and close cooperation with Bureau market development activities to bring to bear the vast experience of industry's sales organizations. Also, we feel that the door should not be completely closed on any program to join competitors in joint advertising promotions at the proper level so as not to endanger established domestic brands. We recognize that there are wide differences of opinion within the industry on this matter.

We feel that the institutional market has been like a neglected stepchild to the domestic industry. Our work through purchasing agents, dieticians, and nutritionists indicates that they are strong advocates of tuna, but because of the extremely small quantity of institutional pack size that is produced in this country, these markets for all intents and purposes, belong to the importers.

We recognize that there are many other major problems in distribution and advertising which we have not considered here, but we feel that these are matters that should rightly be handled at the industry level.

Another suggestion has to do with the development of the 1/4-pound can for single-member families. You will recall that I mentioned that a very low percentage of single member families could be counted as being tuna users. Perhaps the objection is that a 1/2 poundis too big and that the 1/4 pound would be more to their liking. Now I realize that there are 1/4-pound packs on the market, but I feel that advertising, backing up a quarter pound can, could very well be instrumental in expanding sales to single-member families. By the same token, the one-pound can has similar advantages for larger, economy minded, families.

We feel that consideration should be given by the industry to the investigation and development of foreign markets.

We have discussed the matter of accelerated purchases with the military agencies and we feel that they are receptive to additional purchases of canned tuna. We feel that this is a market that the industry should investigate.

Lastly, it is so very important for retailers to place your product on the shelf and boost it by in-store promotion. This again, should be both by brand as well as by product. All of the effort that goes into catching, transporting, processing, distributing, wholesaling and brokering canned tuna goes for naught if there is not adequate space on retail shelves. Tuna is a profit item. The Super Valu Chain study, sponsored by the trade publication, Progressive Grocer, indicated the strong role canned fish plays in the profitable operation of a chain store. Work with the retailer. He's the one who presents the merchandize to Mrs. Housewife. By inshore demonstrations and point-of-sale advertising the retailer can be convinced that the tuna industry wants to improve its position. And when he is convinced that tuna is a fast-moving item he will cooperate. This will work toward the advantage of all.

Incidentally, I couldn't offer you any of these recommendations without the benefit of facts developed through market research. This is one area that we feel merits priority consideration.

We have a strong mutual interest in the matter of merchandising, for we must recognize the fact that we are not only in the business of supplying demand, but also of creating it. Today, hard selling means smart selling. Goods and services are liabilities until they are sold. There is a premium on sound marketing decisions. In our fast-shifting economy, fixed attitudes cannot meet changing needs. Yesterday's marketing techniques will not meet today's changing market. Smart selling calls for using all of the means in modern marketing. This relentless struggle for markets, demands that those of us involved, either directly, or indirectly, in the sales of canned tuna must adopt new methods for new products and provide new services.

The government does not intend to sell your product for you or to tell you how you should sell it. We don't want to affect your individual competitive positions. This is your job and is a traditional activity of private enterprise. We do want to help you sell more tuna. We think that through the important avenues of market research, market analysis, and market development, and with your advice and help, we can help you increase the consumer demand for your product.

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MARKETING TUNA IN FOREIGN COUNTRIES

by

Arthur M. Sandberg 1/

Tuna is sold in world markets largely as canned tuna but it is marketed raw and dried in some countries. As a general rule, only a small part of the tuna catch is consumed as fresh fish. Tuna is also used in specialty products such as antipasto, pastes, and sausages.

New markets for tuna are opening up all over the world. A growing demand and acceptance of canned tuna and tunalike fish have made tuna one of the important items in world fish trade. France and Italy have for many years been markets for canned tuna packed in olive oil. Now, other countries, not only in Western Europe but in the Near East and the Far East, are becoming important tuna markets. Japan and Peru, large producers of low-cost tuna, have been able to open up many new canned tuna markets. Their ability to trade has been facilitated by trade and payment arrangements and by being able to deal in currencies other than dollars.

United States tuna products have participated to a very limited extent in the growth of tuna markets abroad. There are three basic reasons for this:

1. The United States market has been expanding and canned tuna has commanded relatively high prices in this country compared with other markets;

2. Many countries have restricted imports of fishery products from the dollar area; and

3. Other producing countries have been selling tuna at substantially lower prices.

In the past year, restrictions on the balance of payments in many countries have been relieved. Dollar balances are larger today than at any time since the end of World War II. Currencies are more freely interchangeable and countries now have greater ability to trade in fishery products.

For many countries, tuna has been rather high in price for general consumption; for that reason it has been considered a luxury product available only to those who could pay the price. With increased production of tuna, prices have remained relatively constant or have even declined. With higher incomes and better standards of living in many foreign countries, tuna has to come to be accepted as a regular item of food.

Canned salmon and sardines have long been important items in United States fishery export trade (table 1 and fig. 1). Small packs in several recent years have reduced this trade; balance-of-payment restrictions have also created barriers to trading. Exports of canned tuna are a small part of our total canned fish and shellfish exports. In 1958, canned tuna valued at $216,000 were shipped abroad. By way of contrast, salmon exports were valued at almost $7 million; sardines, about half that amount.

About 38 countries bought tuna from the United States during 1957 and 1958 (table 2). Of the domestic canned tuna pack, about one case in 800 went into the export market.

1/ Assistant Chief, Branch of Special Reports, Bureau of Commercial Fisheries, Washington, D. C.

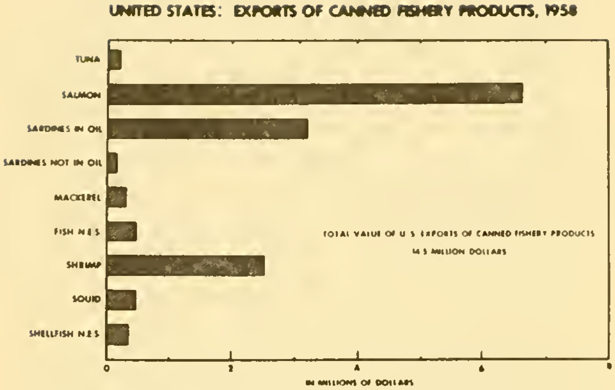

Figure 1.

Venezuela has been the leading export market (figs. 2 and 3), but the recent trend in Venezuela to restrict imports of products which can be produced in that country does not look well for continuation of this trade. Efforts are under way by Venezuelans (with Japanese collaboration) to set up tuna canning operations in Venezuela.

The Philippine market was second to Venezuela in 1957, but no shipments were made to that country in 1958 (probably as a result of Japanese price competition). Other sales were scattered rather well around the world even if only in small quantities.

Japan, on the other hand, exported canned tuna to 72 countries in 1957 (table 3, fig. 4, and tables 4 through 10). About 25 million pounds ($1\frac{1}{4}$ million cases, an approximation based on 20 pounds per case) went to countries other than the United States. West Germany, Italy, Canada, Switzerland and the United Kingdom were leading outlets for Japanese canned tuna in 1957. Other markets were Belgium, Lebanon, Egypt, the Netherlands, and Saudi Arabia. These are all new and growing markets for canned tuna.

Although we are deeply concerned by Japan's exports of fish, there is also a large market at home, for Japan consumes a large part of its catch. Based on data for 1954, it has been estimated that about 68 percent of their tuna catch was consumed by the Japanese themselves mainly raw, dried, and as fish cake or sausage. Canned tuna is not in great demand but its use is increasing. For local consumption, canned tuna made from scraped flesh seasoned with soy sauce is preferred.

Skipjack is the chief species used. Before World War II, the amount of skipjack taken exceeded the total production of all other tunas combined. In recent years, the catch of skipjack has remained fairly constant near 200 million pounds.

"Katsuobushi" is a traditional product which is grated and flaked for use in flavoring soup and other dishes. Several new products of this type, requiring refrigeration, have come into increasing use. Skipjack is also in demand for "sashimi" the raw product, which is sliced thin and spiced.

Bluefin tuna is eaten mainly raw and commands high prices on the home market. In fact, United States fishermen have expressed an interest in exporting bluefin to Japan. Albacore and yellowfin tuna are mainly for the foreign market.

Fish sausage "surimi," a new product since World War II, is becoming one of the more popular fish products in Japan. Some tuna (mostly frozen) is used to prepare this product which is like our frankfurter or hot dog. Fish, other than tuna, and whale meat are also used. One of the reasons for its popularity is that it keeps longer than fish cake ("kamaboko") and it is easier to handle in a casing. Tuna hams, smoked, is another new product. Efforts

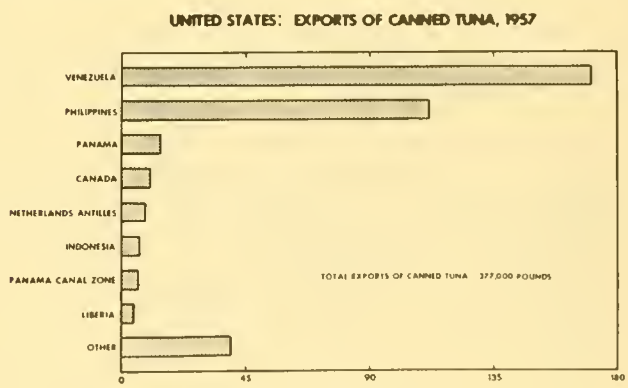

Figure 2.

are being made to promote the sales of these products by advertising in Japan.

According to Japanese export statistics, frozen tuna exported from Japan in 1957 totaled 150 million pounds, of which about 88 percent was destined for the United States and its possessions (table 11 and fig. 5). Canada and Italy were other markets for Japanese frozen tuna.

Fish marketing in Western Europe little resembles marketing as we know it in the United States today. In many southern countries, for example, salted and dried cod are still the staple item of trade. There are few food stores in Western Europe like our chain stores or general grocery stores. Most markets specialize in one product, for example, in horsemeat, in meat, in fruits and vegetables, or in canned goods. A shopper must visit each type of store to get the day's food needs. Canned fish is sold throughout Europe, mainly in shops resembling small delicatessens. However, department store merchandising is increasing and is expected to grow rapidly in the future.

Trade controls in most countries of Western Europe include restrictive import quotas and licensing procedures. In many countries, trade is controlled by government-sanctioned associations of dealers. These organizations usually can determine how much fish is imported and who will sell it. Because of these controls, markups are high. Prices to consumers reflect the lack of free competition. Of course, some countries like Germany and the Benelux have liberalized imports of canned fish but most others control this trade rigidly.

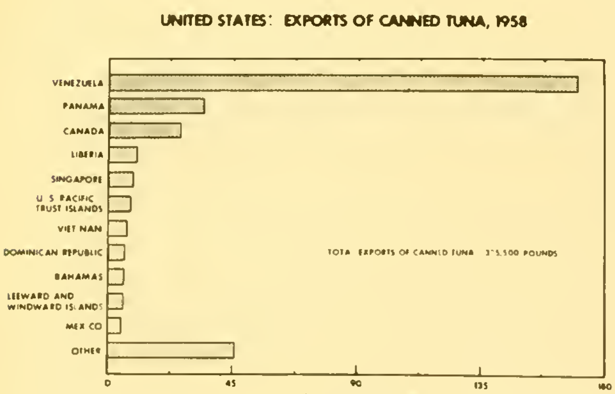

Figure 3.

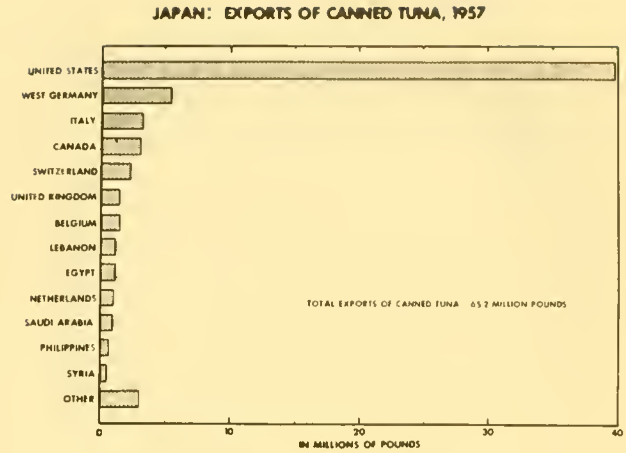

Figure 4.

Italy is second only to the United States as an importer of tuna. Norway has supplied Italy with large quantities of bluefin tuna. For some years, tuna from Spain was a main item. However, since 1956 Spain has lost some of her trade to Japan since Japanese vessels have been landing catches directly in Italian ports. Italy and the United Kingdom are the only countries in Western Europe that freely permit direct landings by fishing vessels of other countries. In Italy, tuna is generally sold in large sized cans of about seven pounds, solid pack, in olive oil. These cans are opened in the retail market or restaurant, and sold in small portions. Tuna is served just as it comes from the can.

Consumption of tuna in Italy has been estimated to be between 45 and 65 million pounds, landed weight basis, annually. The Italian catch is small, coming mainly from Sicilian waters. Some 22 million pounds of frozen tuna were imported from Japan in 1958, largely in a barter deal exchanging Japanese tuna for Italian rice. About 17.5 million pounds (875,000 cases) of canned tuna were imported from Japan, Portugal, Spain, Libya, and Morocco.

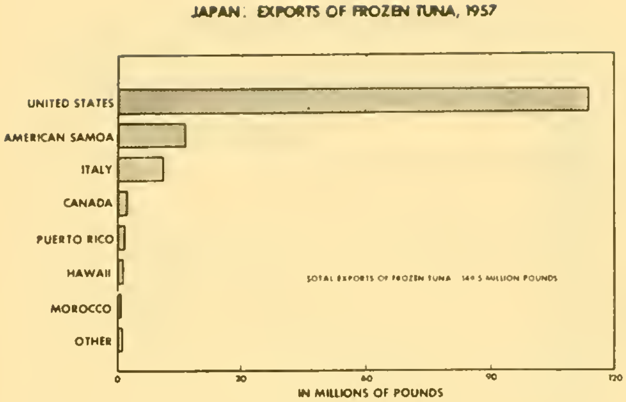

Figure 5.

West Germany is a new and growing market for canned tuna. The leading suppliers have been Peru and Portugal but recently Japanese packs have practically taken over the market. West Germany imported over 5 million pounds (250,000 cases) of canned tuna in both 1957 and 1958, mostly light meat. Prices quoted for light meat tuna, packed in oil, c.i.f. Hamburg, as of May 5, 1959 were reported by the American Consulate to be from $6.40 to $6.80 per case of 48 (7 ounce) cans. Germany also has recently imported some frozen tuna from Japanese sources.

In France, fish marketing and distribution is in the hands of associations which arrange to buy and market through established dealer channels. France has sought to satisfy its demands for fish from home production. Heavy duties, taxes, and quantitative limits apply to practically all fish imports, including canned fish. No import licenses are granted for tuna products. An increase in the French tuna supply from operations out of Dakar has resulted in prices declining considerably in the past year. Production of canned tuna reached 1,100,000 cases in 1957.

In Spain, as in France, some tuna is marketed fresh or frozen; it is also salted, dried, and canned in oil. High costs of production and tin plate have put the Spanish tuna-canning industry at a marked disadvantage on world markets. During 1958, Spain exported 1 million pounds (50,000 cases) of canned tuna.

In Portugal, most of the tuna is canned in olive oil or sauce and exported; little is sold fresh or frozen. Italy has taken more than half of the Portuguese tuna exports; Switzerland, Brazil, Belgium, and the United States are other outlets. Exports largely of tuna canned in olive oil, amounted to about 7 million pounds (350,000 cases) in 1958.

The United Kingdom has recently become a buyer of rather substantial quantities of canned tuna. The market was stimulated by the shortage of canned salmon on British markets. About 1954, Peruvian tuna was promoted in the United Kingdom by a nationwide advertising campaign. The Peruvian product sold readily until Japanese tuna gained a foothold through a trade and payments arrangement in 1957. Canned salmon again became available in the United Kingdom in 1959 so the trend of increased tuna imports may suffer some reverses this year. According to Peruvian export data for 1957, about 13 million pounds (650,000 cases) of bonito and 1.4 million pounds (70,000 cases) of tuna were shipped to the United Kingdom. Japan supplied about 1.5 million pounds (75,000 cases) of tuna.

Belgium and the Netherlands are also expanding markets for canned tuna. During 1957, Japan exported 2.5 million pounds (about 125,000 cases) of canned tuna to these countries. Prices for tuna, solid pack, in oil, c.i.f. Rotterdam, were reported by the American Consulate in April 1959 at from $7 to $7.50 per case of 7 oz./48 for white meat in oil, and $6 for light meat. Peruvian solid pack light meat was reported at $6, up recently from $5.80. Peru has sold about 500,000 pounds (25,000 cases) annually in this market.

Yugoslavia recently imported over 2.2 million pounds of frozen tuna from Japanese vessels fishing in the Atlantic. Sardine canneries in that country are reported to be able to handle substantially greater quantities of frozen tuna during the off season for sardines.

Turning to the Western Hemisphere, and excluding the United States, Canada has not developed a large tuna fishery but cans imported frozen tuna in plants normally used for salmon. Canada bought over 2 million pounds of frozen tuna from Japan in 1957. Canada's canned tuna imports totaled about 3 million pounds (150,000 cases) almost entirely from Japan. Canada, has been subject to Japanese export check prices under which sales are required to be made at not less than $8.65 per case for white meat in oil and $7.70 for light meat in oil.

Brazil has a large potential market for fishery products. In 1956, the Brazilian Government authorized a Japanese tuna fishing company to operate from that country primarily to supply the home market. This company has been selling frozen tuna and recently has started marketing tuna sausage.

In conclusion, the outlook is that the world supply of tuna may continue to increase for several years as new stocks are exploited. Market conditions appear favorable for a considerable increase in world tuna consumption. Improvement in incomes and standards of living in other countries can provide a more favorable climate if tuna prices are competitive with the increasing supplies of other protein foods.

As present trade barriers are relaxed and new markets develop, a greater movement of tuna to other countries would absorb an increasing share of the world supply and may relieve some of the pressure for sales to the United States. But as long as the prices for tuna in the United States market are more favorable than in other countries, there will be a strong tendency for major foreign tuna producers to maximize their marketing in the United States.

Many facets of tuna marketing in other countries could bear thorough study in order to obtain a better measure of conditions affecting the world tuna trade. Changing market conditions will have an important bearing on future United States production and supply.

TABLE 1.--UNITED STATES: EXPORTS OF CANNED FISHERY PRODUCTS, 1958

PRODUCTS	QUANTITY		VALUE	
	POUNDS	PERCENT	DOLLARS	PERCENT
TUNA	335,536	1	216,073	2
SALMON	9,226,711	23	6,668,900	46
SARDINES, NOT IN OIL	17,816,275	44	3,231,400	22
SARDINES IN OIL	645,419	2	164,428	1
MACKEREL	2,307,753	6	332,835	2
FISH (OTHER)	1,199,115	3	495,844	3
SHRIMP	2,161,451	5	2,548,019	18
SQUID	5,583,257	14	500,711	3
SHELLFISH (OTHER)	595,664	2	372,123	3
TOTAL	39,871,181	100	14,530,333	100

SOURCE: BUREAU OF COMMERCIAL FISHERIES; COMPILED FROM BUREAU OF THE CENSUS DATA.

Table 2.--UNITED STATES: EXPORTS OF CANNED TUNA, BY COUNTRY OF DESTINATION, 1957 AND 1958

(QUANTITY IN POUNDS; VALUE IN DOLLARS)

COUNTRY OF DESTINATION	1957		1958	
	QUANTITY	VALUE	QUANTITY	VALUE
BAHAMAS	2,440	2,200	6,000	4,700
BRITISH GUIANA	2,930	1,920	1,950	1,310
CANADA	10,750	7,300	26,107	17,243
COLOMBIA	-	-	1,692	1,499
COSTA RICA	-	-	3,375	733
CUBA	2,339	1,538	2,420	1,720
DENMARK	2,250	1,300	2,250	1,250
DOMINICAN REPUBLIC	3,690	2,005	6,300	4,250
FRANCE	960	1,072	-	-
FRENCH SOMALILAND	2,500	1,180	-	-
GUATEMALA	-	-	2,100	1,490
HONDURAS	-	-	1,350	1,200
HONG KONG	2,600	1,850	2,100	1,450
INDIA	1,250	745	-	-
INDONESIA	7,400	2,322	-	-
IRAN	3,660	2,330	3,710	2,710
IRAQ	1,200	620	-	-
JAMAICA	-	-	3,067	1,825
LIBERIA	5,340	3,577	10,460	6,717
LIBYA	3,000	1,340	1,260	720
LEEWARD & WINDWARD ISLANDS	-	-	5,980	3,250
MEXICO	3,000	1,500	5,000	1,680
NICARAGUA	-	-	2,200	1,160
NETHERLANDS ANTILLES	8,925	5,605	3,150	2,180
PAKISTAN	1,150	1,026	1,500	845
PANAMA	14,420	8,974	34,731	23,422
CANAL ZONE	6,350	2,230	3,780	1,508
PERU	3,423	1,910	780	579
PHILIPPINES	111,851	63,257	-	-
SAUDI ARABIA	-	-	3,498	1,917
SINGAPORE	-	-	9,450	6,530
SWEDEN	525	628	1,050	656
U.S. PACIFIC TRUST ISLANDS	-	-	8,400	3,690
VIET NAM)	)	)	6,980	3,780
LAOS)	750	795	-	-
CAMBODIA)	)	)	1,482	550
TRINIDAD	3,100	2,300	3,600	2,460
VENEZUELA	171,156	82,093	169,814	113,049

Table 3.--JAPAN: EXPORTS OF CANNED TUNA, 1957

(IN MILLION POUNDS)

COUNTRY	QUANTITY
UNITED STATES	39.8
WEST GERMANY	5.4
ITALY	3.2
CANADA	3.1
SWITZERLAND	2.3
UNITED KINGDOM	1.5
BELGIUM	1.5
LEBANON	1.2
EGYPT	1.2
NETHERLANDS	1.1
SAUDI ARABIA	1.0
PHILIPPINES	0.7
SYRIA	0.6
OTHER	2.6

SOURCE: JAPAN, ANNUAL RETURN OF THE FOREIGN TRADE OF JAPAN, 1957. THE MINISTRY OF FINANCE, TOKYO.

Table 4.--JAPAN: CANNED TUNA EXPORTS TO AFRICA, 1957

(IN POUNDS)

COUNTRY	ALBACORE	OTHER TUNA	BONITO	TOTAL
TANGIER	525	-	-	525
EGYPT	1,471	1,125,326	50,126	1,176,923
SUDAN	6,020	33,573	2,732	42,325
NIGERIA	419	736	-	1,155
GHANA	159	419	-	578
SIERRA LEONE	190	86	42	318
BELGIAN CONGO	421	421	-	842
ETHIOPIA	5,898	50,415	17,669	73,982
MAURITIUS	-	635	-	635
KENYA	11	990	315	1,316
UGANDA	-	22	157	179
TANGANYIKA	-	913	168	1,081
MOZAMBIQUE	-	-	315	315
UNION OF SOUTH AFRICA	12,218	4,957	4,035	21,210
TOTAL	27,332	1,218,493	75,559	1,321,384

Table 5.--JAPAN: CANNED TUNA EXPORTS TO THE FAR EAST, 1957

(IN POUNDS)

COUNTRY	ALBACORE	OTHER TUNA	BONITO	TOTAL
RYUKYU ISLANDS	1,788	56,519	368,336	426,643
HONG KONG	-	14,180	1,380	15,560
TAIWAN	981	966	1,784	3,731
MALAYA	1,125	-	-	1,125
SINGAPORE	209	7,202	787	8,198
PHILIPPINES	678,108	2,148	3,676	683,932
INDONESIA	2,057	-	-	2,057
BURMA	840	-	-	840
INDIA	209	18,522	5,874	24,605
CEYLON	106	1,323	209	1,638
NETHERLANDS NEW GUINEA	397	-	190	587
TOTAL	685,820	100,860	382,236	1,168,916

Table 6.--JAPAN: CANNED TUNA EXPORTS TO THE NEAR EAST, 1957

(IN POUNDS)

COUNTRY	ALBACORE	OTHER TUNA	BONITO	TOTAL
ISRAEL	631	-	-	631
IRAN	13,126	-	-	13,126
IRAQ	8,024	25,952	525	34,501
BAHREIN ISLANDS	1,050	19,955	-	21,005
ADEN	12,079	112,199	10,965	135,243
SAUDI ARABIA	5,565	1,005,372	24,211	1,035,148
KUWAITT	3,151	244,632	28,460	276,243
TRUCIAL OMAN AND QATAR	-	2,024	-	2,024
JORDAN	-	191,879	3,338	195,217
SYRIA	28,096	608,188	9,087	645,371
LEBANON	533,380	688,244	21,728	1,243,352
TOTAL	605,102	2,898,445	98,314	3,601,861

TABLE 7.--JAPAN: CANNED TUNA EXPORTS TO LATIN AMERICA AND CARIBBEAN

1957

(IN POUNDS)

COUNTRY	ALBACORE	OTHER TUNA	BONITO	TOTAL
MEXICO	-	2,099	529	2,628
NICARAGUA	-	157	-	157
PANAMA	1,144	2,101	-	3,245
CANAL ZONE	8,401	1,050	-	9,451
BERMUDA	72,891	15,742	975	89,608
WINDWARD ISLANDS	315	-	--	315
TRINIDAD AND TOBAGO	-	4,198	106	4,304
CUBA	2,970	22	11	3,003
CURACAO	1,155	13,201	1,806	16,162
GUADELOUPE	4,829	2,992	5,303	13,124
BOLIVIA	1,951	-	-	1,951
BRAZIL	112	293	-	405
TOTAL	93,768	41,855	8,730	144,353

TABLE 8.--JAPAN: CANNED TUNA EXPORTS TO AUSTRALIA AND PACIFIC ISLANDS, 1957

(IN POUNDS)

COUNTRY	ALBACORE	OTHER TUNA	BONITO	TOTAL
AUSTRALIA	1,859	24,714	3,832	30,405
NEW ZEALAND	485	4,368	106	4,959
NEW HEBRIDES	-	-	295	295
SOCIETY ISLANDS	-	251	-	251
MARIANAS, MARSHALL, AND CAROLINES	8,864	15,596	7,239	31,699
TOTAL	11,208	44,929	11,472	67,609

TABLE 9.--JAPAN: CANNED TUNA EXPORTS TO EUROPE, 1957

(IN POUNDS)

COUNTRY	ALBACORE	OTHER TUNA	BONITO	TOTAL
SWEDEN	344	42,477	23,743	66,564
DENMARK	232	893	53	1,178
UNITED KINGDOM	672,218	149,845	723,150	1,545,213
NETHERLANDS	566,903	368,182	153,569	1,088,654
BELGIUM	481,733	641,205	412,553	1,535,491
FRANCE	10,357	2,020	-	12,377
WEST GERMANY	627,005	3,880,079	848,217	5,355,301
SWITZERLAND	1,716,753	484,458	129,771	2,330,982
GIBERALTAR	-	22,431	209	22,640
ITALY	70,099	2,545,553	578,532	3,194,184
MALTA	-	488,166	86,615	534,781
AUSTRIA	3,773	19,955	2,101	25,829
GREECE	48,995	13,980	421	63,396
CYPRUS	133,775	71,076	13,232	218,083
TOTAL	4,332,187	8,690,320	2,972,166	15,994,673

TABLE 10.--JAPAN: CANNED TUNA EXPORTS TO CONTINENTAL UNITED STATES, OTHER U.S. AREAS, AND CANADA, 1957

(IN POUNDS)

COUNTRY	ALBACORE	OTHER TUNA	BONITO	TOTAL
UNITED STATES (CONTINENTAL)	24,673,511	3,704,208	11,267,936	39,645,655
HAWAII	9,973	17,702	17,596	45,271
PUERTO RICO	92,824	-	-	92,824
GUAM	23,055	14,141	8,291	45,487
SUBTOTAL	24,799,363	3,736,051	11,293,823	39,829,237
CANADA	2,705,173	67,638	278,289	3,051,100
TOTAL	27,504,536	3,803,689	11,572,112	42,880,337

SOURCE: JAPANESE MINISTRY OF FINANCE. ANNUAL RETURN OF THE FOREIGN TRADE OF JAPAN, 1957.

TABLE 11.--JAPAN: EXPORTS OF FROZEN TUNA, 1957

(IN MILLION POUNDS)

COUNTRY	QUANTITY
UNITED STATES (CONTINENTAL)	113.9
AMERICAN SAMOA	16.3
ITALY	11.3
CANADA	2.3
PUERTO RICO	1.9
HAWAII	1.6
MOROCCO	1.1
OTHER	1.2

SOURCE: JAPAN, _ANNUAL RETURN OF THE FOREIGN TRADE OF JAPAN, 1957_. THE MINISTRY OF FINANCE, TOKYO.

TRADE AGREEMENTS AND HOW THEY ARE MADE

by

Arthur M. Sandberg 1/

The General Agreement on Tariffs and Trade, otherwise known as GATT, composed of membership from governments of 37 countries of the world, is an international forum for the operation and administration of trade agreements. Meetings are held semiannually to seek and recommend solutions to international trade problems. It is pertinent to point out the relationship of this organization with the trade agreements program. The Tariff Act of 1930 established the basic rates of duty and the rules to be applied to the importation of products entering the United States. In the early 1930's, it was found desirable, as the first step toward stimulating foreign trade and its benefits to our economy, to break down the barriers which kept goods from moving in international trade and the discriminatory practices which forced reduced amounts of trade into uneconomic channels.

In 1934, Congress passed the Trade Agreements Act, authorizing the President to conclude trade agreements with other countries. In return for reductions by other countries in their barriers against American goods, the President was given authority to modify United States tariffs. This Act has been renewed 10 times by the Congress, each time granting some additional leeway to reduce duties and conclude trade agreements.

The latest renewal of the President's authority in this field was passed by the Congress in 1958. This provided that the President may reduce United States duties in stages, by any one of the following methods: (1) reducing the rate existing on July 1, 1958, by not more than 20 percent, with no more than half that reduction in any one year; (2) reducing the rate by not more than 2 percentage points *ad valorem* (or its equivalent in case of a specific duty - cents per pound).

The President's authority to increase duties was also changed to provide that he *may* raise duties as much as 50 percent over the rates which existed on July 1, 1934 (before any trade agreements had reduced rates.) He may also convert a specific duty to the *ad valorem* equivalent of the 1934 rate. The authority to increase rates, of principal significance in escape clause cases, was amended to minimize the need to resort to quotas. In addition, the President was given authority to impose a duty of up to 50 percent *ad valorem* on a duty free item which has been "bound" in a trade agreement. It is under this authority granted by the Congress that the United States Government participates in the international negotiation of trade and tariff agreements.

Before a tariff concession is offered to a foreign country, reasonable notice is given to interested parties who are invited to present their views on the effects upon domestic industry of reductions in duties for items appearing on a public list. The President seeks the advice of interested agencies of the government and also obtains "peril point" findings from the United States Tariff Commission (these are rates below which the Tariff Commission finds that duties may not be reduced without serious injury to domestic industry). These and other considerations are explored before a concession in duty is offered or made.

The President has established three interdepartmental committees to make

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available their views and advice. The Trade Agreements Committee, (TAC) composed of representatives of the Departments of State, Commerce, Agriculture, Treasury, Labor, Interior, Defense, and the United States Tariff Commission, develops detailed information and recommendations. The Committee for Reciprocity Information, composed of the same membership, receives the views of industry and other interested parties. A third committee, the Trade Policy Committee (TPC), with membership of Cabinet level, was established in November 1957 to review all matters before they go to the President.

No single department has full authority over actions proposed or taken. Usually the department with the principal responsibility for a commodity is looked to for development and presentation of the basic facts. Issues are decided by majority vote. Strong objectors to a majority action can present a dissenting appeal to the President.

The Department of the Interior has participated in the development of trade agreements only since 1951. At the time its membership was obtained, duties on fishery products in most cases had been reduced by 50 percent or more and, in some cases, as much as 75 percent. The Department can now play an important role in deciding what concessions are made in trade agreements. In the preparation for negotiations, or in the negotiations, we can bring to bear upon the decisions the viewpoint of the fishing community. We are represented on this interdepartmental organization by a member of the staff of the Office of the Secretary. The Bureau and its office which works on these problems provide material assistance and recommendations for actions on tariff and trade matters.

The United States Government has announced its intention to enter another round of negotiations with other countries. These tariff-negotiating conferences are scheduled to start in September 1960 with the six members of the European Common Market and ultimately with the other members of the GATT. Preparations are now underway in the Trade Agreements Committee to select a list of items for possible negotiation. Public hearings will subsequently be announced at which interested parties will have opportunity to present facts and views on whether duty reductions should be made in items on the list. Government committees are reviewing export items for which reductions may be sought in duties of other countries.

The list selected by the TAC will go to the TPC for approval, then to the President. Upon approval of the President, offers and requests will be made of foreign governments and actual negotiations will take place. When the negotiations are concluded, the results go back to the President for his approval. If accepted, the President issues a proclamation modifying existing duties in exchange for what he has determined to be reciprocal concessions in duties of other countries. The agreement is then finalized in the GATT and becomes a part of that Agreement.

The present import duties on the various tuna products may be considered for possible modification in import duties. If they are included on the public list now being developed, they may be subject to negotiation in the coming trade conferences. For example, tuna canned in oil is now dutiable at 35 percent ad valorem, it can be reduced by the full 20 percent, or to 28 percent over a period of two years. Similarly, canned tuna in brine could be reduced to 10 percent under quota and raised 20 percent over the quota. Increases might conceivably be negotiated in rates of duty but this would have to be accomplished with the agreement of the other negotiating countries. All these possibilities are matters of speculation at the moment but it is not too early to consider what action, if any, should or could be taken in this field.

The trade agreements program has frequently been called the backbone of United States foreign economic policy. The President's program has two major aims: increased security for the United States through increased economic strength of our allies, and promotion of the long-term economic welfare of the United States through the opening of wider markets for our products. In this effort, the President places great stress on the moderate, gradual, and selective approach to further reductions of the barriers that limit world trade.

The Department of Interior's role in this field has been strengthened by the

Fish and Wildlife Act of 1956, which provided for an Assistant Secretary for Fish and Wildlife, a voice at the Cabinet policy level. Among other things, it also provided for specific representation at negotiating conferences and for authority to participate in the solution of foreign fishery trade problems.

Within this framework, we in the Department attempt to play a constructive role in representing the interests of the fishing community as a whole.

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