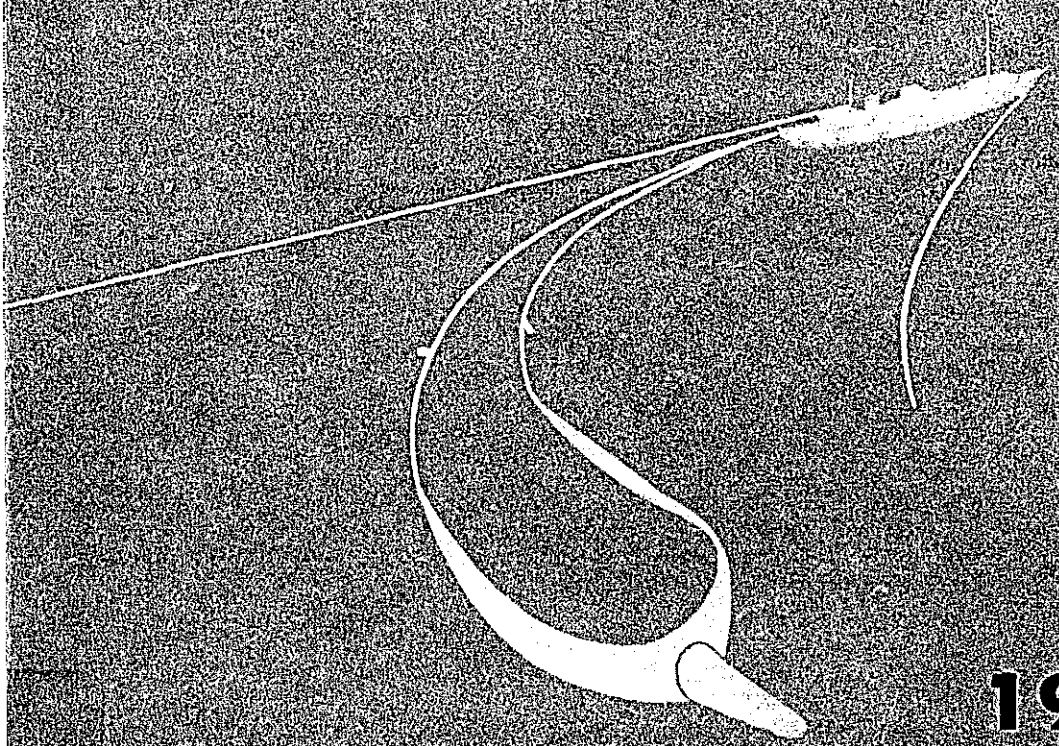
JAPANESE FISHERIES



1960

ASIA KYOKAI
Tokyo Japan

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First Published 1957
Second Edition (revised) 1960

Edited
&
Published
by
ASIA KYOKAI

No. 37, Akasaka-Shinsaka-machi, Minato-ku, Tokyo, Japan
Cable Address: "SECASIA TOKYO"
Tel: (408) 4261~8

Printed in Japan, by Obun Printing Co., Tokyo

Preface

The Japanese fishing industry has made a remarkable progress since the Meiji Restoration. It has adopted advanced fishing methods practised in Europe and North America, and Japan today is the biggest fishing nation in the world.

The Asian countries, which achieved political independence after World War II and are striving to build themselves up into modern nations, are facing more or less similar problems which Japan faced in the past. Above all they are concerned with the improvement of their people's living standard through industrial development. It would be a worthwhile endeavor for Japan to introduce her own experience in fisheries to these nations, which have rich but as yet unexplored marine resources and must depend to a large extent on fisheries in order to improve their living standard. It would also be beneficial for Japan to promote the closest possible cooperation in this field with these nations. The publication of "Japanese Fisheries: Their Development and Present Status" will, I hope, make a considerable contribution in this respect.

Our wholehearted acknowledgement is due to the officials of the Fisheries Agency and the Fisheries Statistics Section of the Ministry of Agriculture and Forestry for their generous assistance and guidance in the preparation of manuscripts and photographic illustrations without which the publication of this book would not have been possible.

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GENERAL ASPECTS OF FISHERIES IN JAPAN

Development of Japanese Fisheries

Japan stretches in a southwest-northwest direction off the east coast of the Asian continent and consists of four major islands with numerous islets. The warm and cold currents wash the southwestern coast of the country, crossing with each other off the coast. Long coastlines furnish fine fishing areas with various species of marine animals and vegetables in quantities.

They include sardine (*Sardinia melanositia*), anchovy (*Engraulis Japonicus*), horse mackerel (*Trachurus japonicus*), mackerel (*Pnenumatophorus japonicus* etc.), yellowtail (*Seriola quinqueradiata*) squid and sole in the sea around Japan; herring (*Clupea pallasii*), codfish (*Gadus macrocephalus*), salmon and trout (*Oncorhynchus*), akta mackerel (*Pleurogrammus azonus*), and Pacific saury (*Cololabis saira*) in the North Japan Sea; skipjack (*Katsuwonus vagans*), tunas and albacore (*Germo germo*) in the Pacific Ocean. In addition, the sea-areas produce such seaweeds as kelps and other edible sea weeds and such shell-fish as abalone (*Haliotis gigantea*), oysters (*Ostrea gigas*), short-necked clam (*Venerupis semidecussata*), shrimp, crab, etc.

The archipelago of Japan consisting predominantly mountainous and hilly islands, animal-protein must be derived from marine products. For this reason, fisheries have been from old times one of the most important industries in Japan.

In 1954, persons engaged in fisheries numbered about 1,000,000, and the number of households depending upon fisheries to make livings numbered 775,000 with 4,000,000—5,000,000 family members, or three per cent of the total population of the country. The ratio would be bigger if the people engaged in the processing of fisheries products are to be included.

Unitl 1910, leading fisheries were hook and line fishing, long line fishing, gill-net fishing, square lift-net fishing, drag-net fishing, etc. and non-powered boats were the mainstay of fishing boats. Fishing areas were confined to the coast of the country. Sardine beach seine fishing was the only one operated on a large scale.

By 1910, powered fishing boats and improved fisheries techniques were first brought into use.

Since the turn of the century, the Japanese society and economy had been speedily modernized, and the number of consumers of fisheries pro-

ducts had risen. Improved transportation facilities, especially railways, ice-making facilities and cold storage facilities have brought about a notable expansion in the fisheries products market. Fishing techniques, on the other hand, have made remarkable progress. Around 1880 to 1900, cotton fishing nets which were manufactured by machines became available, a turning point which made fishing techniques and implements elaborate—on a large scale. Around 1910, motors were installed in fishing boats. At the beginning, there were technical difficulties, but the improvement of manufacturing techniques for engines for marine use prompted motorization of fishing vessels from around 1920. Along with this motorization, efforts were being made to build larger fishing boats. Ships loaded with ice for fish catch came to engage in off-shore and deep sea fisheries, and gradually fishing grounds in Japanese waters were developed. Thus skipjack pole and line fishing, tuna long line fishing, saury drift gill net and stick-held dip net fishing, trawl fishing and large fixed net fishing made progress.

The part the government played in the development of the fisheries after 1910 cannot be overlooked. By 1900, there was already the Government's fisheries institute, positively turning out technical experts on a high level. The Pelagic Fisheries Encouragement Act was enacted to help the construction of big powered fishing boats. Since 1918, subsidies were given for the construction and repair of fishing boats. After 1923, subsidies were also given for the construction of refrigerators in the consuming areas, and after 1932, for the construction of ice-making facilities in the fishing villages.

With the domestic markets for fisheries products expanded, and with fishing boats and techniques improved, Japan's fisheries production began to rise year after year. Before World War II, in 1940, for instance, the total number of fishing boats was 354,215, of which 75,197 were powered boats, fishing in a wide area, and the total catch reached 4,500,000 tons. In 1934–36 production, sardine purse seine fisheries ranked first, comprising 30 or 40 per cent of the total production, followed by herring, codfish, salmon, trout, etc. The total production of the above constituted about 60 per cent of the entire catches. Although whaling, tuna and skipjack fisheries were developing to some extent, coastal fisheries were predominant, constituting 80 per cent of the total.

Fisheries in Japan, especially the off-shore and pelagic fisheries, suffered fatal damage from World War II:

i) Due to the war damage, powered fishing boats in 1945 decreased to 76 per cent in number and less than 40 per cent in tonnage of the 1940 total.

ii) Fish catch dropped from 1940's 4,500,000 tons to 1945's 2,051,000

tons, or a 49 per cent decrease.

Due to the loss of the great part of the territories, post-war Japan was forced to support her teeming population with the limited land. As a result, Japan had to depend upon the fisheries all the more. During 1945—47, the government adopted important measures for the rehabilitation of fisheries. There were many handicaps which had to be overcome: limited fishing areas, inefficient and insufficient fishing boats, dire shortage of fuel, fishing nets ropes, etc. Under unpropitious circumstances, however, fishermen made painstaking efforts to rehabilitate the fisheries industries, and the government provided the funds for reconstruction of fishing boats and ice-making facilities and for repairing of the damaged fishing ports.

On the other hand, in view of the importance of fisheries, the Fisheries Bureau, of the Ministry of Agriculture and Forestry, was elevated in 1948 to the Fisheries Agency, one of the specialized agencies of the Ministry, to become responsible for the unified and systematic fisheries administration.

In 1950, the old Fisheries Law was replaced by its new counterpart. Under the law, fundamental revision was made in regard to the fisheries licenses, permits and fishing area regulations. In addition, the Fisheries Cooperative Association Law, the Fishing Port Law, and the Fishing Boat Law were also enacted in order to increase fisheries production and fishermen's benefits.

As a result of such governmental measures and the fishermen's efforts fisheries made rapid recovery. The following is the present fisheries situation:

i) Fishing Boats

At the end of December, 1958, there were 164,717 powered vessels, 234,194 non-powered vessels, these two types consituted 398,911 vessels, or 1,615,505 tons. Compared with the pre-war peak, 1940's 75,197 powered vessels, and 279,018 non-powered vessels, totaling 354,215 vessels, this was a tremendous increase.

The post-war features are that there are more powered boats than the non-powered ones and that boats are becoming large, equipped with modern apparatuses. The powered boats accouted for 21 per cent of the total in 1940, but increased to 41 per cent in 1958.

Large fishing vessels showed a marked increase. In 1940, fishing boats of more than 20 tons numbered 3,312 but by 1958, they rose to 8,086 and ships of more than 50 tons totaled 4,155 as compared with 909 in 1940. Among large fishing boats, steel ships account for 33 per cent of the more-

than-50-ton category, and 76 per cent of the more-than-100-ton category.

The recent trends of fishing boats are towards high efficiency. In this connection, the spectacular improvement of marine engines must be noted. Previously, diesel engines were mostly for deep-sea fishing vessels, while hot-rod engines and electric ignition engines were used for small-and medium-sized boats. In recent years, technical improvements on the manufacturing of diesel engines have raised efficiency and reduced the fuel consumption remarkably, thereby spreading diesel engines even among smaller fishing boats. In 1958, diesel engines were used for 27 per cent of the total fishing vessels, hot-rod engines 26 per cent, and electric ignition engines 47 per cent.

Installation of various scientific apparatuses and equipment in fishing boats may be another postwar feature. They are being widely used not only for prevention of sea accidents but also for enhancent of fishing efficiency. In fact, they are greatly helping pinpoint good fishing grounds, lower production costs and save manpower. Fishing boats equipped with wireless communication apparatuses increased to 10,000 in 1958 from 1,077 in 1940. In 1950 to 1952, fish finders, radars, lorans, etc. came to be installed. By 1958, fishing vessels equipped with fish finders numbered 8,000; radars, 600; direction finders, 4,500; and lorans, 1,000. Of course, they included small-medium sized boats, too.

ii) Fishing Implements

In Japan's fisheries industry, fishing nets are being used to a great extent, and to keep them in good repair is very costly. Almost all fishing nets used until 1952 were made of cotton which decays in sea water in the course of time. The use of synthetic fibers for fishing nets, too, was a great boon to fisherman, because the new materials are much stronger than cotton, more efficient, and easier to dry. They fast spread from around 1952, and their products replaced principal cotton fishing nets by 1958.

iii) Production

The fisheries production which declined sharply in 1945 recovered quickly to top the prewar peak of 4,519,000 tons, and continued to climb. In prewar years, the principal fishes, which were caught by purse seine fishing, drag net fishing, and fixed net fishing, were sardine, herring, cod, and salmon. In recent years, however, these fishes migrating towards the coast of Japanese islands have been decreasing, with the result that off-shore and deep-sea fisheries are being developed, and saury, anchovy, jack mackerel, mackerel, and tuna have come to be hauled in quantities. Thus the industry's dependence on off-shore and deep-sea fisheries and at the same time culture in shallow seas has notably increased. The production

of culture in shallow seas rose to 214,000 tons in 1958 from 78,000 tons in 1940.

The nation's fisheries production totaled 5,506,000 tons in 1958 and was valued at about ¥246,000 million or $700 million. Of this total, the production of inland water fisheries amouted to a bare 90,000 to 100,000 tons, figures which suffice to show how heavily the Japanese fisheries industry depends on marine fisheries. Seen from the production angle, tuna and skipjack fishing, saury stick-held dip net fishing, mackerel angling, squid angling and trawl fishing west of 130°E longitude and trawl fishing east of 130°E longitude. The fixed net fishing, which was one of the major fishing methods in prewar years, shows a steep decline in production mainly because of decreased migration of herring.

iv) Utilization and Consumption

As much as 90 per cent of the total fisheries products is being consumed domestically, while the remaining 10 per cent is being shipped abroad. For domestic consumption, these products are being processed into various forms, although fresh fish is being consumed in quantities. Part of them are being processed into manure and feed, too.

Around 1940, inferior processing techniques and facilities and inadequate transportation and preservation facilities inevitably converted a considerable portion of fisheries products into animal feeds and manure. For human consumption, fisheries products were taking primitive dried or salted forms.

Recently things have changed sharply in processing, and transportation. In addition to considerably improved railway facilities, trucks have increased tremendously. The ice-manufacturing facilities necessary for transportation of fresh fish increased to 27,569 tons a day in 1958 from 15,804 tons in 1940. Food-freezing facilities expanded to 9,880 tons a day in 1958 from 2,146 tons in 1940, and refrigeration facilities, to 3,063,000 cubic meters from 1,136,000 cubic meters. In 1958, 435,000 tons of fish and shellfish were frozen. Canning factories exist at major landing ports, and 545,000 tons of fresh fish was canned in 1958.

In 1958, 1,414,000 tons of fish was consumed either as fresh fish or frozen fish; 3,214,000 tons, processed food; and 535,000 tons, manure or feeds. As compared with 1940, the consumption of fish as food has increased notably. While the consumption of dried or salted fisheries products is on the decline, fresh fish, frozen fish and canned fish are being consumed in increasing quantities. The per capita consumption was 9.6 kilograms in prewar days, but as a result of increased consumption in farming communities (30 to 40 per cent of the total population), the figure has soared markedly. In 1958, the per head consumption rose to 21.3 kilograms, and

the Japanese takes 70 to 80 per cent of his animal protein intake from fisheries products.

v) Fishermen

Japan's fisheries managements include 252,000 for oceanic fisheries and about 300,000 for inland water fisheries. Fishermen engaged in these fisheries number 790,000 and 310,000, respectively. Households depending on these fisheries are 476,000 and 300,000, respectively.

Oceanic fisheries are operated by large managements owning large fishing boats and smaller managements depending on small fishing vessels, but the latter group of managements accounts for roughly 80 to 90 per cent of the total number. Smaller managements are engaged mainly in coastal fisheries, and their main labor force is family members. They occupy a highly important position in Japan's fisheries policies in that they are developing resources for coastal fisheries at low costs and also offering good employment opportunities.

Current Status of Major Fisheries

(a) Skipjack and tuna fisheries

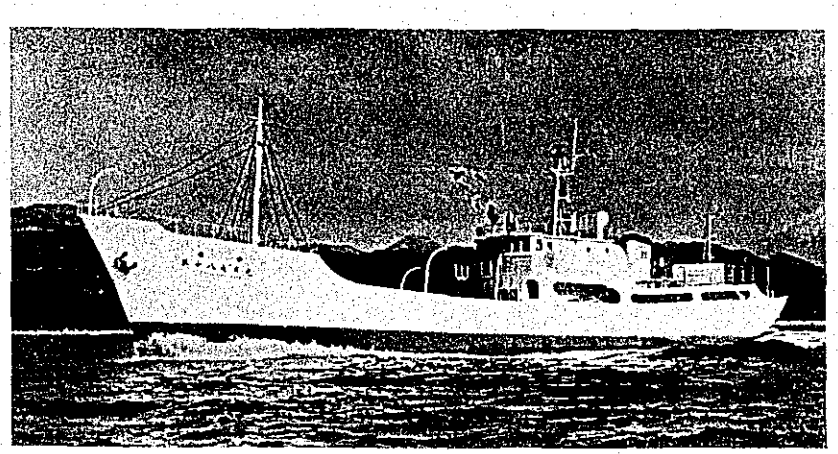
Skipjack and tuna fisheries have developed into a typical pelagic fisheries under the government encouragement given since the 1900's to pelagic fisheries, powered-boat building, and construction of fishing port facilities. In 1939, fishing boats numbered 1,107 (53,561 gross tons), but due to the war it decreased to 373 boats (27,226 gross tons) in 1945 or to 33 per cent in number and to 52 per cent in tonnage of the pre-war levels.

In 1958, it increased to 1,685 boats (217,267 gross tons), the catch amounting to 443,000 tons, surpassing the pre-war peak.

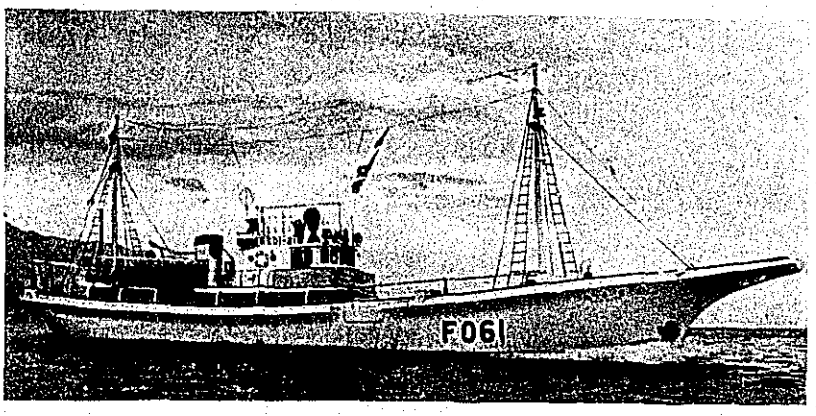
The contributing factors are: (1) as a result of the postwar prohibition of arctic fisheries, skipjack and tuna fisheries on the Pacific Ocean has become important and the investments in this type of fisheries were expedited; (2) gradual relaxation of limitations on fishing area in the Pacific Ocean during the Occupation by the Allied Powers and the increased possibilities for expeditions into the Indian Ocean and the South Pacific Ocean after the peace treaty; and (3) increasing demand for tuna from the USA and other countries.

Skipjack pole and line fishing and tuna long line fishing comprise the skipjack and tuna fisheries. This is because: (1) both have been operated in fishing areas off the shores of the Pacific Ocean and (2) most of the fishing boats of some 100 gross tons have been engaged in skipjack fishing in summer as well as in tuna fishing in winter. However, the skipjack

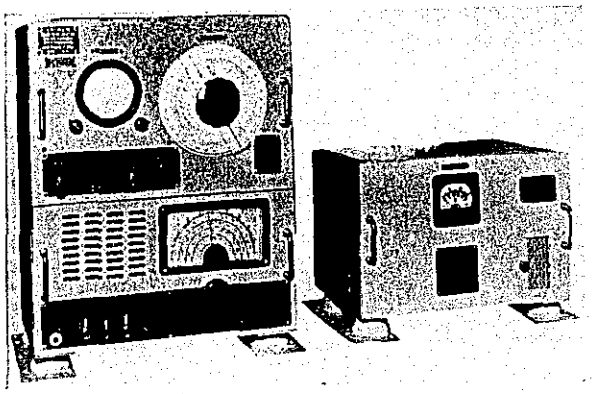
Yaizu Port



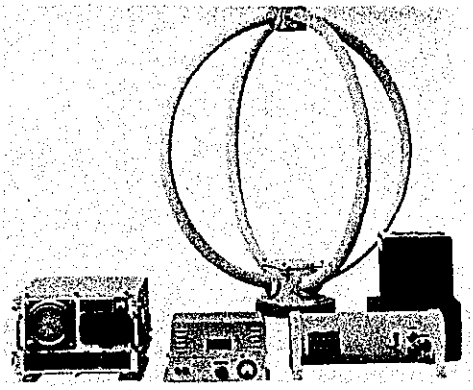
Tuna boat



Skipjack boat

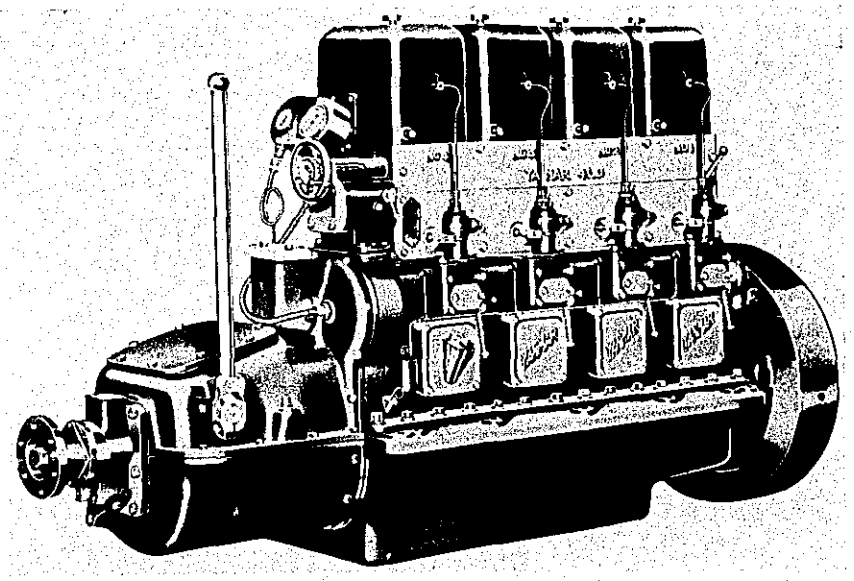


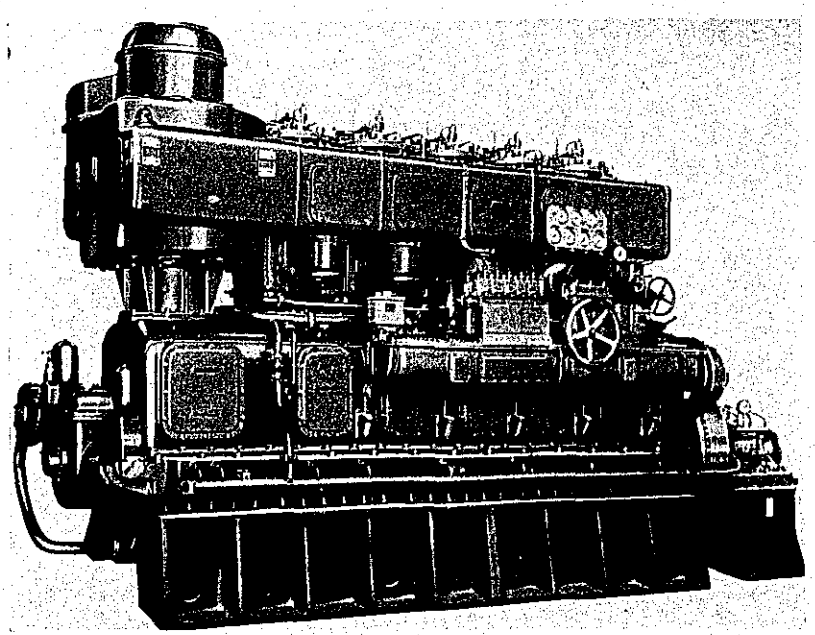
Direction finder



Direction finder

Diesel marine engine,
56 H.P.





Diesel marine engine,
750 H.P.

pole and line fishing clearly distinguished from the tuna long line fishing in fish species, fishing methods, and fishing areas.

Skipjack pole and lines fishing is operated to catch four or five years old skipjack (each weighing 3 to 5 kgs) migrating towards north in quest of feeds in summer. The fishing season lasts from May to September, and June and July are at its peak. The fishing area extends 50 to 500 miles off. Anchovies caught in the coastal sea are carried in a live-well in a boat and are put on angling hooks. The fishing boat measures 100 to 150 gross tons and a crew consists of 50 or 60 members. One voyage lasts one or two weeks, and 20 to 60 tons of skipjacks are caught per voyage. Among the principal fishing ports are those along the Pacific coast such as Makurazaki, Murotozaki, Katsuura, Yaizu, Choshi, Nakaminato, Shiogama, Onagawa, Ishinomaki, Kesenuma, etc.

Most of the skipjacks caught are dried and some are consumed fresh, but recently more skipjacks are eaten either fresh or canned.

Tuna long line fishing is being modernized. A long rope is stretched on the surface of the sea and hooks are hung from the rope at 50 meters intervals and squid or Pacific saury is put on each hook to catch such large fish as tuna, swordfish, shark, etc. Tuna long line fishing is operated in the Pacific Ocean. Fish species caught vary with areas. Among them are tuna, albacore, big-eyed tuna, yellow-fin tuna, broad-bill swordfish, striped marlin, black marlin, great blue shark, porbeagle, etc. Misaki, Yaizu, Shiogama, Ishinomaki, Kesenuma, etc. are major fishing ports for tuna fisheries. In the past, a fishing boat of 100 to 150 gross tons manned with a crew of 25 to 30 members operated skipjack pole and line fishing in summer for 30 to 40 days per voyage and most of such boats were engaged in tuna long line fishing in winter. Fish caught are consumed as fresh fish or exported as frozen or canned tuna, constituitng top export items.

This type of fisheries is also one of the licensed fisheries. Fishermen must obtain the licence from the Minister of Agriculture and Forestry and the maximum limit of the number of boats is set by law.

After the peace treaty came into effect, Japan was allowed to make tuna expeditions into the central and southern Pacific Ocean and the Indian Ocean, and encouragement has been given by the government in building large-sized boats and in improvement of equipment. Since 1952, tuna fishing boats of 200～1,000 gross tons equipped with improved apparatus have been built once after another. In 1958, fishing vessels of larger than 200 gross tons totaled 227.

Improved tuna boats of 300 gross tons make expedition far out into

the Indian Ocean and the southern Pacific Ocean. Each voyage lasts for 60 days or more. About 140 to 180 tons of fish are caught per voyage and frozen on board and landed at a fishing port. From 1950 onward, factory-ship-type tuna fisheries have been carried on.

Tuna being one of the export items, the price of tuna is affected chiefly by the market situation in foreign countries. Due to the pollution of sea waters by radio-activity as the result of hydrogen bomb tests conducted at the Bikini Atoll in 1954, Japan's tuna expeditions were affected seriously.

(b) Pacific saury stick-held dip net fisheries

During the months from September to December, Pacific saury migrate to spawn in large schools from off Hokkaido to the southern part of the Pacific Ocean along the main island. During the very short peak season the Pacific Ocean along the northern part of Japan and Hokkaido are crowded with Pacific saury fishing boats.

The catch in 1940 was only at the level of 20,000 to 30,000 tons, while it reached 575,000 tons in 1958, or twenty times the prewar level. This is credited to the use of stick-held dip net fishing which is more efficient than the traditional drift gill net fishing and to the rapid increase in the number of operation boats. Some of the Pacific saury are packed in ice and sent to consuming areas by trucks or freight cars, others are salted, dried, or canned. Still others are frozen and kept in refrigerators for a long time. When in season there is so much catch the refrigerators are over-crowded, and not enough freight-cars or ice are available, so that fish prices go down. How to stabilize prices is a big problem.

(c) Purse seine fisheries

Purse seine fisheries developed from hand purse seine fisheries using non-powered boats. This type of fisheries was most important in the past when sardines migrated actively. The catch in 1941 recorded 844,860 tons or 22 per cent of the total catch. Purse seine fishing boats were engaged in fishing in the coastal sea of Japan and in the offing of Korea Even now, sardine purse seine fisheries is one of the leading fisheries, comprising 11,737 boats (121,668 tons) operated by 132,000 people and the total catch amounted to 756,000 tons in 1958.

Among fish species caught by the purse seine are sardines, horse-mackerel, mackerel, skipjack, tuna, albacore (*Germo germo*), etc., but the first three are major ones. These are consumed fresh, some are boiled and dried,

and a goodly part are made into canned sardines for export purposes.

Principal fishing areas are: horse-mackerel and mackerel fishing area in the west coast of Kyushu; sardine fishing area in the Bungo Channel between Kyushu and Shikoku; and fishing area for sardine, horse-mackerel, mackerel, skipjack, tuna and albacore in the northern part of Pacific Ocean along the main island. (Before 1940, sardine fishing area in the northern part of Pacific Ocean along the main island was the most fruitful one, but due to the diminishing migration of sardines, the same fishing area came to be surpassed by the fishing areas in the coast of West Japan.)

Structure and size of fishing boats and fishing gear used for purse seine fisheries in the respective areas vary according to the conditions of each fishing area, e.g., tidal current, depth of sea, waves, etc. Even in the same fishing area, different types of fishing gear are used according to the fish species.

At present, purse seine fisheries are classified administratively into four types: large types, designated medium type, medium, and small type according to the size of boats and scope of operations. The first two types must obtain license for fishing operation from the Minister of Agriculture and Forestry and the remaining two from the respective prefectural governors. The maximum limitations are placed licensing and various restrictions are also placed on fishing areas and operating areas, thus ensuring a certain amount of fish-catch per boats.

However, as the annual catch of sardines has been decreasing from the pre-war level, the purse seine fisheries are generally depressed. In order to tide over such depression, efforts have been made to catch fish off-shore and to raise the operating efficiency by the see of large-sized or western-style ships. In West Japan, fishing boats of 60 to 80 gross tons have been built actively and almost all the fishing units are equipped with wireless apparatus and fish finders.

(d) Mackerel pole and line fisheries

Mackerels are being fished by nets and also poles and lines. Of the total catch of 268,000 tons, 27 per cent is by purse seines, and 60 per cent by poles and lines. Rich fishing grounds are in the Pacific, and along and off the coasts of western and northern parts of Kyushu Island, but this is one of the most popular fisheries in Japan. Adoption of new fishing methods and scientific appratuses has been contributing a great deal towards development of new off-shore fishing grounds and higher fishing efficiency. Today large fishing boats capable of moving from one vast fishing grounds

to another are becoming the main force of mackerel fisheries. Of the 165,000 tons of mackerel catch in 1958, about 50 per cent was fished by 30—50 ton and 50—100 ton fishing boats.

(e) Squid angling

Squid (*Ommastrephes sloani pacificus*) production in the prewar years registered only 75,000 to 150,000 tons annually, but in postwar years, it rapidly increased, recording 656,445 tons in 1952, or 14 per cent of the total fisheries production. In 1955, it showed a decline from that of 1952, but still kept itself above 400,000 tons. Squid angling fisheries is one of the most important fisheries in Japan, involving 56,000 fishermen.

Squid is the most important species among decapod kinds, constituting 90 per cent of the total production of the said kinds.

Fishing areas for squid extend all over the sea around the country. There are many rich fishing grounds in the Pacific Ocean off Hokkaido and North Japan. Squid caught from these fishing grounds constitute 80 to 90 per cent of the total squid from the entire country.

The squid angling season varies according to the fishing areas, but generally the peak season is July to December in the fishing areas off Hokkaido and North Japan. Angling is the usual method for squid fishing. Squid fishing is carried on all night by enticing schools of squid with the use of light, as schools of squid approach close to coast. No expensive gear is needed, and many non-powered boats and small type of powered ones with a crew of only family members go out for angling in the season. Fresh squid are dried with family labor. In the squid season coasts are congested with villagers operating squid angling. Income from squid angling fisheries has been the important source of income for these people. In principal fishing areas in the southern part of Hokkaido and North Japan, the squid production constitutes as high as 60 per cent of the total fish production.

Recently larger type of boats measuring 20 or 30 gross tons are on the increase. Small type of fishing boats are confined to operation near the sea-coast, while larger type of boats are allowed to be engaged in fishing in a wider fishing area in quest of schools of squid. Catches are landed at bigger ports. Some of them are consumed fresh and others are frozen or dried.

The Squid season is as short as that of Pacific saury, lasting only a few months, so that they are beyond the capacity of refrigeration or processing plants often resulting in undue fall in prices. In addition, due to the sun-drying method, the quality of dried squid is seriously affected

by the climatic conditions during the drying season. In wet spells it gets rotton, resulting in heavy losses. Further study is urgently needed.

(f) Trawl fisheries operating west of 130°E longitude

Trawl fisheries operating west of 130°E longitude on the wide continental shelves in the East China Sea and the Yellow Sea is also known as "Pelagic trawl fisheries." Presently 805 trawlers (64,350 tons) are operated and the production amounts to 334,000 tons (1958). This type of fisheries is one of the most typical and important high seas fisheries in Japan.

Trawl fisheries in Japan were inaugurated in 1910 by converting non-powered trawlers into powered ones. This type of fisheries has been spread westward. As expeditions were made to the continental shelves in the Yellow Sea and the East China Sea, the size of boats became larger and a rapid increase occurred in the number of boats and in the production, and now developed into the present trawler fleets operating west of 130°E longitude. Under this type of fisheries, a trawl is dragged by a set of two boats at the bottom of the sea. Each boat has a tonnage of 60 to 100 gross tons and carries a crew of 25 persons. Each voyage lasts usually for 17 days and about 40 tons of fish are caught at each voyage. Among the main fishes caught are sea bream (*Pagrosomus major*), snapper, flounder, croaker, skate and ray, guarnard or sea robin (*Lepidotrigra microptera*), etc. In 1958, 398 units were engaged in operation. Shimonoseki, Nagasaki, Fukuoka and Tobata fishing ports are the main bases of their operations. These ports are the leading ones in the country. Fish landed at these ports are transported by refrigerator cars to every corner of the country. Fish caught by trawlers are for the most part consumed fresh and some parts of them are used as materials for fish jelly products (*kamaboko*). Annual production reaches 300,000 tons, more than 15 per cent of the total fisheries production from West Japan, holding an important position for the supply of popular consumption in the western Japan.

Continental shelves in the East China Sea and the Yellow Sea are the fishing areas that have been rapidly developed since 1920. During the last war, almost all of the trawlers were commandeered and eventually destroyed. However, in view of the importance of this type of fisheries from the standpoint of food supply, the rehabilitation program was pushed forward by the government giving priority to it. The number of trawlers in operation surpassed the pre-war level in 1951.

Until the peace treaty became effective, the fishing areas were limited to less than one-third of the pre-war areas, and the licensed trawlers were

forced to be reduced by one-third in 1950 in order to maintain the minimum margin of profit per trawler. Besides the above-mentioned trawlers of six to 100 tons, 53 fishing boats of more than 300 tons are engaged in otter trawl fisheries in the Yellow Sea and East China Sea. These otter trawl fishing boats have been developing fishing grounds in the South China Sea since 1952. Recently they are active in the South Seas, too, in developing untapped fishing areas, and fishing vessels of larger than 1,000 tons are being built for this purpose.

(g) Medium trawl fisheries (operating east of 130°E longitude)

This type of fisheries was started in 1910 by introducing the hand purse fishing by powered boats instead of non-powered ones. By virtue of their higher efficiency and the stabilized catches, the medium trawler fisheries became popular in a relatively short time. The fisheries operated in the fishing areas east of 130°E longitude is known as "trawl fisheries east of 130°E" or "medium type trawl fisheries." About 1,500 boats are engaged in fishing and 521,000 tons were fished in 1958; thus the medium trawl fisheries is increasing its importance.

Kinds of fish caught by this type of fisheries vary with fishing areas. Among the leading species are flounders, codfish (*Gadus macrocephalus*), Alaska pollack (*Theragra chalcogramma*), skates and rays, dogfish (*Squalus suckleyi*) and the like sharks, rockfish, rockcod (*Sebastolobus macrochir*), sandfish (*Arctoscopus japonicus*), gurnard (*Chelidonichthys kumu*), sea robin (*Lepidotrigla spp.*), croakers (*Nibea argentata*), "NIGISU" (*Argentina semifasciata*), etc. These are popular daily food fish in the country. Alaska pollacks, dogfish, and croakers are either boiled or broiled—the most popular type of cooking in Japan. Most of the fish processed into fish jelly products are fish caught by this type of fisheries (fish jelly product manufacturing plants are usually found in fishing ports for the trawl fisheries operating east of 130°E).

Fishing areas for the trawl fisheries spread wide around Japan and the trawl fishing ports are scattered throughout the country. The offing of Hokkaido, the Pacific Ocean north of the main island of Japan, and the Japan Sea west of the main island are particularly notable for the abundance of fish-catch as well as for a goodly number of trawlers engaged in fishing operation.

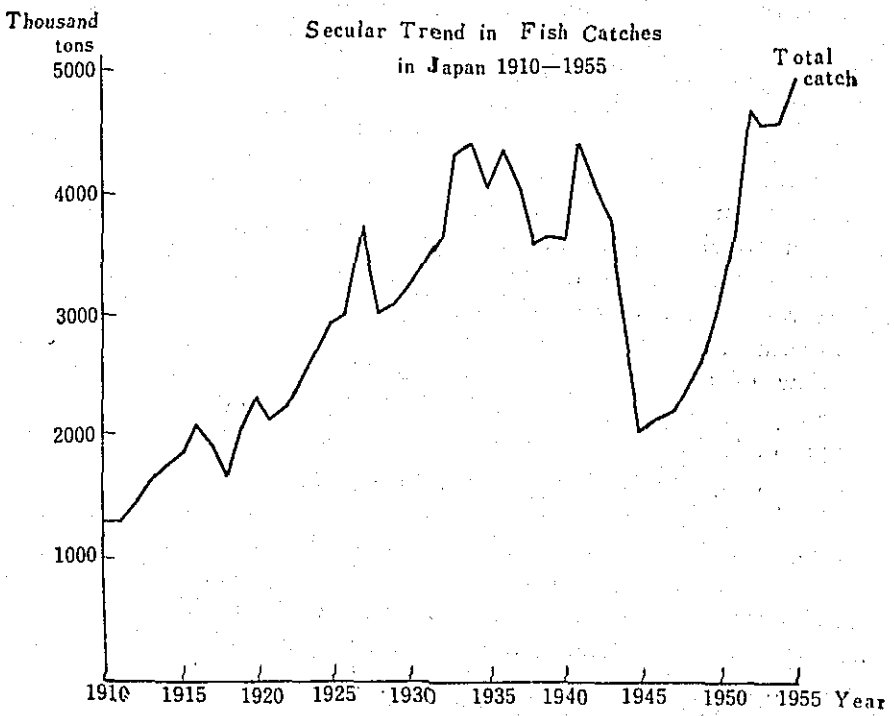
In the southwestern part of the Pacific Ocean and in the western part of the Japan Sea, a trawl is dragged usually by a set of two boats, but by a single boat in the other fishing areas. It is usually to use a wooden boat of 15 to 60 gross tons, but the size of a boat varies with fishing areas. Most of the larger boats of 50 gross tons and over are used in

fishing area in the surrounding sea of Hokkaido and on the northern part of the Pacific Ocean along the main island of Japan.

For medium trawl fishing operation one requires a license from the Minister of Agriculture and Forestry. In order to minimize the friction with the coastal fisheries, restrictions are laid on some fishing techniques, areas, and seasons. It is the established policy to give no more fisheries licenses. Medium trawlers are becoming larger in size. Fishing areas fit for medium trawl fisheries are usually confined to the sea of less than 300 fathoms deep. Due to the limited area of such continental shelves in Japan's surronding sea east of 130°E., it gives rise to keen competition among fishermen.

In view of this, the government is making efforts to develop fishing areas in deep seas or encouraging trawl fisheries to convert themselves to other types of high seas fisheries (mainly tuna and skipjack fisheries).

Powered trawlers of less than 15 gross tons are known as small-type trawlers. About 22,000 small trawlers are engaged in fishing operation chiefly in the Seto Inland Sea, Tokyo Bay, Ise Bay, Mutsu Bay, and the Ariake Sea and 200,000 tons of fish are caught every year. Reflecting an acute food shortage immediately after the war, was a rapid increase witnessed in the number of small trawlers. As a result, fish catch per boat was on the increase year after year but the fishermen faced intense competition To avoid needless competition the number of boats has been reduced since 1951.



N.B. Whale catch excluded.

FISHING GEAR AND FISHING METHODS

Drag Net Fishing

A net attached with a bag-net is dragged by one or two boats at sea bottom and the schools of bottom fish are driven into the bag-net and hauled up. Fish species caught in drag nets vary according to the fishing ground, but most of them are bottom sea fishes which are migratory.

The drag net fishing is divided into five groups according to the scale of fishing operation: otter trawl, trawl operating west of 130°E longitude, medium trawl, small trawl and others. The 1958 statistics indicate that the total catches in drag nets of various descriptions amounted to 1,111,553 tons, constituting 20% of the total fish catches in Japan.

Although the drag net construction varies depending upon its size, it is generally made up of nets and ropes. Nets consist of wing nets which serve to lure schools of fish to move in and a cod end bag which gathers them in. The details can be referred to Figs. 1~6 and Tables 1~5.

(i) Otter Trawl

Trawl is dragged by one boat measuring 250 to 500 gross tons. There are also 1,000 gross-ton class boats. Otter trawlers can continue the voyage for more than three weeks. Fish caught are kept in cold-storage in the boats. Though the total catches by otter trawlers are as low as two per cent of the total catches in drag nets, the otter trawler ranks far ahead of any trawlers in fish catch per boat per annum with 400 tons. The operating units numbered only 46 boats. The head rope of the net is about 45 meters long (the size of a net is represented by the length of the head rope). Two otter boards are used to keep the net spread. A warp is 26 mm in diameter and 800 meters or more long. Diesel boats are equipped with an electric winch of 75 to 150 horse power. Trawling speed is 3 to 4 knots an hour and the regular trawling lasts for four hours.

(ii) Trawl operating west of 130°E longitude.

A trawl is dragged by a set of two boats of 50 to 100 gross tons. Trawlers operate in the same fishing area as in the case of otter trawlers, but the cruising power of the former is limited. Fish catches by the trawlers constitue 32 per cent of the total catches in drag nets of all descriptions.

In casting the net, buoys and trawling ropes are cast in the direction opposite to the course of the main boat and then one wing net, bag net, another wing net, and ropes are cast. When the main boat has occupied the position in the direction for sailing, the partner boat takes the buoys

and starts to operate at a signal from the main boat. The length of ropes and the distance between the two boats differ according to the fishing area, depth of sea, fish species, etc., but in the case of the sea of 100 meters deep, about five coils long each and 250 to 700 meters distance are common. Trawling lasts two or three hours at the speed of 3 to 4 knots per hour. In drawing up the net, the two boats approach closely and a partner boat hands over the rope to the main boat and the net is drawn up by the main boat, while the partner boat casts the net in another fishing ground and in turn serves as the main boat. The gear is as given in Fig. 2 and Table 2.

(iii) Medium Trawler (Bull Trawler)

Medium trawlers are the mainstay of Japan's off-shore fisheries. They rank first in number amongst drag net fishing boats, reaching 1,409 operating units in 1958. About half the number thereof consists of boats of 30 to 50 gross tons and they are scattered all over the country. Fish catches amount to 520,539 tons, constituting as high as 49% of the total catches by the total drag net fishing boats.

A trawl is dragged by a single boat, and no trawl board is attached. In this respect, medium trawlers differ from otter trawlers, but rather resemble purse seine fishing boats.

A rope is in general 2.5 to 3.7 cm in diameter and 8 to 12 coils long. Float lines are 30 to 60 meters long. Ropes are used for driving fish in the central part. Ropes and nets are set like this shape ⟨ ⟩.

The area enclosed by the rope gets narrower as the rope is pulled. Thus the fish in schools are driven in the central part and finally in the bag net. Trawling lasts for 30 to 60 minutes (See Fig. 5 and Table 4). In the case of deep sea fishing, echo meters, fish finders, etc., are used.

(iv) Small Trawler

Small trawlers are defined to mean the trawlers of less than 15 gross tons. This type of fisheries may be described as mechanized coastal fisheries. The operating units reach 28,005, or 3.2 gross tons per boat. Fish catch per boat is only 7.8 tons a year or 20 per cent of the total catches of the total drag net fishing boats.

For the small trawler fishing, *bizen-ami* is used. The floating net is 12 meters long. In order to keep the net's mouth open, a bamboo stick of five meters long is attached to the trawling rope in front of the net's mouth. The net of this type resembles a beam trawl.

Fleet of 3 or 4 units comprising small boats of 10 to 15 gross tons each makes a day's trip. *Bizen-ami* is made ingeniously (See Fig. 6 and Table 5).

The problem of use of unutilized fishing grounds has recently come to the forefront. Deep sea area has been exploited, particularly medium type trawlers have tried expeditions to the sea of 800 meters deep in the northern sea area to catch flounder (*Atheresthes evermanni*), coral rockfish (*Sebastodes fiammeus*), etc.

In addition, fish finder available for drag net fishing in deep seas is specially designed, contributing much to the increased production.

Special attention is paid to deep sea shrimp fishing. As a result, shrimp fishing has become possible in undeveloped sea areas.

Purse Seine Fishing

Purse nets are extensively used in the capture of large schools of small fish such as sardine, horse mackerel, etc., found on the coast and large schools of these larger fish migrating on the off-shore, such as mackerel, skipjack, tuna, etc. Purse seine fishing is operated throughout the country, though differs somewhat according to fish species. Most of the purse seine boats shift from one fishing ground to another according to the fishing season.

A purse seine is designed to be set around a school of fish and so arranged that after the ends have been brought together, the bottom can be closed so that fish can not escape from it. The upper edge of the net is supported by oblong floats and the lower edge is weighted by oblong weights through which the purse line passes. The name of "purse seine" is derived herefrom. Some times a special bag net is attached to the purse seine for the convenience of the capture of fish. The size of a purse seine is generally represented by the length of a float line. There are various sizes of nets ranging from a minimum of 180 meters to a maximum of 2,700 meters.

Schools of fish are detected by the presence of birds flying over them, jumping of fish, bubble formation, color of water, or plankton's phosphorescence emanating from schools of fish, etc. Schools of fish are sometimes lured into the net with the means of fishing lights or baits and the bottom of the net is closed by tightening the ring wire attached to the purse line. At the same time, both of wing nets are lifted up to the boat, thus bringing together the ends of the net (See Fig. 8).

For fishing in the coast or in the wavy off-shore, one boat is used, but two-boat operation is considered more suitable to catch schools of swift fish because the time for fish driving and for hauling the net can be cut by half.

In 1958, the total units operated in the purse seine fisheries numbered 3,464 and catches amounted to 697,140 tons, 15 per cent of the total

catches in Japan, of which 46 per cent is credited to sardine.

For the purpose of export increase in skipjack and tuna into the USA which was opened again after the war, two-boat expeditions to off-shore fishing area have recently become active under the stimulus of the purse seine fishing of the U. S. type. The size of a purse seine fishing boat is becoming larger and net hauling operation has been mechanized. There appeared 200 gross-ton class boats, but most of the boats measure 20 to gross tons. Fishing nets and ropes have come to be made out of synthetic fibers. As a result, the cost for dyeing or drying to prevent ropes and nets from deterioration was saved and they can be used longer.

In addition, fish finders, radars, etc. have been brought into wide use since the end of war. At present, nearly 8,000 fish-finders are installed in fishing boats, thus fish catching capacity per unit is increasing. Consequently, in some fishing areas it showed a decrease in the number of fishing boats in operation.

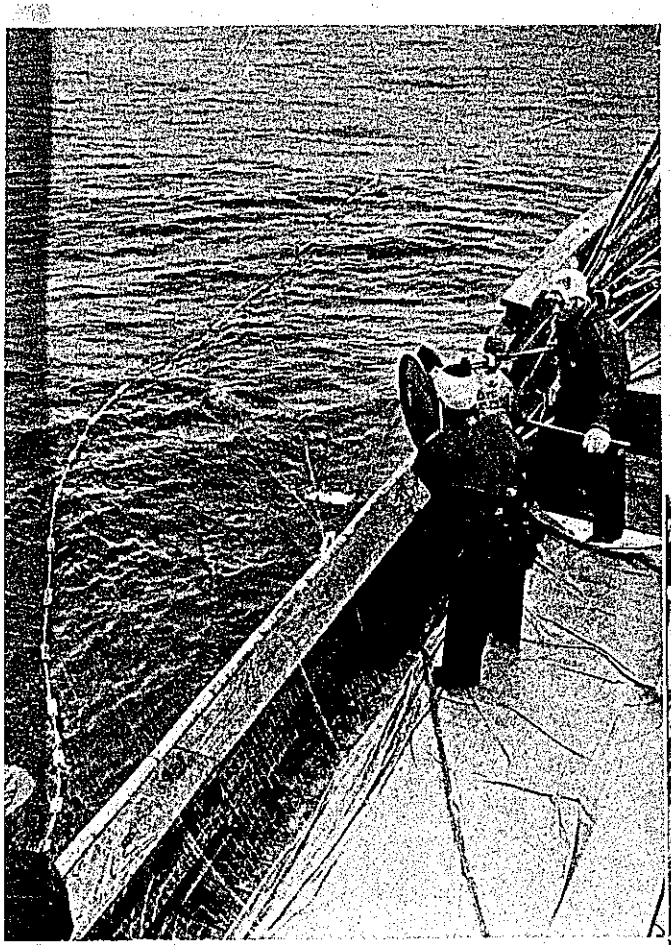
Stick-held Dip Net Fishing

Stick-held dip net is one of the floating lift nets. The net is a square and shallow bag-like one. The stick-held dip net is thrown overboard in a certain fishing ground and schools of fish are lured by fishing lights, feeds, etc. This net was designed by converting a fixed net into a net of movable type.

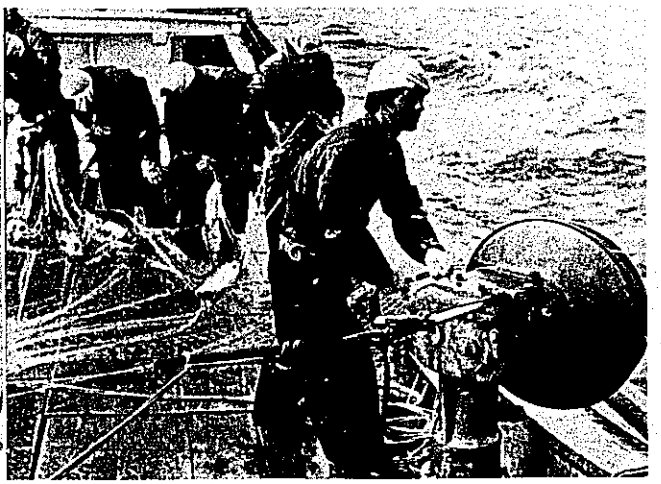
The stick-held dip nets are used mainly for the capture of sardine, horse mackerel, mackerel, pacific saury, etc. Pacific saury is mostly fished in this net. The number of operating units reaches 2,229 with the total catch of 557,972 tons or 66 per cent of the total catch in all lift nets in Japan. All the fish caught are landed at fishing ports still fresh. As the net is flexible, it takes the form of a shallow bag. The upper edge of the net is supported by a bamboo stick instead of floats and the lower edge is weighted by weights and attached with lifting ropes.

The upper edge of the net supported by a bamboo stick is stretched out with poles from the stem and stern on the port side and then lift lines are dropped overboard. The net takes the form of a shallow bag as the boat drifts at the mercy of the wind or current. A school of fish attracted by fishing lights or feeds on the starboard are induced into the net and then lift lines and side lift lines are pulled up quickly.

Stick-held dip net fishing boats are grouped into two: (1) 30 to 60 gross-ton class boats and (2) 100 to 150 gross-ton class ones. The former serve also as drag net fishing boats and the latter as skipjack fishing ones. There are no stick-held dip net fishing boats exclusively used for Pacific



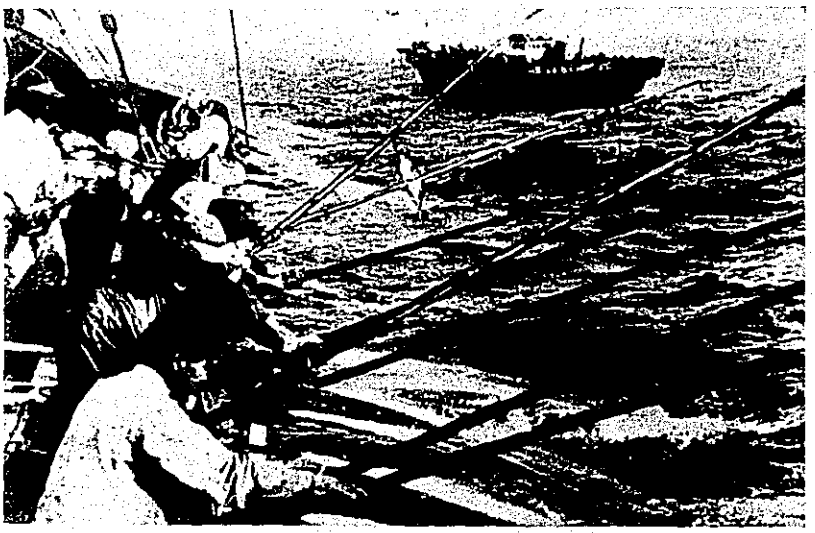
Hauling of gill net at the broadside



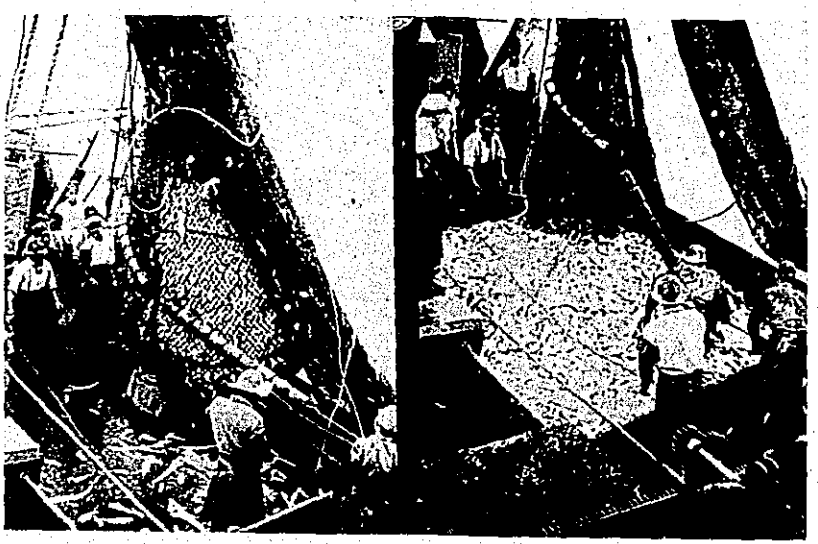
Net hauling

Casting of gill net at the stern

Slip-way in a whaling mother-boat

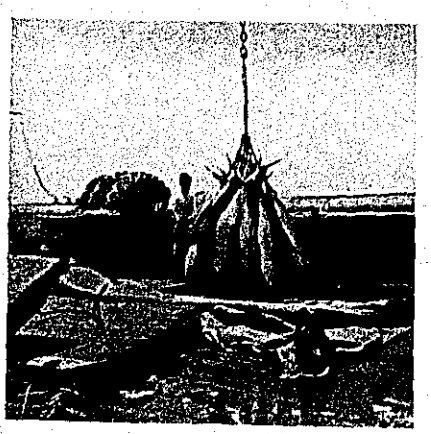


Skipjack angling

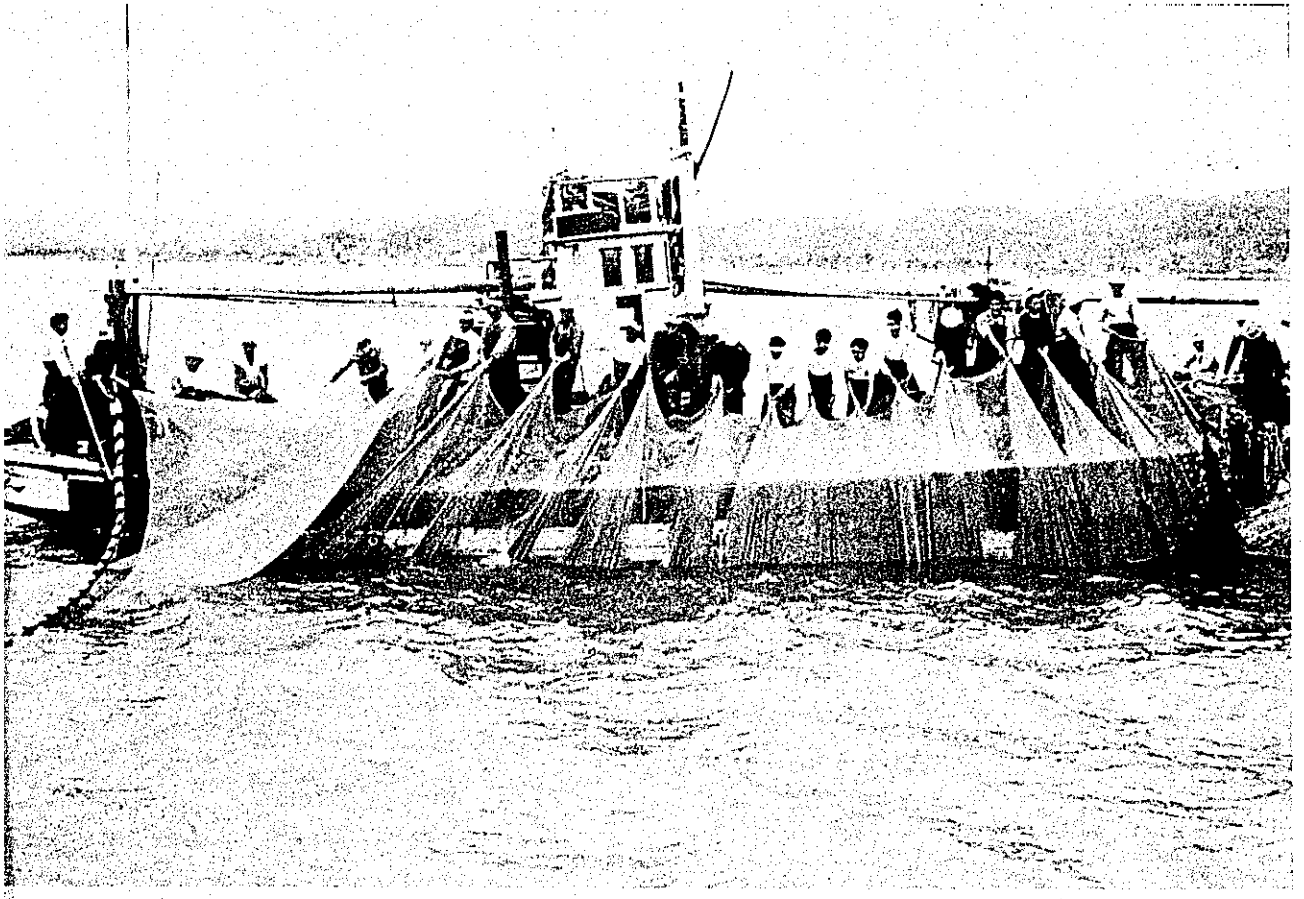


Trawl fishing

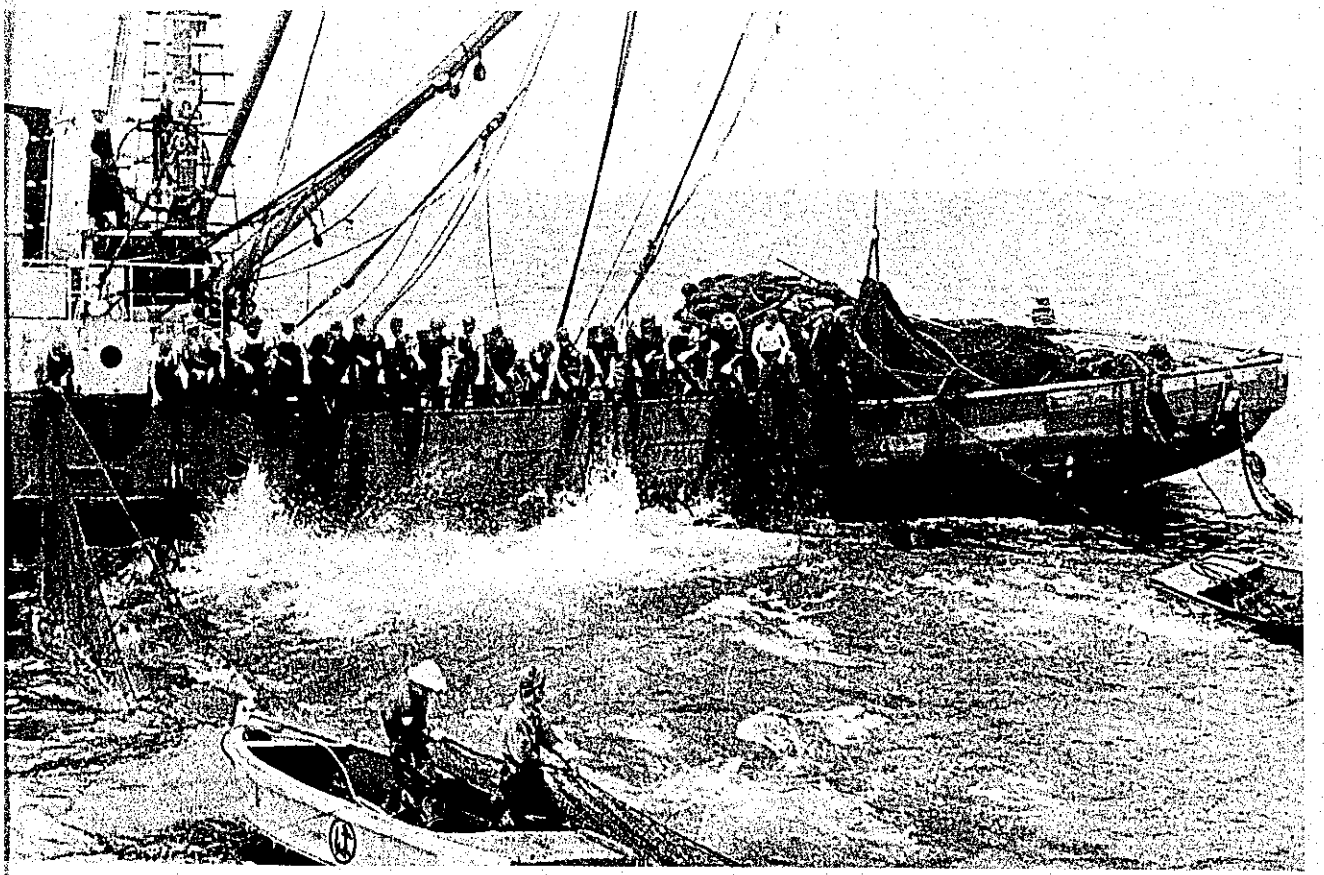
Trawl fishing



Landing of tunas



Two-boat purse seiner in operation



One-boat purse seiner in operation

Net making

Surrounding net fishing

Yellow-tail set net fishing

saury. From the economic and seaworthy viewpoints, boats of 75 to 100 gross tons are regarded as best.

Pacific saury fishing season is confined to the months from September to December. The fishing season is determined according to the fish resources and migration habit. At present, the candle-power of electric light to be used is restricted within 30 k. w. The structure of a Pacific saury stick-held dip net is as given in Fig. 9.

In deciding the fishing season, the southward migration of Pacific saury can be tracked from the condition of fishing areas, particularly from the sea water temperature distribution chart. Because the Pacific saury fishing season comes next to the skipjack fishing season, the northern-most black current has been surveyed fairly well at the end of the skipjack fishing season.

Fishermen look for the fish jumping in the fishing ground. They wait for the schools of fish at night with a help of a search light or fishing light. When fish in large schools are found out, the boat slows down and stops and the search light is put out. After the fish got used to the boats lights on one side board are put out and the net is dropped overboard. After the net has been spread, two fishing lights of 500w each are lighted over the central part of the net and the fishing lights on another board are put off in turn. Thus schools of fish are induced from one board to another and the net is hauled up. From the viewpoint of photoaxis of fish, red colored lamps have recently been brought into use often.

In view of the fact that Pacific saury migrates on the surface waters, surface lights are used in Pacific saury fishing, while for the capture of horse mackerel and mackerel, underwater fishing lights are mostly used.

Fixed Net Fishing

Leading nets are set across the migrating passage along the coast so as to induce a school of fish into the bag net set at the off-shore side end of the leading net. Among the leading nets are large nets set in the sea of 100 meters deep, e. g., a yellowtail fishing net, and a small pound net with a cube-shaped bag set on the coast of 5 meters deep. Among leading nets there is a long net stretching over as far as 4,000 meters off-shore.

In the fixed net fishing, fishermen have to wait for migration of a school of fish. In view of the design of a net, it is not easy to keep the proper form of a large-sized net in case where the current is swifter than one nautical mile. Costs for a trip to and from the fishing ground and for fish searching are saved and the fishing can be met with great success by selection of fishing ground.

Fixed net fishing is fit for the capture of any fish migrating closely along the coast. In Japan, nets with larger meshes are used mainly for the capture of such large fish species as mackerel, yellowtail, tuna, etc., and nets with smaller meshes for the capture of small fish species such as sardine or the like. Fixed net fisheries comprise all the coastal fisheries, totalling 18,239 in fishing units operated with 248,562 tons of catches. Structure of fixed nets is as given in Fig. 11.

Fixed nets are generally drawn up twice a day, viz., once in the morning and once in the evening, but the times vary depending upon the quantity of fish captured in a net.

A pound net with a cube-shaped bag can be hauled up easily. In the case of a net as given in Fig. 10, a cube-shaped bag alone is drawn up by one or two workers. Such nets can be used for capture of large fish species. In the case of a trap net used mainly for the capture of large fish species as yellowtail or tuna, the net is drawn up by persons on board some five boats (of 10 meters long each) placed in line. The net hauled up is dropped again into the sea successively without being drawn up to the boats, except a part of it. As a result boats decrease to one or two as the net end approaches.

Two defects can be pointed out as those of a large size trap net, viz., (a) as there is no machine available for drawing up the net, it requires many hand; (b) many materials are required to make a net.

In Japan, bamboo sticks are generally used instead of floats and straw for making ropes and nets, because bamboo and straw are abundant in Japan. However, nets have to be replaced several times during the fishing season. In order to cope with this, durable synthetic fibers have been brought into use recently for making nets and ropes.

Fixed net are used widely in every part of the country. Pound nets (small type fixed nets) are mostly prevalent in the inland sea fishing grounds.

Long Line Fishing

There is a limit to the quantity of fish caught by a pole and line fishing. The long line fishing was devised to catch many fish at a time. The long line fishing is availabe also in case where schools of fish are not easily found due to the poor distribution of fish in a certain fishing area.

The long line is set so that a fishing ground may be cut vertically by stretching a long main line with many branch lines at regular intervals. Hooks attached to the branch line ends are baited. Namely, it is designed to catch a school of fish passing through the barrier of a long line. After

the lapse of a certain time, the long line is lifted up from one end to catch fish.

Long line fisheries in Japan are roughly grouped into two: (1) tuna long line fisheries and (2) others. Tuna long line fishing units operated are 1,915 boats (comprising pelagic and coastal fishing boats), with the total fish catches of 258,830 tons. Other long line fisheries consist of small-scaled coastal fisheries. The total units operated are as many as 38,339 boats, but the total catches are small with 146,874 tons.

The construction of the long line is very simple, but it varies with the fish species for fishing, fishing ground, size of fishing boats, depth of sea, etc. The long lines used chiefly for catching bottom fish are fixed, while those for pelagic fish catching are generally drifted. The outline of construction of a tuna long line, a typical long line for pelagic fish capture, is given in Fig. 12. The length of the main line per roll is 200 to 300 meters. In the case of a large-sized boat, 300 to 400 rolls are used.

Although catches depend upon the construction of a long line, i.e., size of hooks, number of branch lines, quality of materials, etc., the most important factor contributing to the catches is the selection of fishing ground. In this respect recent tuna fishing boats have displayed their own ability to the full extent. Many large-sized fishing boats have been built so that they can select fishing grounds as they like.

The fishing methods differ according to the fishing ground and scale of operation. In general, on arriving at a fishing ground, long lines are set from early morning. After a while, the long lines are hauled up. A long line is hauled up considering the snap at the bait and the time during which hooks are left under water and the time required for hauling operations. Operations sometimes last till late at night.

A long line is dropped from the stern of a boat sailing at full speed. Hauling operation is carried on mostly by using a line hauler which is driven by motor. Most of the large type boats are equipped with refrigerators for cold-storage and freezing of fish caught, while in small type boats the fish are packed in ice.

Synthetic fibers have come recently into use to make nets and ropes, although in some cases preservatives-coated cotton threads are still in use, vinylon synthetic fiber coated with tar for increasing abrasion resistance seem to have superseded them.

Recently, a long line known as "vertical long line" has come into use with great success for the capture of mackerel, horse mackerel, etc. The vertical long line is attached with 50 to 100 hooks. The distance

between each branch line is 60 cm and each branch line is 60 cm long and the weights of 0.9 to 1.3 kilograms are used.

Pole and Line Fishing

Pole and line fishing is to angle for fish one by one. The pole and line fishing is grouped into three types: pole and line, hand line and trolling.

Except such pelagic fisheries as skipjack and horse mackerel pole and line fishing, other pole and line type fishing is very small-scaled, but is the mainstay of small-scale fisheries among the coastal fisheries.

A pole has a fishhook. The pole and line fishing is convenient for quick and exact motion of fishhooks and for alleviating the impact given by the fish captured.

Skipjack and mackerel pole and line fishing is the typical one. The number of units operated in skipjack pole and line fisheries (comprising pelagic and coastal fisheries) totalled up to 5,636 with the total catches of 184,527 tons. Among the pelagic fishing boats, there are a few as large as 280 gross tons.

A school of fish are first lured by baits and angled on a one-pole one-fish basis in a short time. In the case of mackerel pole and line fishing, efficiency is so high that it is angled at the rate of one fish per capita per second.

In most cases, live baits are used. Jig or oiled baits are also used. Minced meat and juice of fresh and fishing lights are used in order to lure a school of fish.

A fishing boat using live baits is equipped with a live bait pool. There are many holes in the pool through which sea water circulates freely. It is a striking feature of the Japanese live bait pools that sea water is kept in circulation naturally. Sardine live bait pools are installed in skipjack fishing boats. Care is taken so that there is constant supply of fresh sea water.

The size of fishhook varies according to the fish species. Most of the fishhooks are barbed ones. Fishhooks used for skipjack and mackerel pole and line fishing have no barbs because as soon as the fish are angled the hooks must be removed quickly from them.

In skipjack pole and line fishing, jigs are mostly used according to the state of a school of fish.

In skipjack angling, water sprinkling is generally practiced. This is considered a sort of camouflage to let the skipjack think as if there were a great many living sardines. Skipjack angling is practiced during the day time while mackerel angling is done mostly at night.

Hand line consists of line, hook, and weight. The hand line is used mainly to angle for fish living in mid sea and sea bottom. This is a very small-scale fishing, in the same range as the yellowtail angling with charm baits. Squid angling is most typical among hand line fishing. The number of units operated in squid angling is 44,145 with the total catches of 352,658 tons. Squid angling is operated at night by using fishing lights. A set of two lines attached with 5 to 10 jigs each is used by one angler. In the case of 30 gross-ton class boat, a crew usually consists of nearly 20 members.

Trolling is practised on a small scale. Professional trolling is practised generally by 2 to 10 gross-ton class boats to angle for yellowtail, spanish mackerel (*Sawara niphouia*,), skipjack, mackerel, young tuna, etc.

Fishing techniques vary according to the boat. In general, a boat sails in a fishing ground trolling the line attached with baited hooks, keeping the baits in the state as if they were swimming. For this type of fishing, jigs are generally used. In the case of a small boat it trolls 4 to 10 lines usually.

In dropping the lines overboard, supporting bamboo sticks are used. Careful attention must be paid to the length or height of each line so as to prevent the lines from entangling one another at the time of lifting up the catch.

Recently, low frequency electric shock device has come into use for this fishing in order to troll the lines under mid-sea water. The lines are attached with electric cords to kill the catch when they bite, by transmitting low frequency electric shock current.

Fig. 1. Structure of Otter Trawl Net

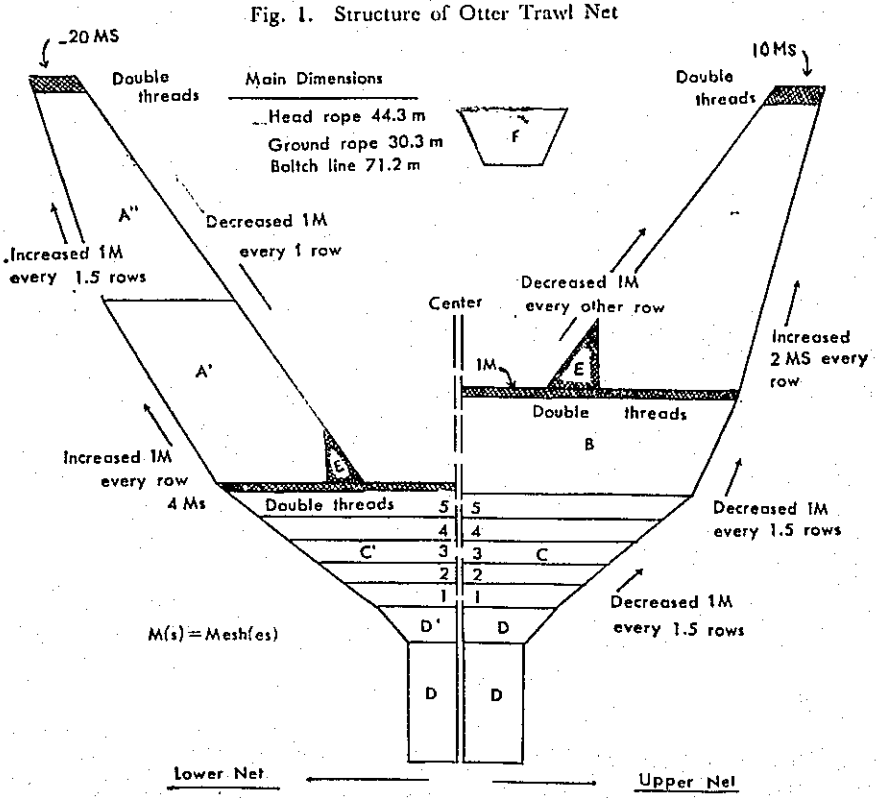


Table 1. Size of Otter Trawling Net

Name \ Item		Mark	Size of Twine (g.)	Size of Mesh (cm)	No. of Meshes (meshes)	No. of Rows (meshes)	No. of sheet	Length (m)
Upper Wing		A	5.0	15.2	10- 80	130.5	2	19.7
Upper edge			5.0	15.2	10	5.	2	
Square		B	5.0	15.2	260-200	45.5	1	
Baiting or Belly	No. 1	C or C"	5.0	8.5	120-100	15	2	8.1
	No. 2		5.0	9.1	140-120	15	2	
	No. 3		5.0	10.6	160-140	15	2	
	No. 4		5·0	12.1	180-160	15	2	
	No. 5		5.0	13.6	200-180	15	2	
Cod end		D	5.75	7.9	60- 60	100	2	
Head		D'	5.75	7.9	100- 60	30.5	2	
Quater Part		E	5.0	15.2	15- 1	15	4	
Lower Wing		A'	5·0	15.2	60- 60	70	2	28.8
		A"	5.0	15.2	60- 20	150.5	2	
Lower edge			5.0	15.2	20	5	2	1.73
Flapper		F	3.25		70- 34	23	1	

Remarks:
1. Size of twine is indicated by No. of grammes 1m. long twine.
2. Material is all Manila twine.
3. Nets are woven by hand.
4. Knots of Nets are all broiding knots.

Fig. 2. Structure of Large Type Trawl Net (Two-boat System)

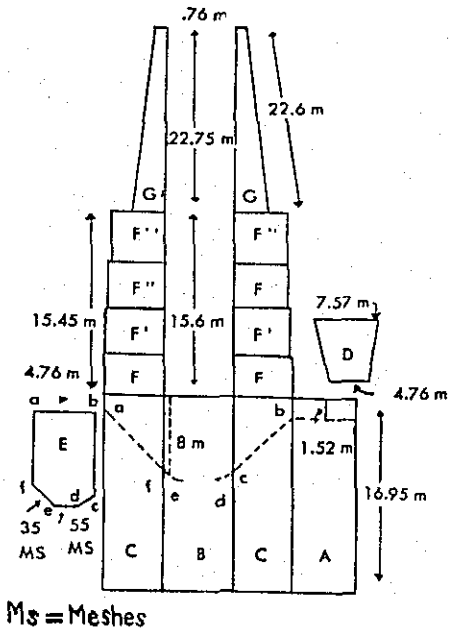


Table 2. Size of Large Trawling Net

Name \ Item		Mark	Size of thread	Size of Mesh (cm)	No. of Meshes	Length of Net (m)	No. of sheet
Bag Net	Upper	A	7	5.5	130	22.75	1
	Bottom	B	7	5.5	150	22.75	1
	Side	C	7	5.5	125	22.75	2
Ceiling		D	7	5.5	150-85	7.57	1
Flapper		E	7	5.5	125	11.35	1
Wing Net		F	7	5.5	100	6.82	2
		F'	7	5.5	100	6.62	2
		F''	7	5.5	100	6.52	2
		F'''	7	5.5	100	6.36	2
Rough Meshed Wing		G	7.45g(1)	24.2	15~7	25.80	2

(1) Weight of one meter.

Remarks:

1. Nets is all woven of No. 20 count cotton thread except G. of which material is Manila twine.
2. Kind of knots is all broiding knots.
3. Size of thread is indicated bv No. of yarns on one strand.

Fig. 3. Structure of Bull Trawl Net

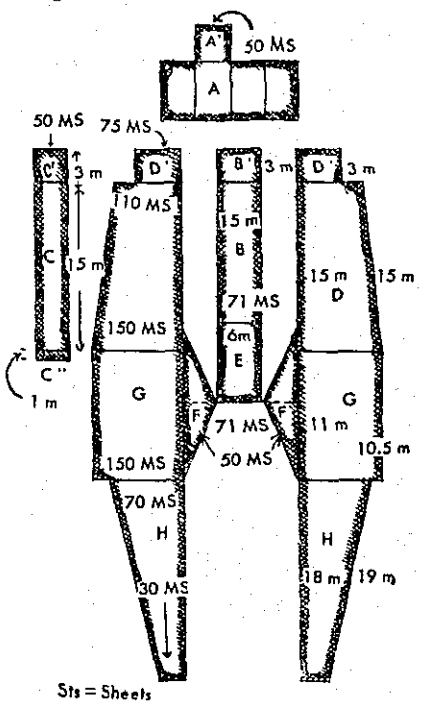


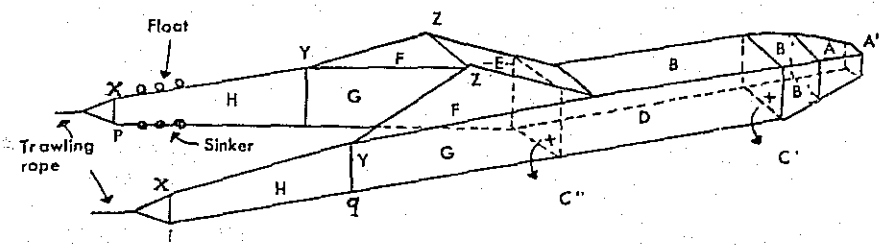
Table 3. Size of the Net

Name of Partial Net \ Item		Mark	Size of Thread	Size of Mesh (cm)	No. of Meshes (Ms)	Length of Net (m)	Length finished (m)	No. of sheet
Bag Net	End	A	25	7.5	200	4.5	4.5	1
	End	A'	25	7.5	50	19		1
	Upper	B	7	7.5	71	15	15	1
	Upper	B'	12	7.5	71	4	4	1
	Bottom	C	7	7.5	50	15	15	1
	Bottom	C'	12	7.5	50	4	4	1
	Bottom	C"	25	7.5	50	1	1	1
	Side	D	7	7.5	150–110	15	15	2
	Side	D'	12	7.5	75	4	4	1
Ceiling		E	7	7.5	71	6	6	1
Triangle		F	7	7.5	1–50–1	21	14	2
Wing		G	7	7.5	150	15	10.5	2
Rough Meshed Wing		H	22	15.0	30–70	18	18	2

Remarks:

1. Size of thread is indicated by No. of yarns on one strands.
2. Nets are all woven of No. 20 count thread.
3. Nets are all used Reef Knot.

Fig. 4. Joining of Partial Nets, etc.



Float: Used dia. 12 cm glass bouy, { 24 pcs between X and Y, 6 pcs between Y and Z, 15 pcs between z and z,

Sinker: Used egg type chinaware, { 14 pcs of 450 g. between p and q, 56 pcs of 110 g. between q and r, 13 pcs of 110 g. between r and r.

Fig. 5. Bull Trawl Net

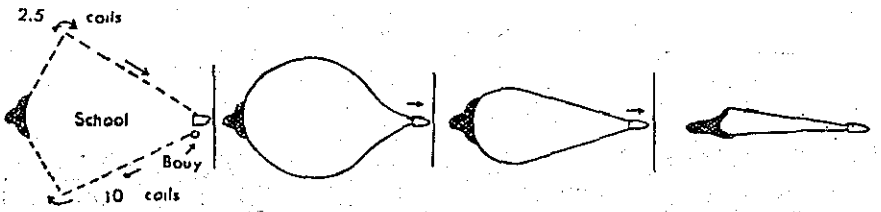


Table 4. Necessary Time for Operation

Item \ Depth of Water	50 m	150 m	250 m	350 m	450 m	Deeper
Approx. time for waiting	5	10	25	25	25	40–50
Approx. time for trawling	20	20	20	20	30	30–40
Approx. time for pulling	50	50	50	60	60	60–

Remarks:

1. This means necessary time to be sunken trawling net and ropes to the bottom.
2. Unit of time is minute.

Fig. 6. Structure of Small Type Trawling Net (BIZEN-AMI)

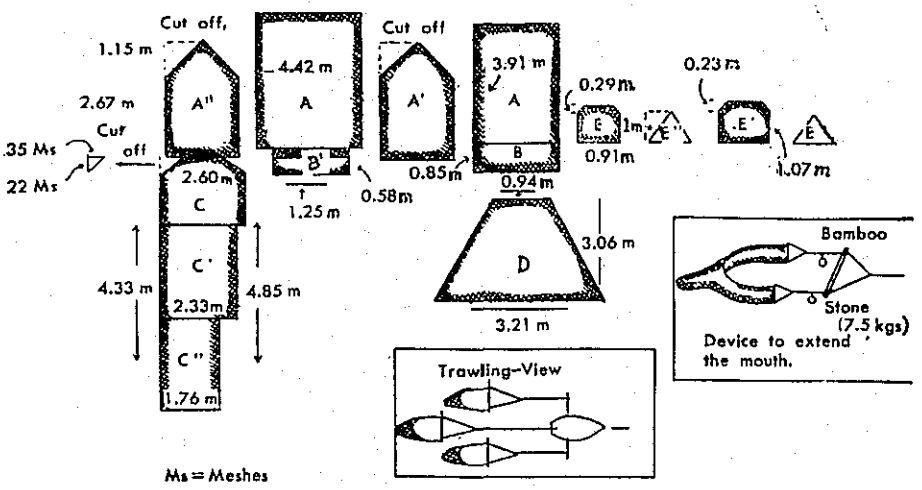


Table 5. Size of Bizen-Ami

Item / Mark		Mark	Size of thread	Size of Mesh (cm)	No. of Meshes	Length of Net (m)	No. of sheet
Bag Net	Upper	A	6	1.9	150	3.91	1
	Bottom	A′	9	1.4	200	4.42	1
	Side	A″	6	1.2	150–0	3.82	2
Brim Net	Upper	B	6	2.4	100	0.85	1
	Bottom	B′	90	7.3	32	0.58	1
Wing Net		C	6	2.1	78–100–78	2.60	2
		C′	6	2.1	100	2.33	2
		C″	12	2.7	100	1.76	2
Ceiling		D	6	2.4	200–75	3.06	1
Flapper	Upper	E	6	1.1	100–60	1.20	1
	Bottom	E′	6	1.2	100–60	1.30	1
	Side	E″	6	1.1	100–0	1.00	2

Remarks:

1. Size of thread is indicated by No. of yarns.
2. Material is all No. 20 count cotton thread.

Fig. 7. Structure of Purse Seine Net (Mackerel)

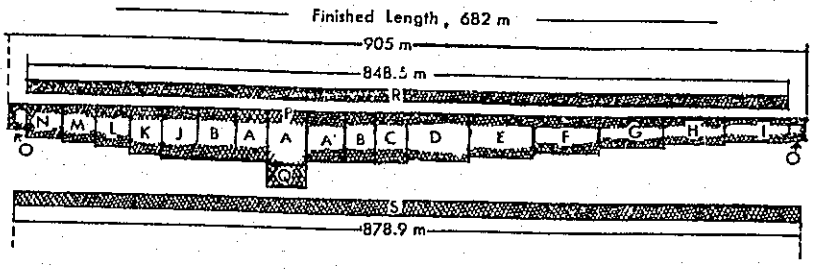


Table 6. Size of Net

Name \ Item		Mark	Size of Thread	Size of Mesh (cm)	Length (m)	No. of sheets
End		A	21	4.7	45	20
By-end		A′	18	4.7	38	19
Inner Wing	No. 1	B	15	4.7	38	19
	No. 2	C	12	4.7	38	19
Right Wing	No. 1	D	9	5.5	76	14
	No. 2	E	9	5.5	76	13
	No. 3	F	9	5.5	76	12
	No. 4	G	9	5.5	76	11
	No. 5	H	9	5.5	76	10
	No. 6	I	9	5.5	76	9
Inner Wing		J	12	4.7	38	18
Left Wing	No. 1	K	12	5.5	38	12
	No. 2	L	12	5.5	38	11
	No. 3	M	12	5.5	38	10
	No. 4	N	12	5.5	38	9
Edge Wing		O	18	6.6	15	7
End-Brim	Top	P	21	4.7	7.5	10
	Foot	Q	21	4.7	9	10
Brim	Float Side	R	21	4.7	2	140
	Sinker Side	S	21	6.6	7.5	145

Fig. 8. Surrounding Operation

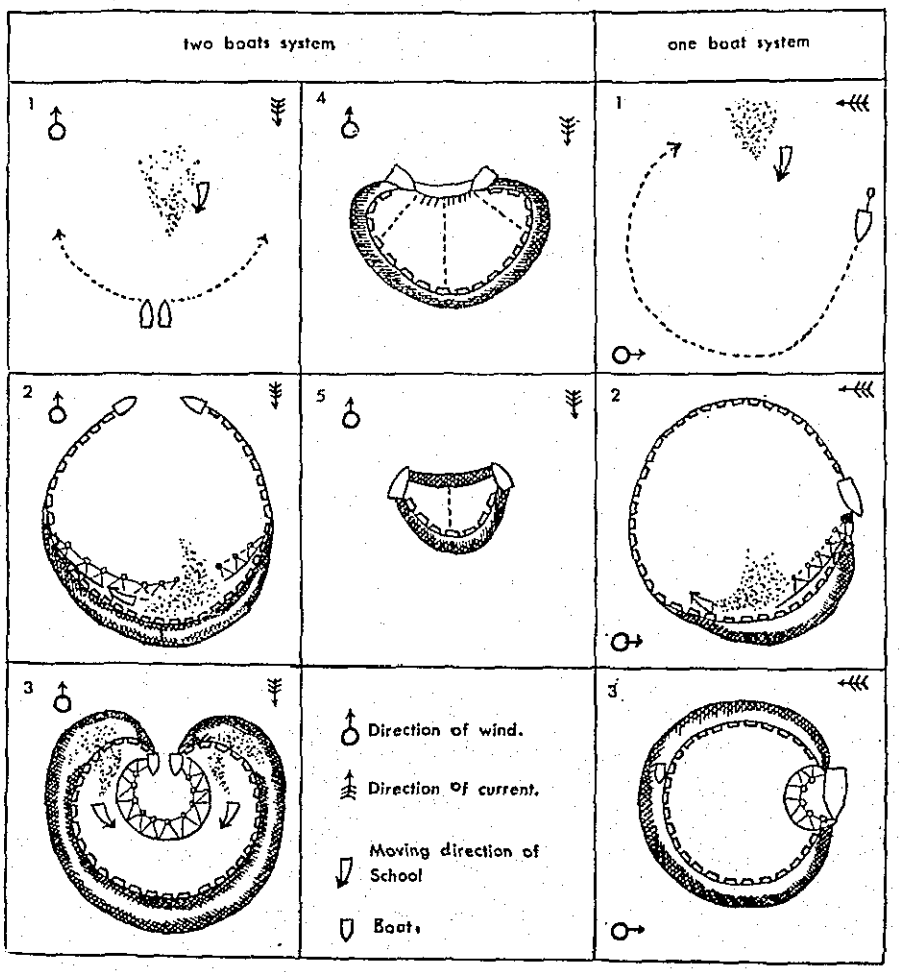


Fig. 9. Structure of Stick-held Dip Net (Pacific Saury)

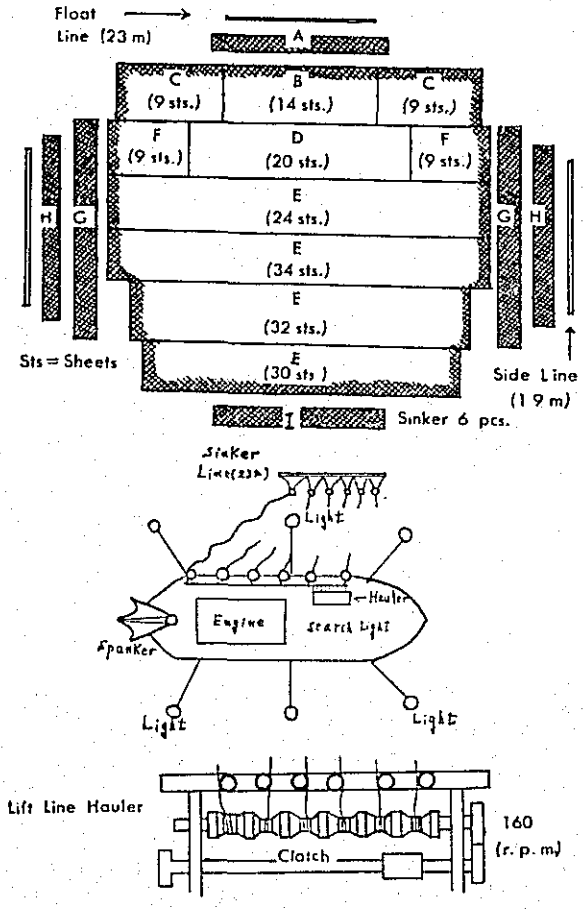


Table 7. Size of Stick-held Dip Net (Pacific Saury)

Item / Name	Mark	Size of thread	No. of Meshes	Size of Mesh (cm)	Length (m)	No. of Sheets	Total Length (m)
Upper Brim	A	12	50	2.75	0.15	16	2.4
End	B	5	100	2.35	7.5	14	105
By-end	C	4	100	2.35	7.5	9× 2	135
Main	D	4	100	2.35	7.5	20	150
Main	E	3	100	2.35	7.5	130	975
Main	F	3	100	2.35	7.5	9× 2	135
Side	G	3	100	2.35	0.75	18× 2	27
Side Brim	H	12	7	2.75	42	1× 2	84
Lower Brim	I	15	50	3.30	0.33	15	5

Remarks:
1. Size of thread is indicated by No. of yarns on one strand.
2. Nets are all woven of No. 20 count thread.
3. Nets are all used Reef Knot.

Fig. 10. Structure of MASU-AMI

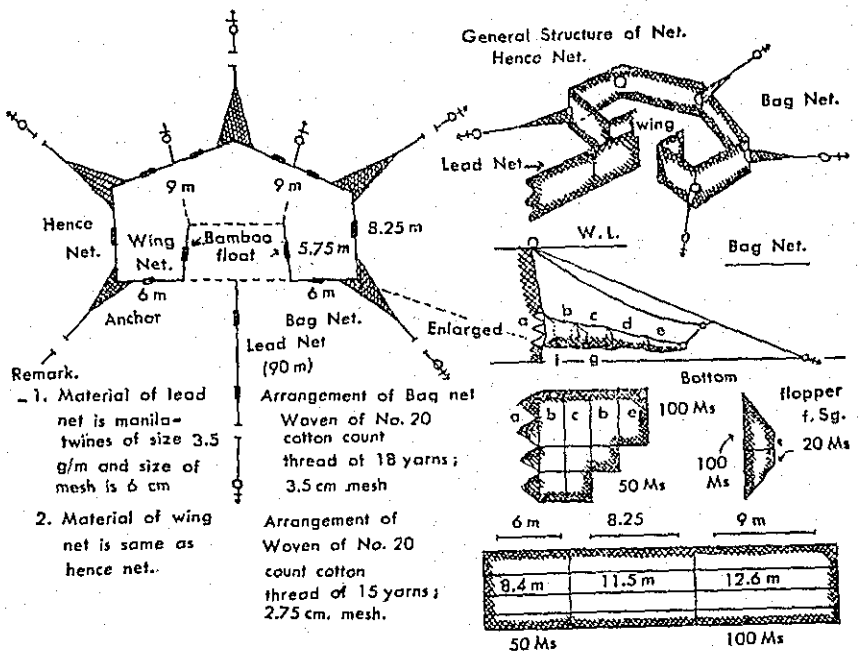
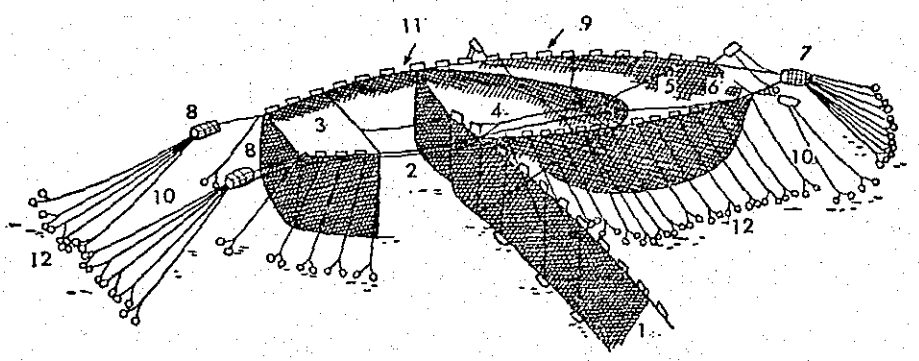


Fig. 11. The Terms of OTOSHI-AMI



1. Kaki-ami (Lead net)
2. Haguchi (Entrance of net)
3. Undoba (Playground)
4. Nobori-ami (Funnel net)
5. Hako-ami (Bag net)
6. Uodori (Landing net)
7. Dai-aba (Float)
8. Yabiki-aba (Float)
9. Gawa-aba (Float)
10. Dohyo-zuna (Sand bag line)
11. Gawa-zuna (Cork line)
12. Dohyo (Sand bag)

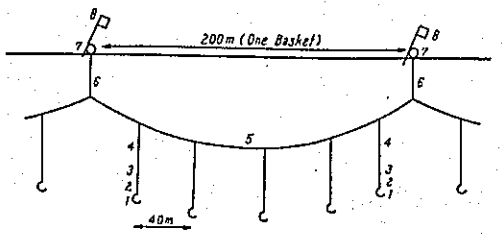
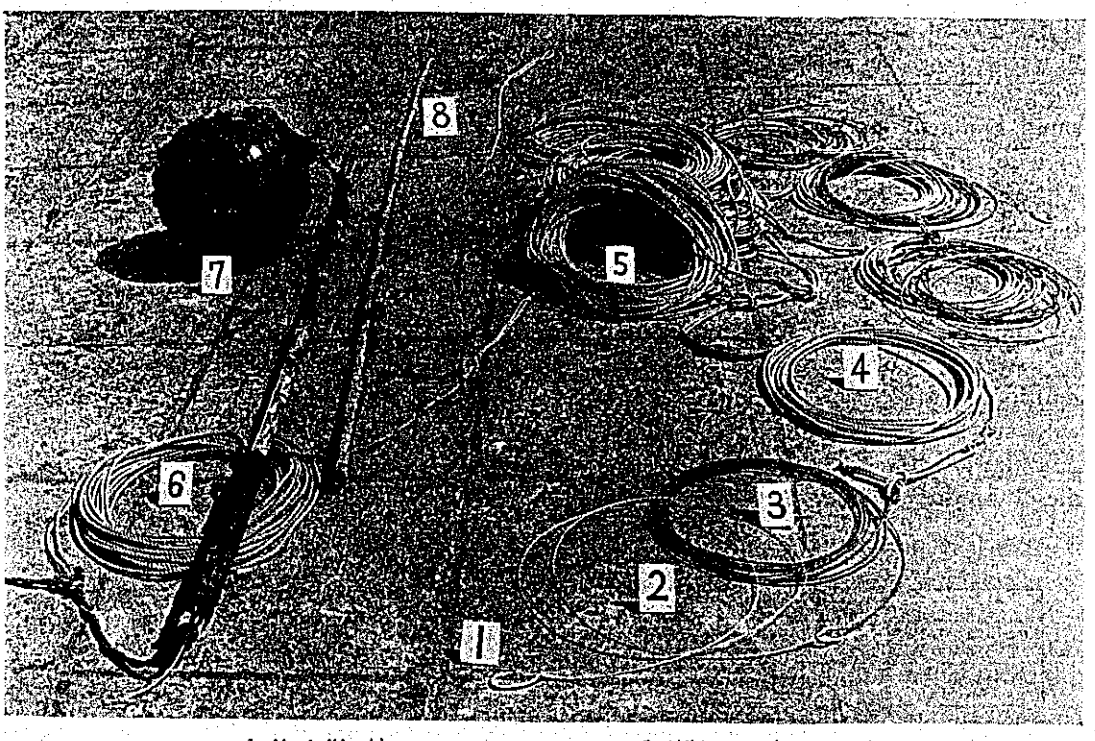


Fig. 12. Tuna Long Line



1 Hari (Hook)
2 Kanayama (Twisted wire)
3 Sekiyama (Coated cotton)
4 Edonawa (Branch line)
5 Mikinawa (Main line)
6 Ukenawa (Buoy line)
7 Bindama (Glass buoy)
8 Bonden (Flag)

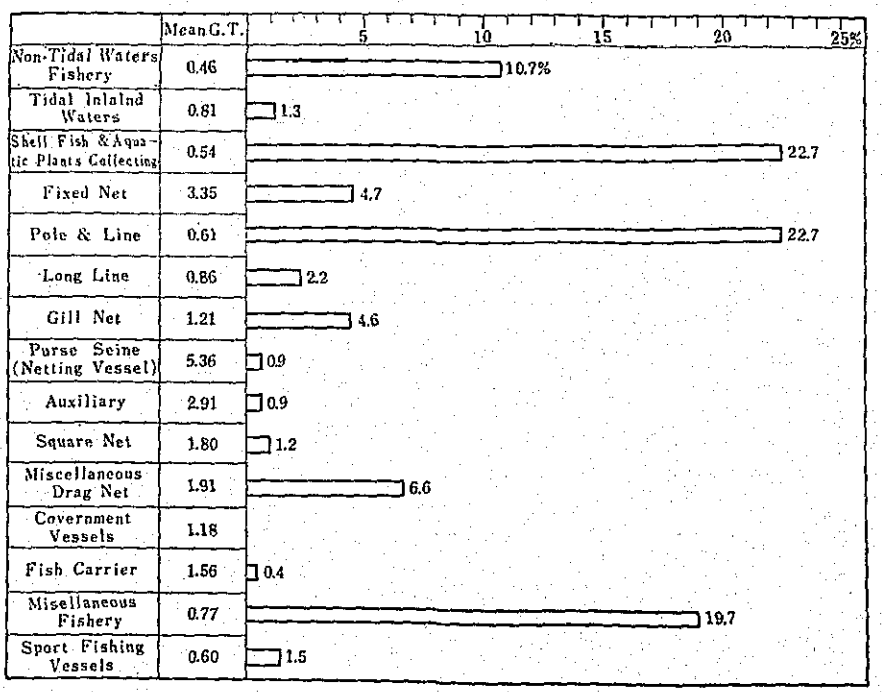
Hauling up a tuna long line

FISHING BOATS

The total Japanese fishing boats at the end of 1956 numbered 398,911 (1,615,505.38 gross tons), but 58.6% of the total consisted of small non-powered boats of average less than one gross ton and the powered ones were only 164,717 (1,391,122.90 gross tons) out of which 84.2% are the small boats of less than five gross tons. Even the powered boats are made of wood to the extent of 99.1%, not to speak of the non-powered ones. Although the percentage of steel ships is very low, the total tonnage thereof constitutes 42.9% of the total tonnage for powered boats and the steel boats average 435 gross tons. In the case of the large boats, steel boats are overwhelmingly great in number, while wooden powered boats are only 22.3 tons on the average.

Among the main engines used for powered fishing boats are electric ignition engine, hot bulb engine, diesel engine, diesel engine attached with supercharger, and steam engine. Electric ignition engines are predominant with 42.3% of the total, followed by hot bulb engines and diesel engines, with 25.8% and 26.9% respectively. Recently hot bulb

Table 1. Non-Powered Fishing Boats



engines are being gradually replaced by diesel engines. This trend is somewhat true of electric ignition engines. Electric ignition engines are used mostly for small boats of less than five gross tons. Hot bulb engines are used for fishing boats of up to 20 gross tons, but those over 70 to 80 gross tons are equipped with diesel engines. In addition, diesel engines attached with superchargers are being used for many of fishing boats due to the recent tendency in the use of large-sized fishing boats. Steam engines are used for special type and old-fashioned fishing boats, and no new ones are equipped with this type of engine.

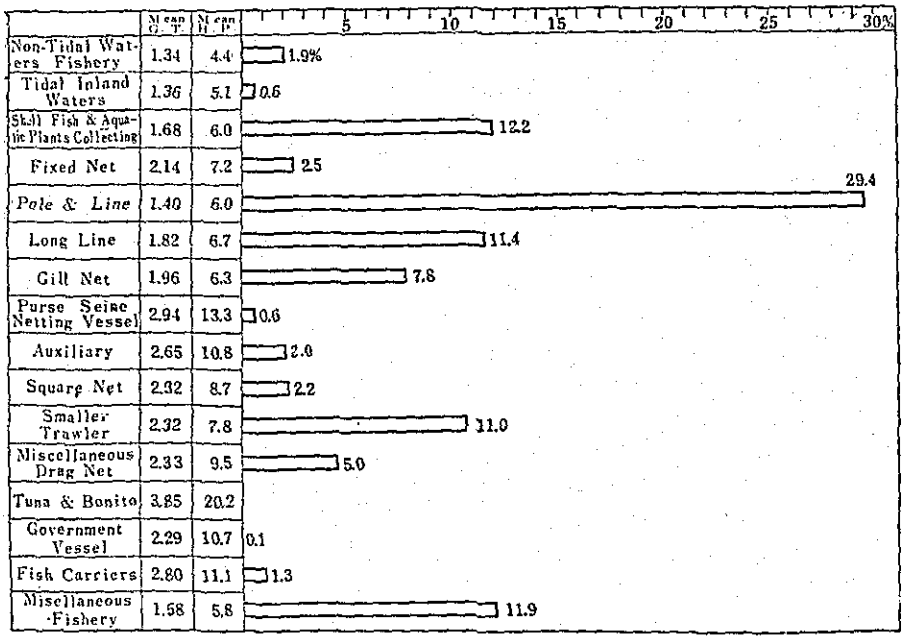
In the cases of coastal and off-shore fisheries, it can be pointed out that non-powered fishing boats are becoming replaced by powered ones year after year and that powered boats are becoming increasingly great in size and in horse power. The tendency is especially noticeable in the pelagic fishing boats, but a steady progress has been made even in the case of small fishing boats. For instance, the electric ignition engines of low efficiency have been replaced by small type diesel engines, or modern apparatus such as radiotelephone set, fish finder, etc. have been installed. Thus constant improvement has been made.

The size of fishing fleet by type of fisheries varies according to the size and grade of fishing boats. The percentage for each type of fisheries by size of fishing boats can be grouped into three categories: non-powered boats, powered boats of less than five gross tons, and powered boats of more than five gross tons, as given in Tables 1–3 (compiled from the data as of the end of the 1958).

As is seen in Table 1, in the case of non-powered fishing boats, those for pole and line fisheries and shell-fish and aquatic plants collecting fisheries rank first in the number with 22.7 per cent each, followed by those for miscellaneous fisheries with 19.7 per cent in non-tidal waters. Fisheries rank fourth with 10.7 per cent, and other types of fisheries are less than five per cent. Most of the fishing boats are one gross ton or thereabout on the average. For instace, the mean tonnage of pole and line fisheries boats is 0.61 gross ton and that of miscellaneous fisheries boats is 0.77 gross ton. The mean tonnage of netting vessels for purse seine fisheries is exceptionally great, averaging 5.36 gross tons, and that of auxiliary vessels for purse seine fisheries and that of fixed net fisheries boats are relatively large, too, with 3 gross tons.

As stated before, most of the powered fishing boats are small-sized wooden ones. The number, average tonnage, and horse power of powered fishing boats vary according to the type of fisheries. As is indicated in Table 2, in the case of powered fishing boats of less than five gross tons,

Table 2. Powered Fishing Boats of Less Than 5 G.T.



Note: The figures on the Antarctic whaling is not shown here because it include those of the mother-boats.

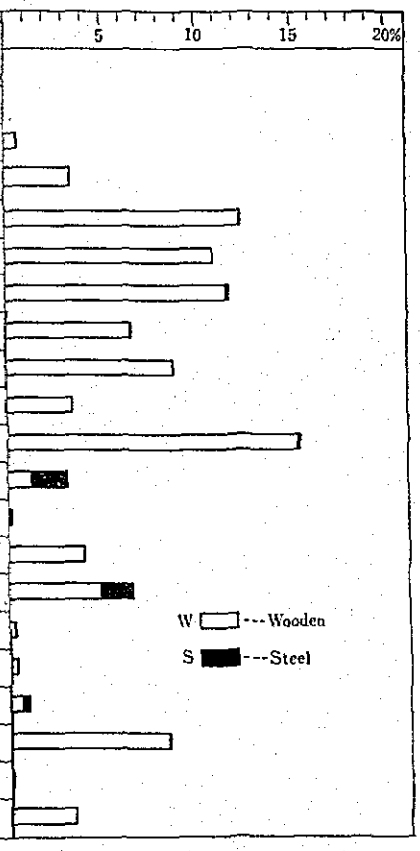
pole and line fisheries boats rank first with 29.4 per cent as is the case with non-powered fishing boats, but the average tonnage is only 1.40 gross tons with the average horse power being as small as 6.0 Fishing boats for shell fish and aquatic plants collecting fisheries rank second with 12.2 per cent, followed by those for miscellaneous fisheries, long line and smaller trawlers with 11.9 per cent, 11.4 per cent and 11.0 per cent, respectively, and fishing boats of other types of fisheries constitute less than 5 per cent of the total. Most of these fishing boats are less than 3 gross tons and 6 to 10 horse power in the average, but the average tuna and bonito boats are 3.85 gross tons and 20.2 horse power.

In the case of powered fishing boats of more than five gross tons, great differences are found between wooden boats and steel ones in number, average tonnage, and average horse power. As given in Table 3, smaller trawlers rank first in number with 15.4 per cent of the total and of them steel boats constitute only 0.2 per cent, but steel boats average 30.98 gross tons with 257.0 horse power whereas the wooden boats average 20.13 gross tons, with 64.4 horse power. The number of pole and line fishing boats ranks

second with 12.4 per cent. Most of those are made of wood and average 16.51 gross tons with 52.9 horse power. Boats for gill net fisheries are third with 11.7 per cent. Fishing boats engaged mostly in coastal fisheries hold a relatively large percentage. Among the group of pelagic fishing boats, tuna and skipjack fishing boats alone are relatively great in number, constituting 6.5 per cent of the total. The percentage of total for steel boat becomes higher in the case of pelagic fishing boats, but medium trawlers west of 130°E made of steel constitute 1.9 per cent, the highest percentage among the steel boats for fisheries of all descriptions, constituting 3.1 per cent. From the viewpoint of the size of fishing boats, in the case of medium trawlers west of 130°E, wooden boats are 68.89 gross tons on the average with 196.5 horse power, while the average tonnage of the steel boats is 87.18 gross tons, with 247.8 horse power, and not great difference in the size

Table 3. Powered Fishing Boats of More Than 5 G.T.

		Mean G.T.	Mean H.P.
Non-Tidal Waters Fishery	S		
	W	8.61	27.0
Tidal Inland Waters	S		
	W	7.72	24.0
Shell-fishd Aquatic Plants Collectig	S	80.01	180.0
	W	13.66	39.0
Fixed Net	S	16.14	48.3
	W	9.37	29.0
Pole & Line	S	143.10	365.4
	W	16.51	52.9
Long Line	S	99.23	244.3
	W	17.95	56.9
Gill Net	S	82.15	275.0
	W	20.52	68.2
Purse Seine (Netting Vessel)	S	95.54	312.4
	W	30.45	107.1
Auxiliary Vessel of Purse Seine	S	35.50	126.4
	W	17.88	58.3
Square Net	S	92.82	210.0
	W	25.78	85.1
Smaller Trawler	S	80.98	257.0
	W	20.13	64.4
Medium Trawler West of 130°E	S	87.18	247.8
	W	68.89	196.5
Otter Trawler	S	413.54	648.0
	W		
Miscellaneous Drag Net	S	19.31	50.0
	W	10.17	36.2
Tuna & Bonito	S	282.41	543.7
	W	74.20	197.2
Coastal Whaling	S	318.01	1356.5
	W	20.34	118.0
Antarctic Whaling	S	594.13	2703.2
	W		
Government Vessel	S	246.23	506.6
	W	31.69	105.9
Fish Carrier	S	466.96	573.8
	W	18.24	55.6
Ref. Fish Carrier & Mother Ship	S	8705.35	4543.3
	W		
Miscellaneous Fishery	S		
	W	12.52	38.1

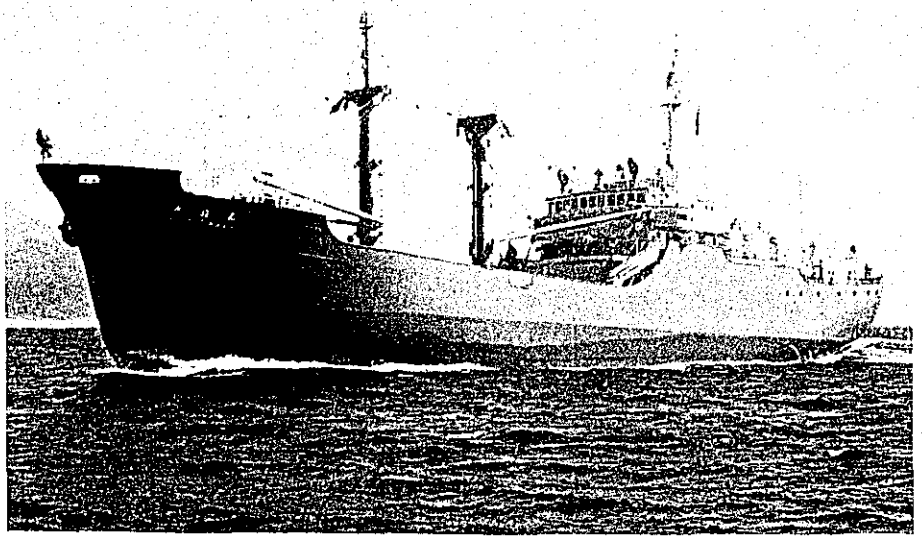


is noticed, but in the case of tuna and skipjack fishing boats, a great difference is found in the average tonnage and horse power between the two types of boats, the wooden ones averaging 74.20 gross tons with 197.2 horse power, while the steel ships average 282.41 gross tons with 543.7 horse power. This fact indicates that tuna and skipjack fishing boats are becoming rapidly larger in size. It is quite natural that trawlers, Antarctic whaling fleet, fish carriers for Antarctic whaling, etc. are all composed of steel boats. The Table 4 shows the representative pelagic type of fishing boats recently constructed, in which The Third Sakae-maru was particularly mentioned because it is the biggest wooden boat constructed after the war, the rest being all steel boats. The Third Sakae-maru is an exceptional one for wooden vessels, since in general the wooden vessels seldom exceed 130 gross tons, beyond which, the wooden vessels are apt to show defects in durability and other respects. Besides, reflecting the straitened timber supply in the country, the shipbuilding costs are getting higher year after year. As a results, fishing boats are shifting from wooden boats to steel ones, while on the other hand, studies of improvement in structure of wooden boats are in progress. Shipbuilding of wooden boats using plywood is now under contemplation.

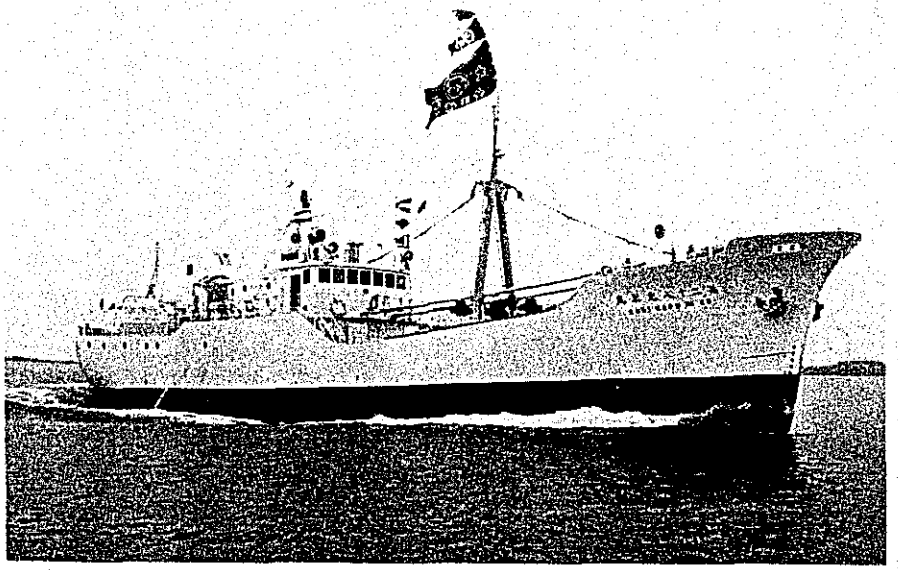
Table 4. Typical Large-Sized Vessels For Pelagic Fisheries

Type of vessel	Name of vessel	Size (length, width, and depth)	Gross tonnage	Horse power of engine	Maximum speeds
		m m m			Kms
Whaling	No. 10 Konan Maru	57×9.7×5.1	734.68	3,280	17.90
Trawler	Asama Maru	64.46×10.5×5.3	993.20	1,200	14.26
Tuna long line	No. 15 Kaiko Maru	56.03×9.3×4.7	817.07	1,200	13.16
Tuna long line	No. 2 Seiju Maru	52.01×9×4.6	693.18	1,150 (attached with supercharger)	12.86
Tuna long line	No. 3 Sakae Maru	33.1×6.62×3.41	235.29	550	11.02
Mothership type *tuna fisheries*	No. 21 Kuroshio Maru	74×12.3×7.5	1,358.27	2,100	14.20

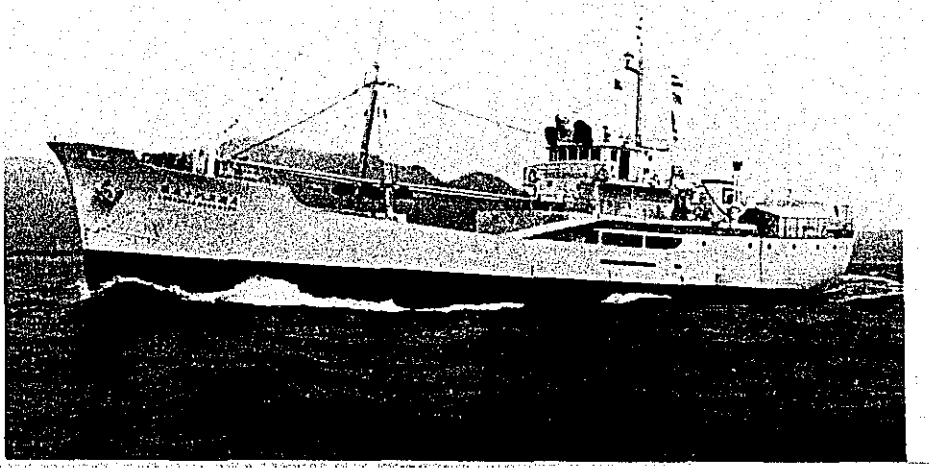
In order to increase the catch and secure safety, improvement in navigation and control of fishing boats, newly-invented instruments of all descriptions are installed to large sized vessels for pelagic fisheries. For instance, there are about 1,000 radar-equipped and 900 loran-equipped boats. In addition, small types of gyrocompasses are attached to fishing boats and automatic steering gears are adopted in order to relieve the crew from their heavy labor on a lengthy voyage.



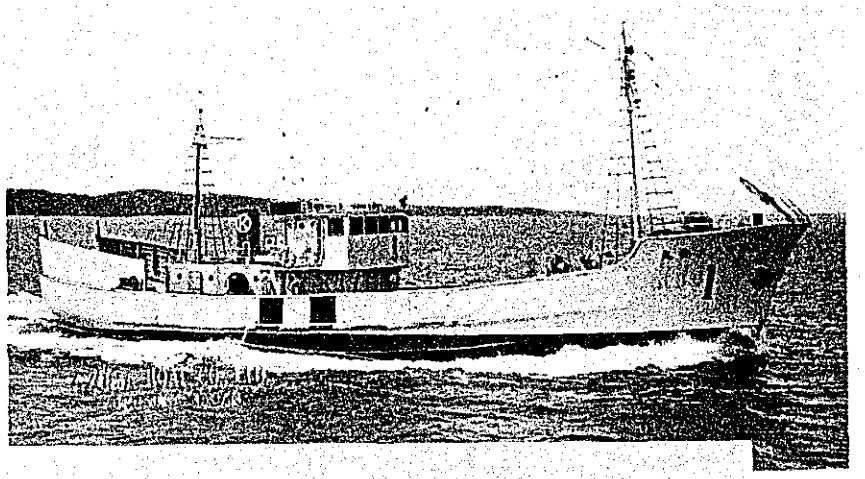
Eio-maru
for tuna long line
fishing



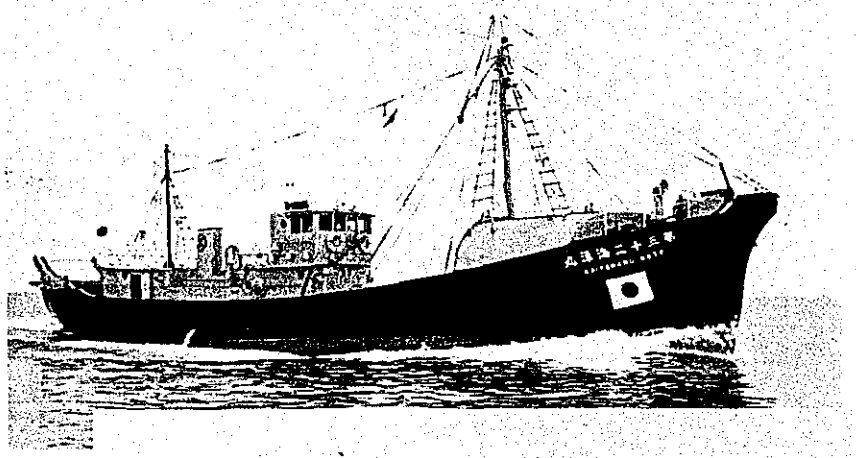
Koei-maru No. 28
for tuna long line fishing



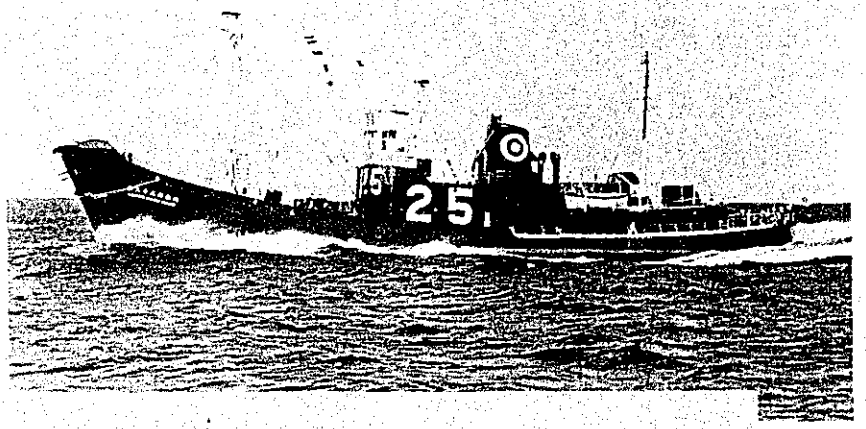
Kuroshio-maru No. 38
for tuna long line
fishing



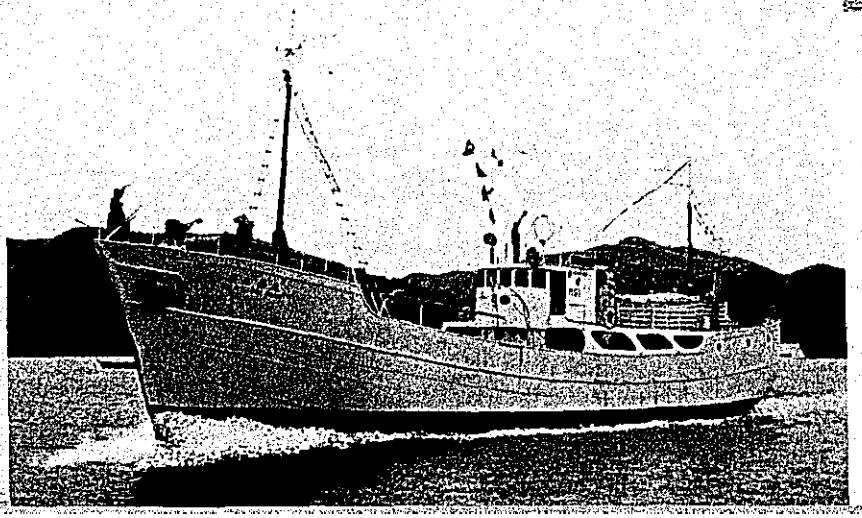
Gill netter,
Daian-maru No. 18



Medium trawler (west of 130°E),
Kaiyo-maru No. 32



Catcher boat,
Konan-maru No. 25



Tuna long line boat (wooden),
No. 3 Sakae-maru

In the case of small-sized fishing boats, sustained efforts have been made also in carrying out improvement. Above all, radio apparatus and radiotelephone sets have been installed widely. With the increase in land radio stations which have been set up with partial government subsidy the number of powered boats of more than five gross tons installed with radio telegraph sets and radiotelephone sets increased constituting 38.4 per cent of the total. Of them radiotelephone sets constitute 26.6 per cent. Thus radio apparatus performs an important role in successful operation of fishing boats.

In the post-war years, fish finders are increasingly put to use. At present, the number of the powered boats equipped with fish finders reaches about 12,000 boats and it is rapidly rising. Fish finders are now used mostly for coral net boats, trawlers, and medium trawlers operating west of 130°E, followed by pole and line, tuna and skipjack fisheries, etc.

In view of the fact that fishing grounds are becoming farther away year after year, research of various devices for heat control within a hatch is now under way. Cork boards have been generally used as heat insulating material, but plastics have recently been brought into trial use. Since it has been proved effective to paint plastic on the surface of lining boards of a hatch, this method has been adopted widely. Out of the total fishing boats of more than 20 gross tons, 13.7 per cent of them are equipped with refrigerators. In the case of pelagic fishing boats of more than 100 gross tons, the number of fishing boats equipped with refrigerators constitutes as high as 69.2 per cent. Ammonia, freon, etc. are used as refrigerants. High speed and multi-cylinder refrigerators have come into use recently. Thus the efficiency of refrigerators will further be promoted.

For smaller fishing boats, there is nothing particular except fish finders as equipment for fish-catching, but in the case of larger-size pelagic fishing boats, a variable pitch propeller is equipped in order that a boat may be operated more efficiently at the time of fish-catching. The power source within a boat is converted into alternating current or a boat is equipped with belt conveyor for easing long-line stretching operation.

INLAND WATER FISHERIES AND CULTURE INDUSTRY

Of the total area, 36,900,000 *chobu* (1 *chobu* = 2.45 acres) of Japan, 4.9% (1,790,000 *chobu*) consists of rivers, lakes, etc. out of which 980,000 *chobu* can be utilized for fish culture, but actually being utilized for culture is 820,000 *chobu*. However, some of the lakes, like Saroma Lake, Notoro Lake, Abashiri Lake, Furen Lake, Atsukeshi Lake in Hokkaido, Hamana Lake in Shizuoka Prefecture, Kamo Lake in Niigata Prefecture, and Chukai Lake on the border of Shimane and Tottori prefectures, etc. are brackish waters lakes, with higher productivity than the inland waters. In the inland water yield statistics made in 1952 and 1953, the catches in the above lakes are excluded, because of the different survey system taken at the time by the Ministry of Agriculture and Forestry. Since it was difficult to include and adjust the statistics for these years in this article, the writer did not attempt to change the figures. However, statistics came to include Abashiri and Notoro Lakes after 1957.

Japan lies from north (46 degrees, north latitude) to south (26 degrees, north latitude), with the backbone ranges of mountains so that there are various kinds of inland water. Most of the rivers run rapidly. Generally speaking the rivers and lakes are small in sizes, some are rich in dietary value, some poor, some are cold water, and some warm. The River Tone covers the widest area, 15,760 square kilometers, and the River Shinano is the longest river, 369 kilometers long. Lake Biwa, with 675 square kilometers is the biggest. Lake Mashu is the most transparent lake in the world, with 41.6 meters transparency. Lake Tasawa is the fourth with 30.0 meters, the 5th, Lake Inawashiro, with 27.5 meters, the 7th, Lake Ikeda (26.8 meters), the 8th, Lake Shikotsu (25.0 meters), and the 11th, Lake Kuttara (24.3 meters).

Most of the rivers are stopped up with embankments for various purposes; hydraulic generation, irrigation, mining and industrial uses, prevention of tidal water, etc. So that in a way the rivers look as if they are a flight of stairs with a succession of reservoirs and embankments. The pools for irrigation purpose number more than 277,000, according to the recent research, and water pooled amounts to 2,150,000 cubic meters, irrigating more than 1,112,000 *chobu*.

Because of the pollution, these waters are less fit for fish culture. The water from mines and factories, sewage from urban areas, use of chemical fertilizer and highly toxic agricultural chemicals are polluting the inland waters everywhere. There is no adequate legislation to deal with the situation and the general public are indifferent to the problem,

so that it is difficul to solve this problem immediately. Together with the advance in the scientific study, legislation suitable to cope with the situation will have to be established so that the fisheries resources will be protected.

Table 1. Production on Inland Water (*t*)

Year	Fisheries Catch (Excl. Weeds)	Cultured Products (Edible)	Total
1949	37,729.8	3,890.2	41,620.0
1950	63,270.7	5,573.2	68,843.9
1951	60,775.1	6,487.5	67,262.6
1952	53,489.2	9,284.2	62,773.4
1953	57,436.8	8,734.1	66,170.9
1954	82,494.3	9,034.8	91,529.1
1955	82,877.6	11,650.8	94,528.4
1956	90,931.8	13,491.7	104,423.5
1957	81,344.6	14,030.6	95,375.2
1958	78,234.4	15,358.7	93,593.1

Of the ponds, lakes, pools, etc. 41,249,400 *tsubo* was utilized for fish culture in 1958, amounting to 15,358.7 tons of edible products. Besides the above, there is 499,800 *tsubo* of waters surface utilized for gold fish and crap (not edible). Also 14,428,800 *tsubo* is exclusively for fish culture.

The produce from the inland waters utilized for fisheries and culture industry is shown in Table 1.

Fisheries on the Inland Waters

Most of the fisheries on the inland water is carried out on the water for public purposes, within the bound of the related legislation such as Fisheries Act, Fisheries Resources Protection Law, etc. The fisheries cooperative associations or their federations are authorized to be jointly engaged in the fisheries by the prefectural governors only when the waters are fit for the increased production of fisheries animals and vegetables and only when the entrepreneurs aim at increasing these products. At present except a few areas, the authorization is given for most of the areas. The degree of government control varies. In some cases only the members of the cooperative associations are exclusively engaged in the fisheries, or in others only a particular type of fishing gear and method is allowed, or in others any one can operate freely.

There are very few people who are engaged in the inland water fisheries on full time basis, most of them being the farmers and foresters, and they operate only for a certain period of time a year.

As of the year 1958, the number of fisheries cooperative associations was 924, with the total membership of 494,265. The function of these associations is limited to the control of the fishing area and the propagation, and most of the economic activities are left with the agricultural cooperatives. Besides the full-time members there are some who pay in

the dues to those associations so that they can fish for recreation.

Fisheries rights are granted the fisheries cooperative associations or their federations, which had applied to the governor of the prefecture inadvance, when they are found qualified, within the bound of prefectural fisheries program set up for the overall use of the water and development of the fisheries productivity.

Various methods are taken for the inland water fishing: from simple angling, spearing, to a big and complicated one shutting off the rivers, etc. The cormorant fishing on the River Nagara is almost an art, and on the River Naka, Ibaragi Pref., a special net is used to fish the salmon there. The simpler type of fishing can be operated individually, but as the scale grows larger, the joint type is adopted.

Table 2. Inland Water Fisheries: The Amount of Catch (t)

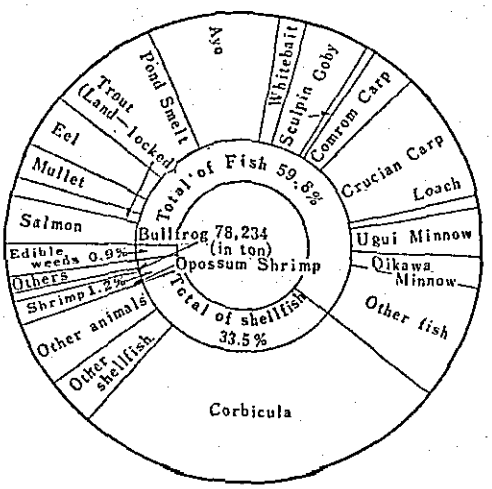
Year	Total Catch	Animal				Weeds
		Total	Fishes	Shell-fishes	Others	
1941	73,012					
1942	74,062					
1943	66,900					
1944	73,537					
1945	59,400					
1946	44,775					
1947	49,087					
1948	37,687					
1949	37,729	31,837	20,962	9,337	1,538	5,892
1950	63,270	40,462	25,987	11,737	2,738	22,808
1951	60,775	38,137	23,850	11,925	2,362	22,638
1952	53,489	41,737	26,212	13,312	2,213	11,752
1953	57,436	45,262	28,237	14,625	2,400	12,174
1954	82,494	51,825	34,687	14,062	3,076	30,669
1955	82,877	58,237	40,575	14,025	3,637	24,640
1956	90,931	66,787	46,762	16,125	3,900	24,144
1957	81,344	79,537	49,687	24,187	5,663	1,807
1958	78,234	77,544	46,773	26,194	4,577	690

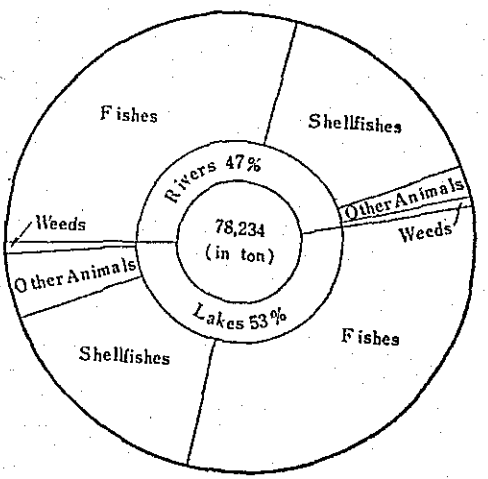
As is seen in the above table, the Figures in 1958 showed: 99.1 per cent for the animals and 0.9 per cent for the weeds. Out of the animals, fishes hold 60.3 per cent, shell-fish, 33.8 per cent, and others, 5.9 per cent. The areal breakdown showed: rivers, 47.3 per cent, and lakes and ponds, 52.7 per cent. Of the inland water animals, 47.1 per cent was taken from the rivers and 52.9 per cent from lakes and ponds. The weeds breakdown showed 75.1 per cent from the rivers and 24.9 per cent from the lakes and ponds.

Most of the animals and vegetables are natural ones, but some of the operators instal nests for the fishes (carp, wild gold-fish, pond smelt, etc.), or prepare the bottom of the river for the fish to lay eggs (salmon, trout, *ayu*, *ugui* minnow, etc.) for encouraging propagation, or releasing seeds (trout, eel, *ayu*, carp, wild gold-fish, corbicula edible frogs, etc.)

Table 3. Catch By Kinds of Fishes (t)

Name of Fishes	Total Catch	‰	Rivers	Lakes
Grand Total	78,234	1,000	37,034	41,200
Total of Fish	46,773	598	22,949	23,824
Salmon	2,368	30	41	0
Trout(Land-locked)	863	11	10	5
Mullet	1,601	20	16	0
Eel	2,801	36	40	20
Pond Smelt	5,761	73	2	128
Ayu	6,761	86	126	10
Whitebait	1,119	14	2	22
Goby	3,437	44	6	90
Sculpin	269	3	5	0
Surt Smelt	20	0	0	2
Common Carp	2,152	27	39	25
Crucian Carp	8,727	115	75	130
Loach	393	4	13	6
Ugui Minnow	2,353	30	37	5
Oikawa Minnow	1,409	18	17	0
Other fish	6,874	87	91	103
Total of shellfish	26,194	335	12,481	13,713
Corbicula	23,901	305	70	218
Other shellfishes	2,293	30	9	75
Other animals	4,577	58	1,086	3,491
Shrimp	943	12	3	31
Opossum Shrimp	2,477	32	0	41
Bullfrog	146	1	0	1
Others	1,011	13	12	5
Total of Weeds	690	9	518	192
Edible weeds	690	9	15	2
Non-edible	0	0	15	623





Culture on the Inland Waters

The culture industry on inland water can be divided into two types:

one on the water for public use, based on the areal fisheries rights and the others, privately owned hatchery, etc.

As was previously described, the joint fisheries rights are granted by the governors for the use of the public inland water, and another one, the areal fisheries rights which permit the exclusive use of a certain area for the culture of fish, shellfish and weeds and are granted by the same procedures as those for the joint fisheries rights. However, since the areal fisheries rights are granted only when special conditions are filled, there are not many whose applications were passed.

The culture industry on the privately owned ponds, etc. need not be controlled by the fisheries regulations, and it is intensively operated, by individuals or by private firms.

These two types of culture industry produce edible fishes and their eggs, snapping turtle, gold fish and carp (not edible), etc.

The production in the past 8 years is shown in Table 4. The surface utilized for culture is the actual surface on which the culture was conductd, and the production amount includes those for home consumption and also those sold to the markets.

The yield of the inland water culture include paddy fild culture during 1941–1958 is as follows:

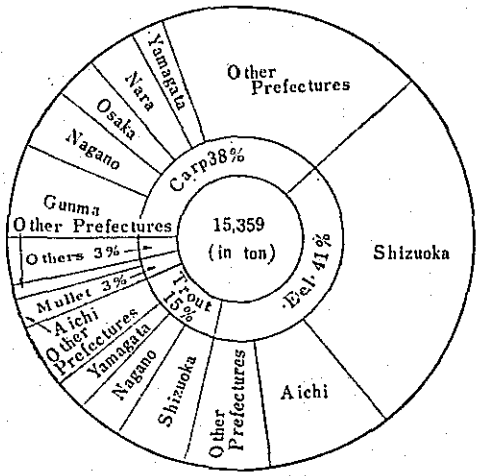
	Total yield (t)	Carp	Eel	Mullet
1941	261,093	14,193	12,397	
1942	236,666	12,060	8,441	
1943	295,890	15,948	6,761	
1944	187,196	13,406	1,350	
1945	129,948	7,593	468	
1946	86,036	3,480	150	
1947	116,171	1,601	127	
1948	90,258	2,362	161	543
1949	3,889	2,898	168	585
1950	5,571	4,140	337	738
1951	6,487	4,619	1,005	574
1952	9,284	6,003	2,260	701
1953	8,734	5,227	2,459	354
1954	9,034	4,511	3,139	528
1955	11,656	6,224	3,642	562
1956	13,491	6,256	4,902	554
1957	14,522	6,224	5,688	456
1958	15,820	6,275	6,276	413

Table 4. Yield of Inland Water Culture

		Area used for culture (1,000 *tsubo*)	Yield (t)			Area used for culture (1,000 *tsubo*)	Yield (t)
Total (Edible)	1951	64,223.2	4,934,6	Mullet	1951	4,390.9	574.9
	1952	60,495.3	8,108.3		1952	6,752.5	701.3
	1953	61,565.6	7,738.5		1953	4,125.5	354.4
	1954	36,401.3	8,224.9		1954	4,165.4	528.0
	1955	45,489.8	10,939.1		1955	4,066.0	562.5
	1956	41,957.5	12,870.0		1956	5,563.3	554.6
	1957	42,007.4	14,030.6		1957	309.4	456.0
	1958	41,249.4	15,358.7		1958	45.4	413.8
Common carp (Include crucian carp)	1951	23,409.2	3,071.6	Loach and Minnow	1951	22,087.2	112.1
	1952	26,341.7	4,834.1		1952	10,399.2	75.3
	1953	27,599.0	4,236.4		1953	11,812.6	237.7
	1954	20,274.0	3,701.6		1954	5,023.0	192.7
	1955	25,641.7	5,512.9		1955	6,476.2	268.8
	1956	21,881.2	5,645.6		1956	4,935.8	122.2
	1957	1,579.5	5,746.9		1957	—	—
	1958	1,305.9	5,829.2		1958	—	—
Eel	1951	9,530.4	1,005.8	Snapping turtle	1951	22.9	7.1
	1952	12,161.2	2,260.5		1952	29.9	12.0
	1953	9,713.4	2,459.3		1953	52.5	6.0
	1954	6,292.1	3,139.1		1954	24.8	5.6
	1955	7,815.5	3,642.4		1955	25.5	7.5
	1956	8,612.4	4,902.4		1956	8.1	10.1
	1957	3,047.7	5,688.0		1957	19.9	12.4
	1958	2,927.7	6,276.5		1958	20.8	10.6
Trout	1951	4,365.9	105.0	Bullfrog	1951	189.3	29.6
	1952	4,357.2	166.1		1952	56.1	21.3
	1953	7,883.0	380.3		1953	3.9	26.6
	1954	274.4	615.4		1954	1.7	3.0
	1955	1,079.1	894.4		1955	151.1	1.1
	1956	422.8	1,566.8		1956	13.2	0.7
	1957	187.5	1,786.9		1957	0.2	9.4
	1958	170.7	2,364.1		1958	—	7.9
						(1,000 number of fish)	
Ayu	1951	227.4	28.5	Goldfish including coloured carp	1951	216.8	26,992.0
	1952	397.4	37.5		1952	221.0	22,717.0
	1953	375.6	38.6		1953	264.2	55,200.6
	1954	345.7	38.3		1954	295.6	35,111.1
	1955	234.4	48.4		1955	330.1	49,072.7
	1956	520.3	66.4		1956	403.5	53,769.2
	1957	18.4	78.4		1957	476.4	
	1958	22.4	98.9		1958	499.8	85,799

Notes: 1) The total area for culture includes culture in ponds, culture by fishery rights, and culture in reservoirs.
2) The area for culture by species of fish for 1957 and 1958 is that for culture in ponds.
3) 1 *tsubo*—3.3 m²

The prefectural yield of inland water culture (edible ones) by major kinds of fish during 1958 is as follows:



As is seen in Table 4, the water surface utilized for the culture has gradually decreased while the yield per unit of surface has gradually increased, because of the change to more intensive method of culture. The tendency is especially noticeable in the culture of eels, trout and *ayu* partly because the entrepreneurs dealing in the culture of them are the full-time ones, or at least the culture industry to them is the main occupation.

Table 5. Paddy Field

	Total				Common			
	Edible				Edible			
	No. of Farmhouses	No. of Employees	Area for Culture (1,000*tsubo*)	Yield (t)	No. of Farmhouses	No. of Employees	Area for Culture (1,000*tsubo*)	Yield (t)
1949	—	—	27,685.5	938.6	—	—	27,393.9	918.4
1950	—	—	26,723.7	1,248.4	—	—	26,570.4	1,238.2
1951	—	—	26,458.5	1,552.9	—	—	26,411.1	1,547.6
1952	—	—	23,269.8	1,176.0	—	—	23,110.2	1,169.6
1953	—	—	21,371.1	995.6	—	—	21,220.2	990.7
1954	98,211	104,352	20,160.0	810.0	98,153	104,290	20,151.3	810.0
1955	93,647	97,008	19,911.0	717.5	93,484	96,845	19,886.4	711.7
1956	85,382	88,051	18,606.4	621.4	—	—	18,373.6	610.9
1957	97,160	—	20,032.0	492.0	97,022	—	19,970.0	477.7
1958	86,472	—	14,428.0	461.9	86,370	—	14,410.0	446.2

As the economic and social conditions stabilized, there has been more demand for the gold-fish, colored carp, etc., the culture of which having already adopted intensified method, so that the increase in the yield means in this case the increase in the surface of water utilized.

Culture of Fish in the Paddy Fields

In Japan where the agriculture, especially the rice paddy field is intensively developed, many paddy fields are also raising the vegetables and fishes such as carp, wild gold-fish, loach, etc. Nagano, Niigata, Tochigi, Gifu, Miyazaki, Yamanashi, Yamagata Prefectures are the main producing areas, mostly of carp. The sliding terrain (easier to pour in and drain out water), far from the sea, is suitable for the purpose.

Table 5 is the recent statistics on the paddy-field fish culture.

The oldest record on the paddy field fish culture in Japan dates back to the middle of the 19th century, and even before that time it must have been universally practiced all over Japan. Since the end of the 19th century, however, there were more people who went in for the paddy field fish culture, especially after the breakout of W. W. II. Because of the fishing on the sea was curtailed, there was sudden interest in the industry as an important source of animal protein. After the war, the food situation gradually improved so that the farmers are losing interest in the paddy field fish culture. Besides, because of the use of chemical fertilizers and powerful agricultural chemicals, the paddy field is getting unfit for the culture and the industry is declining.

Fish Culture

Carp				Others			
Fish Seed							
No. of Farmhouses	No. of Employees	Area for Culture (1,000 *tsubo*)	Yield (1,000 piece)	No. of Farmhouses	No. of Employees	Area for Culture (1,000 *tsubo*)	Yield (t)
—	—	1,493.4	80,216.5	—	—	291.6	20.2
—	—	2,416.8	149,038.5	—	—	153.3	10.2
—	—	2,536.5	73,016.0	—	—	47.4	5.3
—	—	2,541.9	22,802.0	—	—	159.6	6.4
—	—	2,277.0	23,670.0	—	—	150.9	4.9
13,553	13,734	3,081.0	22,450.7	58	62	8.3	0
16,319	17,288	3,803.9	17,392.8	163	163	24.6	5.8
—	—	6,814.3	13,983.3	—	—	232.8	10.5
—	—	—	19,381.0	138	—	58.4	14.3
—	—	—	26,754.0	102	—	18.0	15.7

However, in some geographically favorable area, the rice raising is going alongside of fish culture, suggesting the possibility for future development depending upon the guidance and dissemination activities. The production at present is from 112 to 750 kilograms for one *chobu* of paddy field, and experiments proved that fish culture not only does not harm the vegetables raised alongside of rice, but also favorable effects on it.

Major Animals Produced By Inland Water Culture

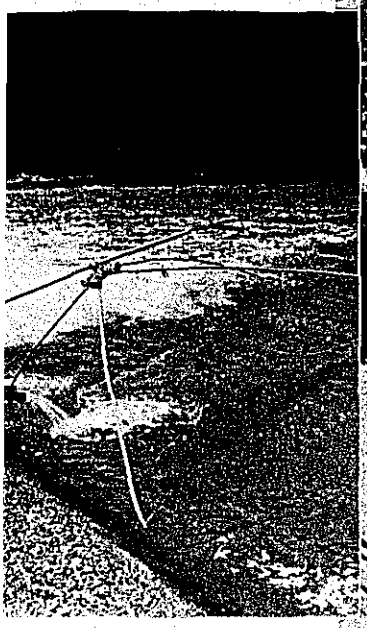
The following are the major animals produced on the inland water in Japan.

Common carp	(Cyprinus carpio)
Wild gold-fish	(Carrasius auratus)
Eel	(Anguilla japonica)
Salmons	(Oncorhynchus heta, O. gorbusha, O. masou)
Trouts	(Salmo gardneri, Salvelinus fontinalis)
Ayu	(Plecoglossus altivelis)
Mullet	(Mugil cephalus)
Gold-fish	(*Carassius auratus, var.*)
Other species of fish	
Snapping turtle	(Amyda japonica)
Bullfrog	(Rana catesbiana)

Carp: Carp are cultured most frequently in Japan. In order to be supplied as food, carp must be cultured at least for two years after they were hatched. Carp are cultured in reservoirs, running water pools, or in paddy rice fields. Carp are fed with silkworm pupae, mysis, wheat-bran, rice-bran, etc. Quantity of feeds for carp varies according to the type of carp culture. For example, carp in reservoirs are fed on natural foods, while in the case of running water carp culture, artificial feeds are given by night and day during seven or eight months. In the case of running water carp culture, carp are harvested 700 kilograms per *tsubo* (3.3 sq. ms.) for six months. Such intensive carp culture techniques are peculiar to Japan. Running water carp culture has been carried on by fish-culturists for money making, but not for scientific experiments. Seed fish are supplied by culturists themselves, but not collected from natural waters.

Wild gold-fish: Wild gold-fish are sometimes cultured in pools, but very few in number as compared with carp cultured in pools.

Eel: Elvers (young larva eels weigh about 30 grams) are caught in the spring when they migrate up the rivers from sea and placed in ponds and fed with such inferior fish as sardines, herring, akta mackerels, in addition to silk-worm pupae until autumn. By and by young eels are marketed. This is the most popular eel culture method. Eels are cultured for half a year to three according to the culture method. It is considered



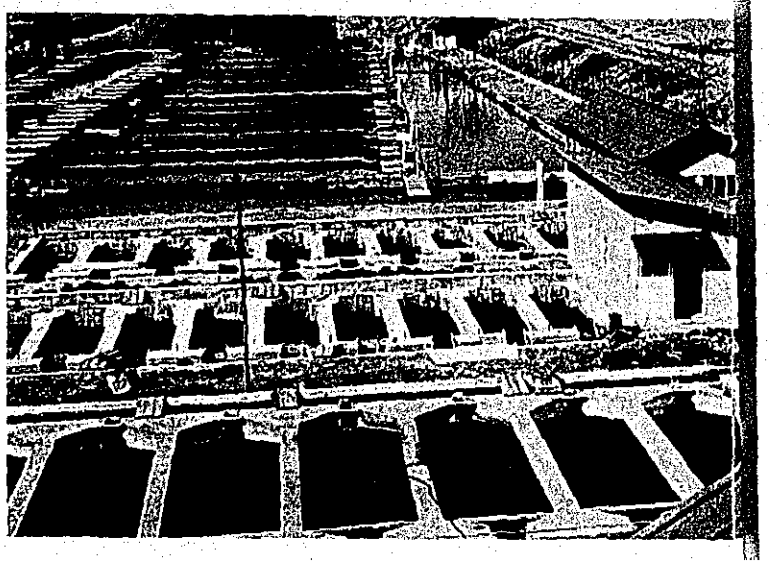
Catching of young Ayu

Young Ayu caught

Catching of edible tuna

Feeding of eels

National hatchery at Nikko



Ponds for trout culture at the Fisheries Experiment Station, Nagano Pref.

that, from various points of view, a small-scale eel pond-culture is disadvantageous. It is reported that an individual eel culture in a pond of less than one hectare does not pay. In addition, the optimum quantity of phytoplanktons growing in the water has close connection with the appetite of the eel. In view of this, "to obtain water containing optimum quantity of phytoplanktons" is virtually a key to the success in eel culture.

Salmon: The usual kinds of salmon found in Japan are *Oncorhynchus keta*, *O. gorbusha*, and *O. masou*. Hokkaido ranks the top in the amount of the yield, next Tohoku District. The eggs are spawn in the rivers, and hatched larva go to the sea, to grow up there, and after 2–5 years, migrate up the rivers again to spawn and die. The grown up fish is 60 to 100 cm. long, and catching of salmon is limited by the law and prefectural fisheries adjustment regulations so that natural propagation of salmon will be encouraged. Artificial hatching and releasing larvae in the streams are being practiced. In Hokkaido there are 55 national hatcheries, and in the prefectures in Tohoku District, nearly 80 prefectural hatcheries or those run by the fisheries cooperative associations are being operated, hatching about 400,000,000 eggs and releasing the larvae.

Trout: Among trout species cultured in pools in Japan are two species: rainbow trout and brook trout. The culture method used in Japan is almost similar to that prevailing in European and American countries. As trout culture farms in Japan are generally far from the coast, fresh fish are seldom fed to trouts. In Japan, rainbow and brook trouts are generally fed on silkworm pupae, mysis, rice-bran, or wheat-bran. Rainbow trouts fed on such feeds are refrigerated and exported to foreign countries. Considering that expenses for feeds constitute 60 to 80 per cent of the total costs, it may be concluded that feeds supplied to trouts are by no means inferior to those in other countries. The export of frozen rainbow trout has increased rapidly recently. In 1955 it was 323 tons, $ 252,988, but in 1958, it jumped to 958 tons, $ 791,936, and it is mainly exported to the U.S.

Ayu: *Ayu* is the most favored fish in Japan but rather expensive. The season is limited to four or five summer months a year. *Ayu* living in the rivers feed on such microbes as diatoms and blue-green algae which grow on the surface of gravels lying at the river bottom. Fish culturists in Japan met with great success in concerting *Ayu* into a cultured species. Young *Ayu* (each weighs about 1 gram) collected in early spring in the estuaries near the mouths of rivers are placed in running water pools and fed liberally for several months to grow up to 70 grams and then marketed.

Silkworm pupae, mysis, wheat-bran, or sometimes fresh fish are fed to *Ayu*, as in the case of trouts. But these feeds must be pulverized and made into dumplings with the use of starch. *Ayu* are not so common in Japan as carp. The production of *Ayu* is less than one per cent of the carp production, but due to the high price it would fetch, *Ayu* culture is expected to develop increasingly.

Mullet: Mullet are generally cultured together with eels. Young mullet migrating up the rivers are enticed into pools and fed together with other fish until autumn. Mullet are cultured generally in brackish water and seldom in pure fresh-water. No artificial feed is given to mullet. Mullet seem to feed on residue of feeds given to other fish. Upon reaching the maturity (some 200 grams in weight) they are marketed.

Gold-fish: Techniques of gold-fish culture is peculiar to Japan. Japan has a long history of gold-fish culture. Gold-fish has no food value at all, but its culture is very closely connected with the Japanese daily life. The method of gold-fish culture is similar to that of carp culture in pools, but efforts are being made by culturists constantly to find novel species or to maintain excellent breeds. Gold-fish are exported and serve to earn foreign currency.

Snapping turtle: Snapping turtle culture has been practised on a very small scale. This is cheifly due to the fact that snapping turtles must be reared at least four years before marketing. After approaching the maturity (500 grams in weight) turtles can be shipped to the market. Snapping turtles feed on fresh shrimp, crab, earthworm, or entrails of fish.

Bullfrog: Bullfrogs were imported to Japan about 1917 from the US and were bred and cultured in frog culture farms until 1941. Bullfrog culture ceased with the outbreak of W. W. II. The Japanese do not take to eating frogs, and during the war the bullfrogs were not exported, so that they increased in number. After the war, with the resumption of trade, these naturally raised bullfrogs came to be collected and exported. At present, parent bullfrogs are cultured to have eggs hatched. The tadpoles are fed until the end of their transformation stage. After that they are placed in the natural water. Only the leg part of bullfrogs is frozen, wrapped and exported. However, the peak year was 1957, with 407 tons, $923,723 exported, and bull-frogs became more scarce due to indiscriminate catching. Production of edible frogs is on the decline, and consequently, their exports are decreasing.

CULTURE IN SHALLOW SEA WATERS

The days when people thought the fisheries resources were inexhaustible are the thing of the past, and for some time the fishermen who constitute the great majority of the Japanese fisheries entrepreneurs are having a difficult time. Especially the trend is now for the bigger fishing boats and with the development in mining and industry the production per unit of effort decreased suddenly, and the fishing grounds are diminishing because of the pollution due to the water from factories, agricultural chemicals, and reclamation of land, etc. The fishing grounds for pelagic type of fishing are getting smaller also because of the international limitation. How to change to new occupations is getting a serious problem for these fishermen. Administrative measures on the control of pollution of water is being examined, but the solution of the problems on this point needs vast capital, effort and time.

What might be the answer to the above problems is the shallow sea culture industry, which tries to utilize the fishing grounds to the utmost, maximizing the production per unit of fishing grounds by artificially controlling the propagation of fishes, shellfishes, sea-weeds, etc.

There are several stages of development seen in the technique used for these culture industries. The big three culture industries in Japan are those of pearls, oyster and laver, and the skills needed for these three types of culture are very much advanced. These industries are the most universal, important, and well established ones in Japan.

Besides the above, there are other types of culture practiced in Japan, not so well established as an industry, but carried on only on a small and local scale, operated by the members of the families as a sideline, and not so much artificially controlled as in the above three types. This type of culture is being encouraged with powerful administrative measures and considerable expenses. This type of culture is distinguished from the above types of culture in the sense that it cannot be fully controlled by men and it is more of supplementary nature to stabilize the fishermen's economy, rather than a full-time occupation.

The following are the more general ones belonging to this type of culture.

Oyster Culture

There are several kinds of oysters in Japan, and those industrially important include *magaki* and *suminoegaki*, a variant of *magaki*. *Magaki* is found

all over the country, but *suminoegaki*, in the Ariake Sea, Nagasaki Prefecture.

The culture of oyster was started in Hiroshima Prefecture around 1675 and spread to other areas. It is the most important of shellfish cultures. There are two types of oyster farming, that is, the production of seed oysters and the raising of seed oysters. The production of seed oysters is limited to Miyagi, Hiroshima and Kumamoto Prefectures and most of the culturists combine the seed oyster production with the culture of oysters.

The oyster farming is being operated by about 8,400 entrepreneural units. Of these, nearly 4,300 units depend more than 50 per cent upon oyster culture for their revenues, while the others are engaged in agriculture, pearl culture, the raising of laver, or coastal fisheries at the same time. In any cases, they are mostly on a small scale.

There are three different culture methods: hanging, stick and sowing. Classification of entrepreneural units by methods is given in Table 1:

Table 1. Management Units of Oyster Culturists

Year	Real No. of Management Units				Total No. of Management Units					
	Total	Raising of seed *oysters* only	Culture of edible *oysters* only	*Both* seed oysters & edible *oysters*	Total	Hanging Culture			*Stick* culture	*Sowing* culture
						Raft type	Long-rope type	Simple hanging type		
1953	7,834	—	—	—	7,581	4,006		2,033	369	1,173
1954	7,118	—	—	—	7,118	3,481		1,808	664	1,165
1955	7,488	198	5,351	1,939	7,290	3,371	211	2,188	194	1,326
1956	7,345	167	5,044	2,134	7,178	3,567	374	2,026	122	1,089
1957	7,529	186	6,323	1,020	8,214	3,646	793	2,620	120	1,035
1958	8,478	324	6,930	1,224	8,755	3,599	818	2,875	284	1,179

(1) Sowing type of culture is practised all over the world. In Japan, seed oysters are "sown" on the sandy ground screened off with bamboo mats. But this method is old, not ensuring high productivity (about 300 grams of shucked oyster per square meter) and therefore it is not practised much today. Only *suminoegaki* is being raised by this method in the Ariake Sea because it suits the ground there (4 kg of shucked oyster per square meter).

(2) In the stick type of culture, seed oysters which are grown on bamboo sticks or stones are not scraped off, but these bamboo sticks and stones are collected together in one place so as to handle them easily. This method is also practised widely in the Ariake Sea (0.6 to 4.2 kg yield per square meter).

(3) The above two methods are suitable for unexplored ground and operations are economical, but the yield is relatively small. The hanging

type utilizes the oyster-farm three-dimensionally, thus raising productivity per unit of ground. This method was devised because the culture ground was getting crowded due to the development of the culture industry. It is mostly practised in Japan at present. The hanging type can be divided into three systems.

a) Raft system: This method was devised in 1924, and is practiced in the sea more than 12 feet deep. The sizes of rafts differ depending upon the ground, but mostly about 18×30 (feet), and buoys and anchors are attached to the rafts. About 150 ropes or wires 10–20 feet long studded with 15–20 shells (called collectors) are hung from the rafts. In this way the seeds are better exposed to the current and can get more feed, so that they grow up fast. The yield per raft is 470–560 kg (without shells).

b) Simpler hanging type: It is practiced in the sea less than 10 feet deep. First, stakes are driven into the ground and then the poles and bamboos are tied to them to make a frame about 6 feet wide, 60–180 feet long. When the frame is 180 feet long, 700–1,000 ropes or wires 5–6 feet long with 7–10 collectors are hung, from which there is about 560–750 kg of oyster (without shells) yield. Compared with the raft system, this needs less material, can weather rough seas better, the only defect being it is practicable only in the area where the depth of the sea is adequate for this type of culture. In Miyagi and Hiroshima Prefectures this method is prevalent.

c) Long rope system is practiced in offshore ground, where it is deeper than the sea where the raft system is practiced. This method can weather the rough seas best of all. Drums are floated on the sea, and between the drums about 240 feet long main thick rope is stretched. To the main rope about 240 straw ropes, to which about 25 collectors are hung, are attached. One unit yields 450–560 kg of oysters (without shells). This is practised in Miyagi Prefecture, but less frequently now.

The yield of oysters is shown in Table 2. From Sanriku area (Miyagi, Iwate Prefectures as the center) the oyster is shipped to Tokyo market and from the Inland Sea area, Hiroshima and Okayama Prefectures as its center, it is shipped to Kyoto, Osaka and Kobe area. The oyster produced in Ariake sea, Saga and Nagasaki Prefectures as its center, is shipped to the northern Kyushu industrial area. All are without shells, packed in barrels. Recently the oyster in oil is exported overseas in great quantity.

About 60–70 per cent of seed oyster for domestic use and more than 99 per cent of the seed oyster for export use is produced in Matsushima Bay, Miyagi Prefecture. Although some are produced in Ariake Sea and

Table 2. Production of Oysters

(Unit: tons)

Year & Area	Yield (without shells)
1954	13,556
1955	14,422
1956	16,725
1957	18,649
1958	20,051 (100%)
Iwate	1,642
Miyagi	3,570
Total of Sanriku District	5,212 (26%)
Okayama	315
Hiroshima	9,699
Total of Inland Sea	10,014 (50%)
Fukuoka	32
Saga	1,067
Nagasaki	111
Kumamoto	47
Total of Ariake Sea	1,257 (6%)
Others	3,568 (18%)

Hiroshima Prefecture, it is not much, enough to supply the local need only.

In the example of Miyagi Prefecture, the seeds are collected, as follows: From the middle of July to the beginning of August, the oyster lay eggs, and after 14–15 days the eggs begin to live their own lives attached to some shells. The 50–60 shells of scallop, oyster or abalone, are strung to 5-feet long wire, and the wire is hung from the frame installed in the sea most suitable for collecting the seeds. About 20–25 baby oysters per one shell are usually attached. If the baby oysters are left alone the shells get too big, so that they are removed to shallower sea with firmer bottom at the end of August or in the beginning of September, exposed to the sun, wind and waves, not soaked in the water all the time. The seed oysters are sold between December of that year and March next year. The seed oysters for export go through strict examination, and are exported after being classified into two classes, broken and unbroken. During the voyage, the cases are left on the deck, and sea water is sprinkled on them from time to time. If broken, there must be more than 16,000 baby oysters per box, and if unbroken, more than 12,000, according to the

regulation. The recent situation of the export of seed oyster is as in Table 3.

Table 3. Export of Seed Oyster

Year	Unbroken (case)	Broken (case)	Total (case)	Price per case
1952	17,720	54,291	72,011	un. $3.00 bro. 4.00
1953	11,124	H 1,500 54,334	66,958	un. 3.50 bro. 4.00
1954	6,174	47,164	53,788	un. 3.70 bro. 4.81
1955	25,715	26,619	52,534	un. 3.40 bro. 4.30
1956	14,821	84,971	100,619	un. 4.50 bro. 5.20
1957	12,309	47,308	59,617	un. 4.70 bro. 5.40
1958	11,425	48,023	59,448	un. 6.50 bro. 7.00

Laver Culture

Laver is a food peculiar in Japan, made from *amanori* or *aonori*, seaweed which is artificially raised, picked, and spread into a shape and dried.

The Japanese favored seaweed as food from old, and *nori* has been inseparable from their diet, and its culture has been practiced for a long time. It is very nutritious, especially rich in vitamin A. Table 4 compares the nutritious value of *nori*.

The origin of culture of *nori* is not clearly known. But it has been proved that already around 1670 in Tokyo Bay it was artificially raised on bamboo mats, so that it must have been started earlier than that. In the muddy bottom of the shallow sea the rough bamboo sticks (or oak boughs, after stripping leaves) were stuck, and let them bear the spores of *nori*. This is called perpendicular style and is still practiced.

Around 1915, however, biological study on *nori* was made, so that germinating and raising of *nori* can be conducted rationally. As a result the horizontal type of culture method was devised, increasing the production greatly.

There are about 61,606 management units of various culturists, as much as 99.7 per cent of which are individual entrepreneurs. *Nori* growers constitute 81.5 per cent of those engaged in the shallow sea culture. It takes wide sea area (57 per cent of the total area where shellfishes or weeds are cultured), and production is unusually high (¥13,000 million). The culturing techniques are highly developed.

Table 5 shows the trends of *nori* growers, and thriving lines of business register sharp rises in the number of growers. The *nori* season lasts from September through March, and therefore fishermen or farmers can engage

Table 4. Nutritious Value

Commodity	Water (g)	Protein (g)	Fat (g)	Carbohydrate		Ash (g)	(Ca) (mg)
				Sugar	Dextrose		
Purple laver							
Best quality	11.4	35.6	0.7	39.6	4.7	8.0	260
Common quality	11.1	34.2	0.7	40.5	4.8	8.7	470
Lower quality	13.4	29.0	0.6	39.1	7.0	10.9	510
Hen's egg							
Whole	75.0	12.7	11.2	—	0	1.1	65
Yolk	49.5	16.1	32.5	—	0	1.9	150
Butter, Salted	15.9	0.6	81.2	0.2	0	2.1	10

Note: Each item in 100 gram.

in growing *nori* in their off-season.

Table 5. Management Units of Nori Growers

Year	Total	Seed collecting	Culture	Both seed collecting and culture
1954	48,555	—	—	—
1955	51,425	19	47,341	4,065
1956	53,509	25	50,519	2,965
1957	56,077	47	51,758	4,272
1958	61,606	50	58,156	3,400

Nori culture is being practised in five major *nori*-culture areas: mostly along the coastal area of Sanriku district, off Miyagi and Iwate Prefectures, along Tokyo Bay, off Chiba, Tokyo ,and Kanagawa Prefectures, Mikawa Bay, off Aichi and Mie Prefectures, Inland Sea, off Hiroshima and Okayama Prefectures, and the Ariake Sea, off Kumamoto, Fukuoka, Saga and Nagasaki Prefectures. Especially a sudden increase in the production from the Ariake Sea has become noticeable. Table 6 shows the production in these areas.

The method of *nori* culture: When the temperature of sea water gets lower in September and October, the spores are let loose, which are caught by the bamboo screens, nets, etc. From the end of October to the middle of November, these are transferred to the culture area. The sea-weed is

of *Nori*

(P) (mg)	Fe (mg)	Vitamin					Refuse	Remark
		A (I. U.)	B_1 (mg)	B_2 (mg)	Niacin (mg)	C (mg)		
510	12	44,500	0.25	1.24	10.0	20	0	
380	23	38,400	0.21	1.00	--	20	0	
280	36	20,400	0.12	0.89	--	20	0	
230	2.6	800	0.10	0.30	0.1	0	11	
570	6.3	2,000	0.25	0.30	0	0	0	
20	0.1	2,400	0.01	0.03	0	0	0	Nacl 2.0%

Table 6. Nori Production

(Unit: 1,000 pieces)

Year & Place of production	Yield
1954	1,628,439
1955	1,689,511
1956	2,170,793
1957	1,458,337
1958	2,091,320 (100%)
Iwate	19,730
Miyagi	188,213
Total of Sanriku District	207,943 (10.0%)
Chiba	639,065
Tokyo	189,945
Kanagawa	9,857
Total of Tokyo Bay	838,867 (40.1%)
Aichi	321,502
Mie	125,127
Total of Mikawa Bay	446,629 (21.3%)
Ehime	56,465
Hiroshima	22,001
Yamaguchi	18,464
Total of Inland Sea	96,930 (4.6%)
Fukuoka	143,290
Kumamoto	117,357
Nagasaki	10,537
Total of Ariake Sea	271,184 (13.0%)
Others	229,767 (11.0%)

picked from as early as the end of November in some areas, but usually the first picking is started during December, reaching its peak in January, ending March-April. As the sea-weed grows, *nori* is picked from three to five times. When *nori* leaves grow to 3–5 inches they are picked, cut, and spread on the mats, in exactly the same method as the Japanese paper and dried in the sun. The producers' price per piece of *nori* is around 6.5 yen. From perpendicular type of culture, 15–20 pieces of *nori* is taken per stick, and from horizontal type, 1,500–3,000 pieces per net.

Shell-fish Culture

Clam Culture

This is practiced in the inland seas, bays, all over Japan. One is a rough method, just sowing the seeds, and the others is a more intensive type, sowing more seeds per unit of area, artificially controlling the culture. The former method is practiced when the culture is operated jointly, and the latter, by individuals who have their own culture grounds. In the intensive method, 0.3–0.4 gallon of seeds are sown per $1m^2$ yielding 0.6–0.8 gallon of shell-fish after 1–2 years. Care is taken so that the starfish which is the enemy to the clam will not attack them. Also the culturists see to it that the shells do not lie too closely together, and die.

Mogai Culture

This shellfish is rather expensive and can be raised in the muddy bottom where it is not fit to raise clam, so that the culture is being practiced extensively in Okayama, Hiroshima, Fukuoka, Saga Prefectures, etc. The seeds, 0.6–2.0 mm long, are transferred to the culture area, at the rate of 0.4–0.7 gallon per $1m^2$ and after a year or two, average 0.8–1.0 gallon are yielded. The seeds must be farmed, just like oyster seeds, by hanging type of culture, using collectors (straw or palm), since there is very few natural ones.

Konbu (Kelp) and *Wakame* Culture

The kelp is produced mainly from Hokkaido, is expensive, and the culturists rely on it very heavily as their source of income. The kelp is attached to the rock in the sea, and reach maturity after two years. The kelp which reached one year old can grow up even after being washed off from the rock by the waves, if it had its root left, so that some culturists developed a rotation system for the maximum use of the culture area.

More positive method of increasing the yield is to throw the rocks and stones into the sea so that it would be easier for kelp to find something to attach themselves to, or the rocks which are exposed in the air are blown up by explosives, to let them lie in the bottom of the sea to help kelp grow. Recently the spores of kelp is artificially sown to the collectors, as in the case of oyster culture, but this method is not as yet extensively practiced.

The kelp is dried, eaten as food, and the inferior one is used industrially as raw material for iodine, potassium, alegine acid, etc. Before the war, kelp was greatly exported to China, but after W. W. II, the export has stopped. *Wakame* is produced in the Inland Sea and all over Japan, is a food, and similar method to increase its production as in the case of kelp is being planned.

Gelidium Cartilagineum Culture

The seaweed is used for making agar-agar, is found all over Japan, but especially in the Izu islands, Shizuoka Prefecture, and Chiba Prefecture. It fetches a high price, and is under the complete control of the fisheries cooperative associations everywhere, and there is strict regulation as to the period of harvesting, and the period when the harvest is prohibited. The members abide by these regulations and sell their harvest jointly through the associations. Because picking is profitable and it is easy to pick even by a woman, it is the most paying occupation as family labor. The weed is picked during May-September, and sold at around ¥200 to ¥300 per kg (dry weight).

The weed is bleached in water, boiled, and melted, gelled, frozen and gets dehydrated to turn into agar-agar, which is an important export item. The same methods are taken, as in the case of kelp, to increase the yield, such as throwing stones and rocks into the sea, surface rock being exploded, harmful weeds eliminated, etc.

Others

Besides the above, the seeds of scallop and abalone, etc. are transplanted, and useful seaweeds such as gloispeltis furcata, *ogonori* and prawn and fishes are being encouraged, but not on too extensive a scale.

The Encouragement of the Industry

The above is an outline of the shallow sea culture industry. Most of the types of this industry is practiced by poor fishermen. In order to stabilize their economy, national and prefectural subsidies are given so

that the industry will get sufficient encouragement. Such spendings amounting to 500,000,000 to 600,000,000 *yen* a year, are made on the following businesses:

1. Control of Protected Water Surface

In order to increase the production of clam, abalone, *mogai*, scallop, etc., it is important to secure great quantities of seeds. All over Japan there are 12 natural seed farms directly controlled by the prefectural offices prohibiting the general public to catch the shellfish, and is being resorting to more positive measures to increase production of seeds shells planned.

2. Improvement of Fishing Areas

The bay water is nutritiously enriched because many rivers flow in there but sometimes there is too much food, the putrefaction of which causing carbon hydrogen. Some of the sea bottoms are too firm, or too ragged. Water tight bulldozers are operated in these areas to eliminate superfluous nutritious particles, breaking up and levelling up the bottom etc. Also where the bottom is too soft, sand, earth, etc. are thrown in to get it firmer, so that it would be fit for the sea-shells to live in. At present about 20 water tight bulldozers are being operated.

3. Water Route Making

In the shallow sea where the current does not run smoothly, the productivity is poor, so that the bulldozers or dredges are worked to make the water route. This method is specially effective in the case of *nori* culture.

4. Scraping the Rocks

When the harmful weeds such as lime seaweed adheres to the rocks, the useful weeds cannot grow, therefore when the rocks lie between the lines of ebb and high tide, it is scraped off, but when the sea is 3–10 meters deep, the divers dive in wearing the diving suit, and using the cutter driven by the engine in the boat, scrape it off. When the weeds are big, the hook is used from the boat, or sometimes they are exploded off.

5. Blowing up Rocks

The rocks which are exposed upon the sea surface and which do not serve for the production of useful weeds are blown up, so that it will be submerged under the water for the weeds to attach themselves to.

6. Throwing in the Rocks

Where the sea bottom is sandy, the stones are thrown in so that it would be easier for the seaweeds to get adhered to them. About 500–600 kg per square meter of stones are thrown in where they will not be buried in the sand and at the time the spores of the useful seaweeds are released.

Considering the low amount of expenses needed for this operation, it is very effective, so that it is practiced widely.

7. Installing Shelves for Fishes

It has been known from old many fishes are caught in the sea where there is a sunken vessel. This is because the fish like the shady place, and because shell-fishes and seaweeds are attached to the sunken vessel, thus providing rich source of food to the fish. The useless ships, full of stones, lumber, bran, etc. are submerged so that the sea nearby will furnish a useful fishing ground, but the wooden vessels get rotten in about three years, so that about 1 cubic meter metal box, hollow inside, with windows open, are made, and about 100 of them are submerged in one place, to make a permanent fishing area. This is practiced in many areas.

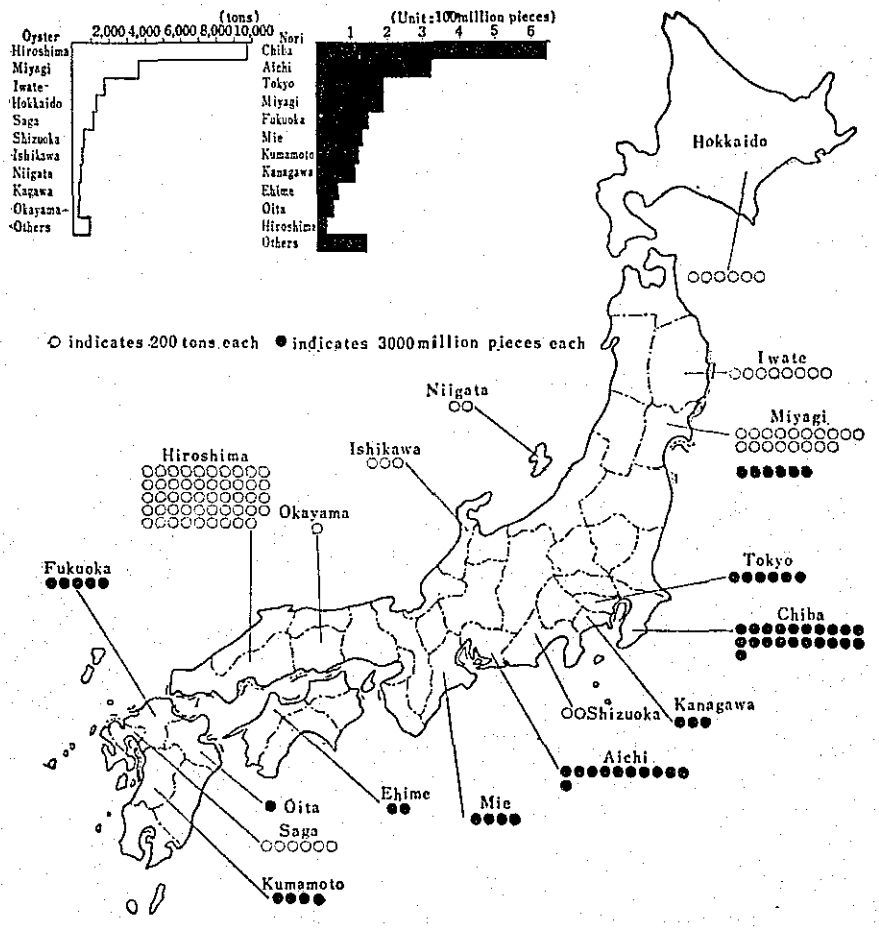
8. Artificial Farming of *Nori*

There are only a few places which can furnish excellent seeds of *nori*, so that it is not easy to increase the production. The biological status of *nori* has been made clear recently so that it is now known that the spores get into a shell-fish, live on conchoceries, and when the water temperature gets around 22° C, let out the spores. Taking advantage of this nature, artificial seeding is carried on. The boiled and disinfected oyster shells are spread in the bottom of tanks around February-March, and the grown-up *nori* leaves are scattered on top of them. The spores get inside the shell, and keeping the temperature of water from going up too high in summer, the conchoceries are let develop. When the water temperature becomes fit for the culture, the conchoceries are let to release the spores in a short time of 10–30 minutes, and the spored sticks are transferred to the culture field or the seashells in which the conchoceries entered are let hung from the net, release the spores so that the seeds can be produced artificially as planned. At present there are some technical difficulties, but the per unit productivity is very great, 120 per cent to 200 per cent of the seeds naturally collected, and the quality is superior, and much more development along this line in the future is expected.

9. Building Up *Nori* Field

Besides the fact that *nori* culture has expanded greatly in recent years, the culture ground is getting scarce because of draining out the shallow sea, reclamation, pollution because of the water from the factories, and more offshore area is being utilized, but such an area is very windy, and the waves are high, and the culture sticks are easy to break, not to mention the fact because of the distance from the mouths of rivers, there is less

nutritious salt, etc. On this kind of sea, the concrete stakes are driven into the bottom of the sea at 0.5–0.9 meters interval for 100 meters long, to ward off the rough waves, and the water of the rivers is sidetracked to this area to furnish nutrition, so that a new *nori* culture area with high productivity will be built up.



PEARL CULTURE

Characteristics of Pearl Culture

Japanese pearl culture is a unique industry in the world, also an unusual one among the shallow-sea, non-tidal water culture industries in Japan. The reasons for its uniqueness are:

1) While the other culture industries aim at supplying of food, the pearl culture is for furnishing jewelry, even more superior in shape and quality than natural pearls. They are not intended for the domestic consumption, but 98% of the production is exported to many countries.
2) Besides the technique necessary to control the sea-shells, same as in other fields of culture, the skill, somewhat like grafting in surgery, is needed to insert the kernels in the shells (*pinctada martensii*), which are found only in the seas surrounding Japan.
3) The period necessary to get the pearls differs depending upon the sizes of the pearls, but usually it takes from one to four years and the period necessary in getting the mother shells included, it takes 4 to 7 years altogether. Recently the shells are not scattered but are hung from rafts in the sea. Also the shells are moved around from one area to another, according to factory production system, and precaution is taken to safeguard them against the natural disasters.

Outline of History of Pearl Culture in Japan

About 70 years have past since Mr. Kokichi Mikimoto originated the culture of semi-spherical pearls, and 50 years since Mr. Tokichi Nishikawa invented the method of spherical pearl culture. Constant effort was made during this time in improving the culture skill and much progress has been recorded in all the phases of pearl culture. The progress can be divided into the following stages.

1) Period of Natural Pearls, 1840–1893

During this period, the shells naturally containing pearls were collected, then transplanted in one place, and the pearls which were formed in these shells were collected.

2) Semi-spherical Pearl Culture, 1894-1925

During this period, the semi-spherical or 3/4 spherical kernel were inserted between the shells and the mantle, and left in the sea until they were covered with pearly substance.

3) Spherical Pearl Culture, after 1926

In 1912, late Mr. Tokichi Nishikawa invented the method of getting spherical pearls, and patented it. After 1920, the method came to be shared with others, and the skill developed rapidly. From then on the culture period was shortened, the sizes of pearls got bigger, and the quality was much improved.

The Kinds of Cultured Pearls

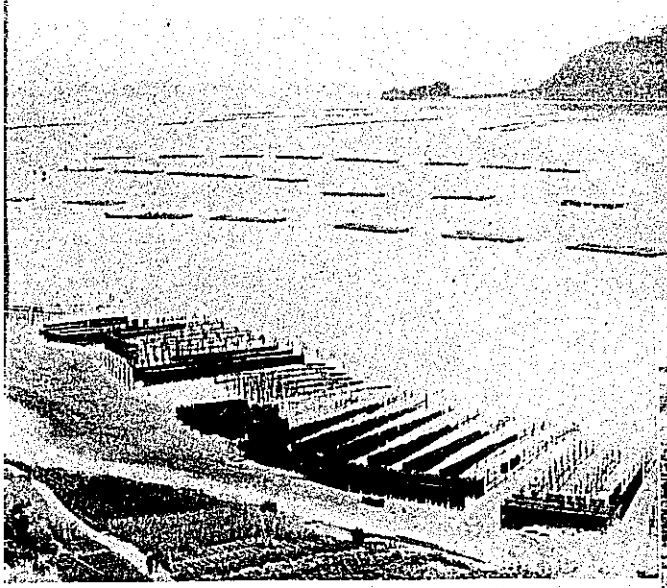
The following kinds of shells are used in Japan on an industrial basis each having its own feature, but *Pinctada martensii* kind is the most predominant (99.8% of the total weight).

Sea shells	*Pinctada martensii*
	Pteria macroptera
	Pinctada margaritifera
Fresh water shell	*Hyriopsis schlegeri*

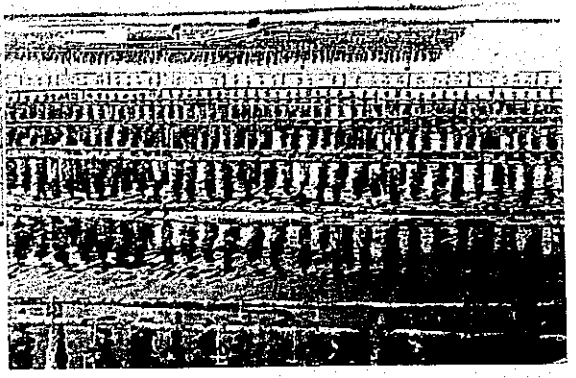
The *pinctada martensii* is found west of the line which connects Chiba and Ishikawa Prefectures, and Mie Prefecture has been famous for pearl culture, but it is carried on also in Nagasaki, Kochi, Wakayama and Ehime Prefectures, numbering 22 Prefectures altogether. Only Fukuoka, Tottori, Okayama and Osaka Prefectures are the exceptions to this rule. The prefectural governments went in strongly encouraging the pearl culture industry, giving fund or guidance through the Fisheries Experimental Stations, in order to help the impoverished coastal fishing industry or to develop hitherto unutilized sea surface. In the non-tidal waters, too, the pearl culture is practiced, as in Lake Biwa, Shiga Prefecture, using *hyriopsis schlegeri*, without using the kernels. Although still in the experimental stage yet, in Inbanuma, Chiba Pref., Kasumigaura, Ibaragi Pref. (using *cristaria plitica spatiosa*), and Hokkaido (using *unio margaritiferus*) are carrying on pearl culture. Based on the services contract, in the Melgie Islands, Burma, and the Augustus Island, Western Australia, the Japanese technicians are carrying on the spherical and semi-spherical *pinctada maxima* pearl culture. Also in Hongkong, success is being achieved in experimenting on the semi-spherical pearl culture using *pteria penguin*. Indonesia and the Philippines are about to start the similar experiment.

Pearl oyster culture

Oyster farm Hiroshima



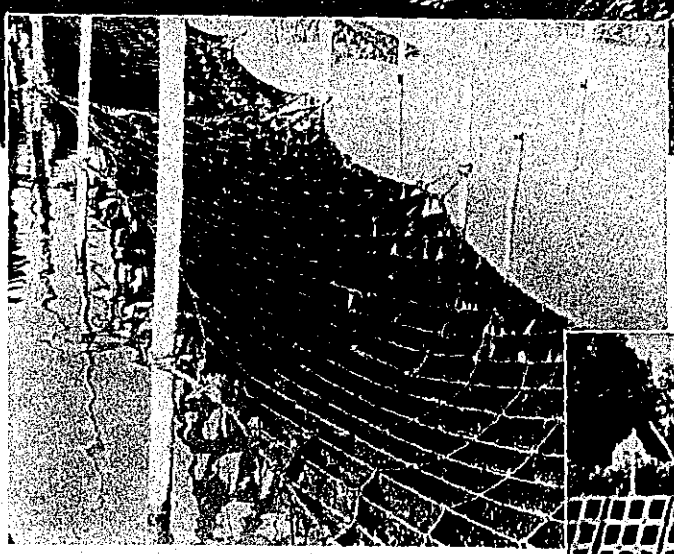
Shelves for seed-oyster and rafts for oyster culture off Hiroshima City.



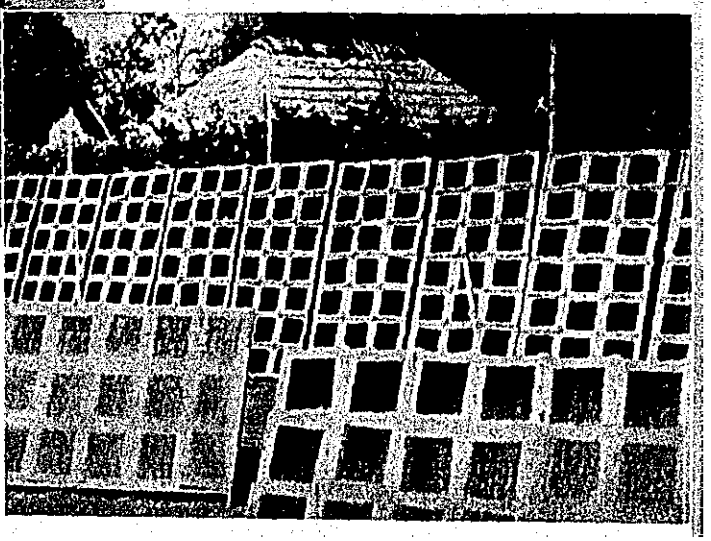
Operation of pearl oyster (A nucleus is inserted in a pearl oyster)

Bird's-eye view of a pearl oyster farm at Ago Bay, Mie Pref.

Laver farmat Lake Hamana



Full grown lavers on the coir-yarn nets just before harvest



Drying of laver

Present Situation of Pearl Culture

The Transition in the Production and the Entrepreneurs

The production of pearls has been stimulated due to the favorable conditions in the overseas markets and the continued increase in the demand, as seen in the next table. Since 1953, both the production and the number of entrepreneurs exceed the pre-war peak.

The change in the production was seen not only in the increase in the amount, but the sizes of pearls have changed, showing the trend that

Kan (3.75 kg)

Year	No. of Entrepreneurs	Amt. lifted to shore	Year	No. of Entrepreneurs	Amt. lifted to shore
1951	700	7,500 kg	1955	1,643	24,535 kg
1952	1,200	10,500	1956	1,732	26,620
1953	1,200	13,125	1957	2,574	30,058
1954	1,645	16,875	1958	3,001	48,085

Spherical Pearls Lifted to the Shores

Year / Prefecture	1955		1956		1957		1958	
	Quantity kg	Percentage %	Quantity kg	Percentage %	Quantity kg	Percentage %	Quantity kg	Percentage %
Mie	18,801.8	76.6	21,371.6	80.2	22,604.6	75.2	35,400.8	73.6
Nagasaki	2,583.0	10.5	2,525.6	9.4	2,175.8	7.2	2,895.0	6.0
Hiroshima	484.1	1.9	471.8	1.7	1,487.6	4.9	1,873.9	3.9
Ehime	322.9	1.3	234.4	0.9	865.5	2.9	2,298.8	4.8
Wakayama	468.0	1.9	307.5	1.2	563.3	1.8	658.1	1.4
Kōchi	427.9	1.7	306.0	1.2	469.5	1.6	709.1	1.5
Tokushima	39.4	0.1	21.0	0.1	313.1	1.0	597.8	1.2
Kumamoto	212.6	0.9	265.9	1.0	255.8	0.9	444.0	0.9
Shizuoka	321.4	1.3	374.6	1.4	262.5	0.9	514.1	1.1
Hyōgo	421.9	1.7	328.9	1.2	207.8	0.7	546.0	1.2
Ōita	111.0	0.5	30.0	0.2	150.4	0.5	120.0	0.2
Others	340.9	1.6	382.5	1.5	701.6	2.4	2,027.3	4.2
Total	24,534.9	100.0	26,619.8	100.0	30,057.5	100.0	48,084.9	100.0

bigger sizes are favored, because 65% of the pearls exported are in the form of necklaces without the clasps, and they are strung with bigger pearls recently. As is usual in the transitional period, some of the sizes were in much demand and fetched high prices while the prices of those not in demand came down, until the adjustment was made.

When Shells Are Lifted to the Shores

The season varies but usually it is from September until February next year. The next list shows the monthly break-downs, showing how seasonal the pearl culture industry is, just like agriculture and other types of fisheries.

Monthly Breakdown of Pearl Production:

September	3%	December	23%	March	3%
October	11%	January	30%		
November	15%	February	15%		

Progress in the Culture Skill

There are three outstanding progresses made in the skill of pearl culture after the war. (1) Mother shells are farmed and raised as an industry (2) The rafts are hung in the water, and the shells are not scattered around, so that more shells can be cultivated. (3) The studies are made on the characteristics of the particular sea-shores, so that suitable method of culture can be adopted. For instance, in regard to (1), after 1950, the demand for mother shells increased suddenly, but it could not be filled immediately since in 1944 there was a big earthquake in the southern seas, and in 1945 and 1946, the shells were exposed to the cold current, so that the shells, which amounted to 1,312,500 kg in Mie Prefecture decreased to 37,500 kg to 75,000 kg. The entrepreneurs had to give up the idea of depending upon the natural mother shells alone, and started farming the mother shells using rafts method, so that the cultivation and supply of mother shells can now be planned. As to (2), because of the shortage in the material and fund, drastic cut in the production cost had to be achieved. Also because of the sudden increase in the number of the entrepreneurs, the areas for cultivation became crowded. The wire-net baskets formerly used to hang shells in the sea were gradually replaced by the long trunks, synthetic fibre nets, etc., then the present method, called hanging bamboo rolls came to be adopted. The ropes used are now synthetic ones, instead of the straw ones. These changes in the method of cultivation brought about the decrease in the production cost shortening the period needed for cultivation, and increased the possibility of cultivating thick-coated cultured pearls.

To achieve (3), the areas are chosen each for specific purpose. In order to get the superior pearls, the rafts are moved around, and the chemicals (illuminol R. II, α-naphthol, Ca 45, etc.) are used to speed up the coating of pearl-substance. The National Pearls Institute was established in Kashikojima, Mie Prefecture, in May, 1954, equipped with modern scientific research facilities, and is engaged in the basic research on the production of superior pearls.

Planning of Pearl Production

Since 98% of the production is exported, the prices have to be stabilized and there must be a happy balance between the overseas demand and production in Japan. Also the right sizes in the right amount have to be cultivated because 65% of the export is in the form of necklace strings (without clasps). The bigger sizes are favored recently so that more medium and big sizes have to be produced, as well as superior quality ones. Pearl Culture Industry Law (enacted in 1952) aims at planning of pearl production. The pearls cultivation associations all over Japan practice the joint sale of the pearls, so that the price of pearls is stabilized and export of them has been increasing.

Recent Export of Pearls
(Jan.~Dec.)

	Weight (gr)	Amt. of Money ($1,000)
1954	11,925	7,240
1955	18,008	10,040
1956	23,303	13,322
1957	26,070	16,499
1958	33,561	17,685
1959	40,928	23,792

Note: Customs Statistics, Finance Ministry, excluding those for J.E.C.

The export of pearls has been increasing as seen in the accompanying table. The major market is the US, constituting 60%, and Switzerland, Western Germany, France, Italy, Canada, India follow, and there are altogether 79 countries to which the pearls are exported.

Quality Control

In order to guarantee the quality of the pearls to be exported, Export Examination System was started, together with the establishment of Pearl Culture Industry Law in 1952. There are two examination centers in Japan, one in Tokyo, the other in Kobe, and although at first the quality of pearls was merely divided into two classes, high grade and low grade, after April, 1957, those classified as low grade at these centers and those whose prices are lower than the specified prices cannot be exported, but they are bought up and burnt down by the government according to the Quality and Prices Agreement of the Exporters Association, based on Export and Import Procedure Law.

REFRIGERATION IN THE JAPANESE FISHERIES

Refrigeration in Japan today extends to such fields as ice-making, cold storage, frozen food, air conditioning, etc. In view of its start and fields of utilization, the Japanese fisheries are inseparable from the refrigeration industry.

History of Ice-making Industry

The use of natural ice in Japan goes back a long way. It is recorded that around 400 A.D., the people at the time knew how to make use of an underground storage of natural ice, called ice-room (*himuro*) and some of the ice was presented to the emperor (Emperor Nintoku). At the time the ice seems to have been used for chilling *sake* in the summer time. However, it was much later when the use of natural ice on an industrial basis began. Around the time of Meiji Restoration, Kahei Nakagawa, a businessman who was acquainted with the American missionary people and medical doctors, saw that the foreign colony in Yokohama imported the natural ice taken in Boston over 15,000 knots distance by a sailing vessel taking 6 months. He started to utilize the natural ice taken in the area near Yokohama. However, because of lack of experience in the transportation of ice, the transportation cost too much and besides much of the ice melted away. Undaunted of failures, however, Nakagawa succeeded at last in driving away the imported ice from Boston by getting better and cheaper ice from Hakodate, Hokkaido, 700 km. away, in 1871, 7 years after his initial attempt. During 1878–1883, the foreigners started ice-making business in the foreign colonies of Yokohama, Kobe and Osaka. In 1883, however, a Japanese ice-making company was established which took over the ice-making factory previously built by the foreigners. In the beginning the foreign engineers helped, but after a short while the Japanese could handle the ice-making operation alone. It was after World War I when the Japanese-made mechanical equipment and insulation material for the ice-making factory came to be used.

Up to 1887 the natural ice competed with the machine-made one, but gradually it could not put up such a strong fight any more since the machine-made ice was always about 10% cheaper, and the production of natural ice had to depend upon the winter weather. Although the market for the natural ice became smaller, while it lasted it was a very profitable business and its operators could prepare themselves against the time the

natural ice would not be in so much demand and switch to the ice-making business. In the early ice-making days all sorts of manufacturing methods were adopted. This proves that there was no factory which had the decisively superior technique and also the ice-making methods improved very rapidly. In 1890 there was Linde's ammonia system ice-making machine, in 1897, DaVerne's ammonia system distilation water machine (British made), in 1899, Frick's ammonia type ice-making machine (American) and in 1907, plate ice system ice-making machine (American).

It was in 1897 when the ice-making machine was first installed by a Japanese engineer, and the first Japanese-made ice-making machine was manufactured in 1900, 22 years after the ice-making plant was imported in 1878.

In 1885 the fisheries had the first contact with the ice-making industry, when the transportation experiment of naturally frozen fish in ice by a sailing vessel between Korea and Shimonoseki took place, but for some time after that there was no development along this line. In 1897 the ice was used for the first time for ice-storage of fresh fish at the fish market in Tokyo. Around 1907, storing fish in ice became more or less a common practice.

The ice-making in Japan first started in big cities, gradually expanded to medium sized cities, big fishing areas, medium fishing areas, small cities and then to small fishing areas. Ice was used for summer time drinks, very expensive at first, but gradually it came to be used for medical and

Table 1. Changes in Ice-making and Cold Storage Capacities

	Ice-making			Cold-Storage			Refrigeration		
	No. of Factories	Capacity (T/D)	Index	No. of Factories	Capacity (M^3)	Index	No. of Factories	Capacity (T/D)	Index
End of 1930	592	11,043	70	270	513,068	45	49	492	23
" 1935	983	14,288	90	394	660,102	58	100	1,000	47
" 1940	1,050	15,804	100	830	1,136,575	100	228	2,146	100
" 1941	1,253	16,000*	101	830	1,280,130*	113	300	3,000	140
" 1943	761	12,505	79	857	1,196,266	105	323	3,225*	150
" 1945	681	9,700	61	790	1,046,840	92	269	2,634	123
" 1950	1,225	16,586	105	1,713	1,448,158	127	590	4,790	223
" 1955	1,577	24,426	155	2,205	2,347,608	207	811	7,591	354
" 1956	1,662	25,860	164	2,344	2,630,162	231	862	8,496	391
" 1957	1,709	26,862	170	2,449	2,862,094	252	915	9,468	441
" 1958	1,729	27,599	174	2,560	3,104,612	273	949	9,905	460
" 1959	1,744	28,357	179	2,594	3,300,161	291	976	10,340	480

* Pre-war peak

storage (fish) purposes. As the fisheries expanded their scale, from the coastal fishing to off-shore and then to pelagic, the fishing vessels increased, and the demand for ice for fishing use increased together with the improvement in the facilities at fishing ports. At the end of World War II, the industry was severely damaged on account of the air-raids, but in a few years after the war remarkable recovery took place.

History of Cold Storage and Refrigeration

It is said that the beginning of cold storage in Japan was in 1898 when a foreign trading firm in Kobe installed a small refrigerator. Next in 1901, Kota Nakahara who had newly returned from the US established Japanese Cold Storage Co., and started the cold storage of fresh fish at Yonago, Tottori Prefecture, the first of its kind. However, at the time there was no adequate refrigeration equipment, so that the fish had to be frozen in a cold room taking a long time, and naturally it did not taste good. At the time the people were not used to the frozen fish and the fish market in Kansai area had no ice box to store the frozen fish, so that Nakahara's attempt ended in a failure. In 1908, Teikoku Cold Storage Co. was established with 3 million yen capital and built the cold storage house at Tsukiji, Tokyo. It was 532 *tsubo* wide, equipped with Bilter type refrigerator (US made), with German made suction gas engine type motors. It was the biggest and the newest in Japan and 110,000 cubic feet storage room could accommodate 1,100 tons of frozen goods. Meat, fish, eggs, vegetables, fruits and silk-worm egg paper were stored. However, the business was in the red until 1913 because the general public did not understand the nature of the industry. It could maintain its operation only by making and selling ice as the side line.

There were new ice-making companies established around this time, and cold storage industry spread. Although there was no attempt for frozen fish after the failure of Nakahara, in 1919 Ihei Kuzuhara came back after inspecting the refrigeration industry in the US, and wanted to adopt the air-freezing system which was widely practiced there, and invited the American engineer, Howard Jenks, to expand the industry in Japan. In February, 1919, Kuzuhara succeeded in the experiment to store the frozen fish for a long period of time at Ito, Shizuoka Prefecture. In 1920, Jenks designed and supervised the construction of two refrigerators, one at Mori, Hokkaido, and another, at Kesenuma, Miyagi Prefecture. The one at Kesenuma was completed in June and the other, at Mori, in August. These two refrigerators were put into operation as soon as they were com-

pleted. In January, 1921, the frozen fish was shipped to the fish market in Tokyo by train for the first time. Although the people did not take to the frozen fish too kindly at first, all the frozen fish was sold out in two weeks. The cold storage factories were built one after another at the major fish centers in Japan. By 1923, Kuzuhara Refrigeration Co. had 20 million yen capital paid in. In the meanwhile, in 1921, the first refrigeration boat, Enoe-maru (655 tons) was built, and between 1922–1926, five others were made, each 1,000–1,500 tons class, and produced, carried and distributed the frozen fish, together with the freezing factories on land. At the time of the big earthquake in Kanto, in 1923, the frozen fish was released to the earthquake victims and greatly appreciated. Kuzuhara's business was quite an ambitious one at the time, but unfortunately the financial conditions of his business deteriorated due to the panic later, and had to fold up in 1926. His name should be remembered, however, as the one who founded the refrigeration industry in Japan.

Himurogumi and Sanriku Fisheries Refrigeration Co. and others also went in for frozen fish industry, but these were either dissolved or merged with the newly established companies. However, some of the old-timers are still working actively in the refrigeration industry today. Part of the reasons why these companies rose and failed were because they imitated the American technology and business operation blindly and did not try to assimilate them into the Japanese conditions; besides, the importance of frozen food was not recognized by the people.

Hayashikane & Co. was engaged in fishing centering around Shimonoseki—later became Taiyo Gyogyo Co.—and established refrigeration factory, using the quick freezing Ottesen system of refrigeration, the newest at the time. Although this system had its merits, it also had its defects, and did not come to be widely used in Japan.

Based upon the failures and experiences of the early periods, an entirely original refrigeration method was devised in Japan. Tohata Refrigeration Co., in Tohata City, established in 1929, used sodium calcium liquid for the first time, called U.M. Quick Freezing equipment. This method was devised jointly by Takeshi Murayama of the company and Mr. Udel, the engineer for Frick Co., who came to Japan in 1928, and was an improvement on Kolbe's Floating Pan System. The UM system was used for the refrigeration of fish in the fishing boats as well and its superiority was recognized in the fish markets.

In 1923, Kyodo Gyogyo Co. (the present Nippon Suisan Co.) at first installed air freezing equipment in its trawlers, but later installed the quick freezing sodium calcium shower type equipment to the newly constructed

6 diesel trawlers (360 tons, with 550 HP), which had the capacity of 3.5 tons a day freezing capacity. Since the fresh fish was frozen in only 2–3 hours, the markets welcomed the fish frozen by this method, and ship-frozen fish almost became a trade mark. Mr. Chiyoma Iwamoto further improved this method and devised Flat Tank system, which came to be installed in many trawlers.

The Japanese government recognized the necessity of refrigeration in fisheries, and Fisheries Agency, Ministry of Agriculture and Forestry encouraged the construction of refrigerators, refrigeration boats, and ice-making factories from 1923, and for this purpose established the subsidy system, which lasted until 1937. There were 148 refrigerators, 20 refrigeration boats, 113 cold storage houses and 52 ice-making factories which came to be built, with the help of the subsidy.

As the production of frozen fish increased for general consumption, the demand increased suddenly after 1940 for the military personnel. Therefore, the production jumped from 45,000 tons in 1934 to 132,000 tons in 1940. After the war the industry again showed remarkable progress.

Table 2. Production and Export of Frozen Fish

Year	Production (tons)	Export (tons)	Year	Production (tons)	Export (tons)
1924	1,882[1]	0	1944	66,917	0
1925	3,060[2]	0	1947	68,000	?[9]
1927	8,001[4]	40[3]	1948	93,800	?
1930	14,826[5]	4,250	1950	163,500	14,658
1934	44,810[6]	1,878	1951	175,000	25,594
1936	45,000	5,452	1953	277,000	45,873
1938	113,395	7,231	1955	300,000	77,304
1939	132,364	22,603	1957	374,000	93,801
1940	82,633	26,223	1958	435,000	130,679
1941	139,469	37,956[7]			

1) Only handled by Hayashikane & Co.
2) 〃
3) The first export from Japan.
4) Combined figure of three companies, Nippon Suisan, Hayashikane and Nichiro.
5) 〃
6) Over-all figure.
7) Most of this figure was for Manchuria and China only. After 1941 the export to the US was stopped.
8) Export was restarted after 1947.

Present Situation of Ice-making Industry

In 1959 there were 1,744 ice-making factories in Japan, with the capacity of 28,357 tons a day. The capacity reached about 5,500,000 tons in 1959. About 57% of the ice made is used for fisheries, and the rest,

43%, for other uses.

The ice for fisheries use is made at the ice-making factories in the fishing ports all over Japan, to be loaded in the tuna boats, skipjack boats, trawlers, etc. and also in ships which transport fresh fish, cold storage freight cars, trucks, etc. The ice-making factories favorably situated geographically are busily occupied all the year round, so that they have hardly time to overhaul and repair the freezers. However, in the fishing ports where the fishing season is only of short duration, the ice-making factories need not be fully operated, so that their income is lower. The ice is seldom transported a long distance since it is bulky, easy to melt, and altogether costs too much in transportation cost. Of 5 million tons of ice produced annually only a small portion is shipped by railway. (In 1950, 110,000 tons, in 1953, 110,000 tons, in 1955, 150,000 tons and in 1958, 100,000 tons).

The production per factory averaged 16.3 tons a day in 1959 but there are bigger factories which can produce more than 100 tons a day in bigger fishing ports and cities, but these are not many in number. There are only 4 factories which produce more than 200 tons a day and 25 factories which produce 100–190 tons a day. The factories have to be built where they would be fully operated and where water, electricity, piers, sidings, etc. are easily available.

To the technology of ice-making Japan did not contribute any original idea. Since hard water is rare in Japan there is no need for the equipment to soften the hard water. The transparent ice must be used for fisheries purposes and otherwise, and it is made by sending low pressure air bubble into the ice cans by drop tubes, stirring up the water. The ice cans 300 lbs type and 400 lbs type, were imported from the US, but 400 lbs type was too big for the Japanese to handle, so that it is seldom used now. The bigger factories tend to use as bigger can grids as possible so that it would be more efficient to lift the ice. At present, the construction and transportation material used for the ice-making factories can be furnished in Japan.

The basic formula of ice-making has not been changed for over half a century, and is inefficient, and although various quick ice-making machines were devised, these are not extensively adopted in Japan.

Present Situation of Cold-Storage Industry

At present, there are 2,594 cold storage houses covering a total space of 3,300,161 cubic meters. One cubic meter can accommodate 0.4 ton of goods, so that they can refrigerate about 1.32 million tons. Of the total, however, 1,159,820 cubic meters are for storing of ice and Class C cold storage rooms (−2° to 0°C). Generally speaking, the ice-manufacturing

factories in cities fill up their storage rooms with ice in the March-June period in preparation for the busy summer season.

From autumn to winter, the demand for ice seasonally decreases, and ice storage rooms are used as Class C cold storages to preserve apples, onions, etc. Of the total space, Class A storages (under −10°C) occupy 1,214,841 cubic meters, or nearly 45 per cent; Class B (in between Class A and C temperatures), 641,192 cubic meters or 19 per cent; and Class Super A (less than −20°C to −30°C) is 284,308 cubic meters or 0.8 per cent.

Class A storage plants store frozen food, Class B, salted and dried fish, and Class C, apples, eggs, onions, fresh fish, etc. which should not be frozen.

The cold storage houses accommodate about 91,110,000 tons of goods a year and the rate of utilization was 38 per cent in 1956 (the ratio is obtained by Capacity × 365/tonnage stored a year × 100%). About two-thirds of stored goods are marine products. Bigger cold storage houses of two or three stories are seen in big fishing ports and cities.

Building materials and machinery for cold storage houses can be manufactured in Japan. Ice-manufacturing factories on land and refrigerators use ammonia, and hand-worked types are predominant. Phleon refrigerators are used also in fishing boats. The ammonia type is in great use on land for economical reasons.

Recent Characteristics

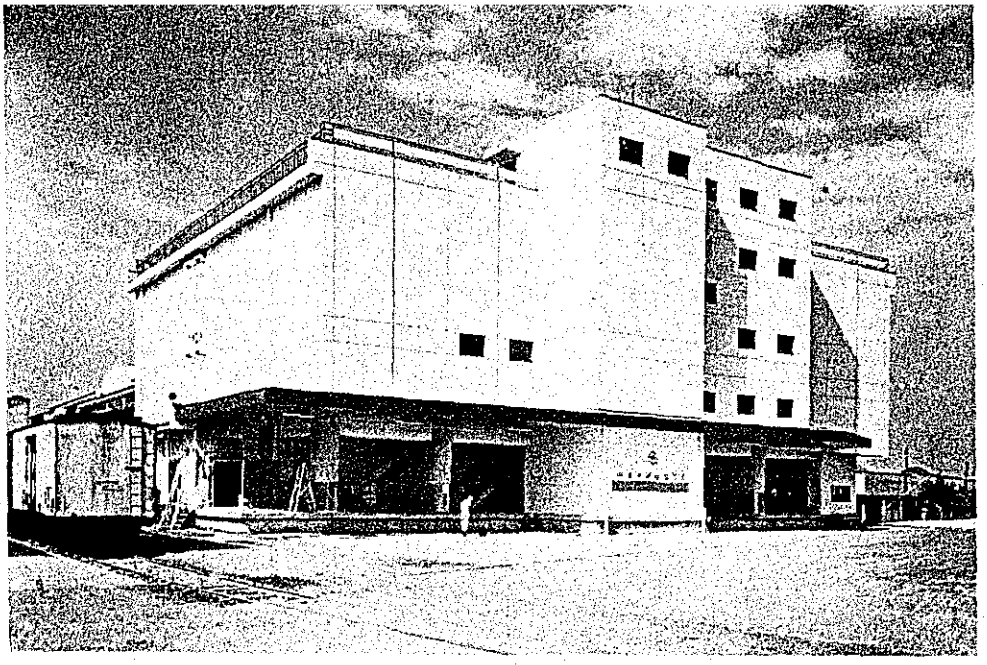
1) *Increases in the refrigerating capacity in the past five years* average eight per cent, and they are notably in Class A storages (about 12.3 per cent).

2) Area-wise, cold storages show a noteworthy increase in big consuming districts and fishing districts, and Class A cold storages or better have increased by an annual average of 21.4 per cent in the past five years. Per factory scale has been also expanding year by year.

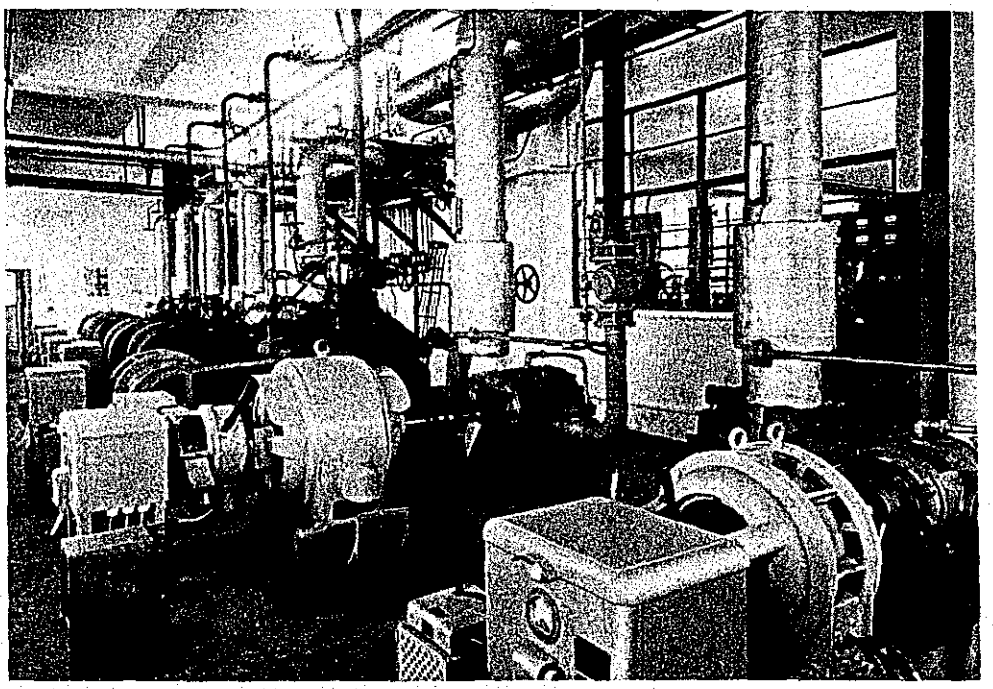
3) The refrigerating method has been improved, and the air-blast system has become popularized. Automatic control and operation by the use of automatic valves are now becoming commonplace.

4) Marine products such as frozen fish and fresh fish are still accounting for a major portion of the foodstuffs in cold-storages, and an increase in storage of frozen fish is remarkable. The weight of dairy products is *also rising recently.*

5) In reflection of the need of stabilizing fish prices throughout the four seasons and making good use of marine products by freezing or pro-



External view of new refrigerating plant



Machine room of refrigerating plant

Slicing of quick frozen food

New type cold-storage room (air-blast system)

Weighing of tuna *meat for canning*

Fish cutter—
cutting fish for canning

cessing, the popularity of cold storage houses is fast rising in fishing districts and big consuming districts, and they are playing a bigger and bigger role in the distribution mechanism for marine products.

Now that Japan's fishing zones are being restricted internationally on a larger and larger scale, and off-shore fisheries are sluggish, major fishing companies are vying with each other in advancing into the fields of the processing of farm produce and dairy products. Result: construction of many largescale cold storage plants.

Present Situation of Frozen Marine Products

In 1958, frozen fish totaled 435,000 tons, 112,546 tons of which was frozen tuna exported. Such exports earned $32 million. Major frozen fishes are mackerel pike, cuttlefish, tuna, sardine, mackerel and whale which are produced in Hokkaido, Miyagi, Aomori, Shizuoka, Iwate, Chiba, Tokyo, Kanagawa, Ibaraki, and Osaka (in this order).

The freezing capacity was 10,340 tons a day in 1959, and the static air freezing type was predominant. The flat tank type, Ottesen type, Finnegan system, etc. were also in use but on a much smaller scale.

There are 65 mother ships and carrier boats equipped with refrigeration facilities. These refrigerating boats have a total freezing capacity of 2,673 tons a day, and their freezing method is mostly the flat tank type, followed by the static air freezing type, and direct brine freezing type (immersion system, spray or fog system). Besides, trawlers of over 400 tons are equipped with flat tank quick freezing facilities; 89 large trawl boats (capable of sailing west of 130°E) and 13 surrounding net boats have refrigerators and cold storage rooms.

Frozen fishes include tuna largely for exports and cheaper fishes for domestic consumption. The use of freezers these days has made it possible to deliver any fish at any season, with the result that fish prices have been stabilized considerably.

Production of frozen fish has been a sharp up-curve, and in 1958, it registered a 16 per cent rise over the previous year. Especially cuttlefish, mackerel pike and other fishes which can be caught abundantly have come to be refrigerated in increasing quantities. This phenomenon may be an evidence that efforts are being made to check fish prices from dropping at a time of good hauls, while the consumption of fish—in the form of frozen fish—is on the rise.

During the war and the time of a controled economy right after the war's end, frozen fish was popular specially in farming communities, but

the recent advancement of freezing techniques is adding to the popularity. Recently major companies have embarked on the production and sale of quick frozen foods, and stockers or deep freezers for their sales are spreading throughout the country. To commercialize as many marine products as possible is highly important in enhancing and stabilizing the income of fishermen. The changing consumption trends of the people will boost the production of quick frozen food (pre-cooked food, stick, fillet, etc.) and frozen fish rapidly.

THE HISTORY AND THE PRESENT SITUATION OF THE FISH CANNING INDUSTRY

It is not known exactly when the canned food was imported to Japan in the first place. The world history of the industry goes back to 1810 when Nicolas Aperl invented a new bottling method after experimenting for 15 years. In 1820, Peter Durand, an English man, succeeded in obtaining the patent right on the canning method, using tin cans, from the British government. Fifty years later, in 1870, an American teacher at Tokyo Industrial College (later, faculty of engineering, Tokyo University) lived in Tokyo and canned fruit for his home use. In 1871, Masanori Matsuda, of Nagasaki, learned how to make canned sardine in oil from M. Julie, a French teacher at Kounkan School, Nagasaki, and started manufacturing the canned fish products for the first time in Japan. In 1874 Minosuke Yamada, of Chiba Prefecture, started manufacturing canned pickles, using various vegetables, although his family's line of business for generations was pickled radish. Yamada's canning was the first attempt by Japanese without foreigners' help. In 1875, Sakichi Yanagisawa came back from the U.S. and started manufacturing canned peaches in syrup. The following year Matusgoro Ofuji, returned from the U.S., started manufacturing of canned tomato. In 1876, Kiyotaka Kuroda, director of the Development of Hokkaido, established Canning Experimental Station at the mouth of the River Ishikari in Hokkaido, on the advice of Geblon, an engineer hired by the Japanese government. In September of that year D.S. Treet (56 years old at the time), Maine, and W.S. Swatt (25 years old), Californian, came to Japan as instructors for canning. In 1877, Kenzo Ikeda bought the whole set of handdriven canning machinery in New York and installed it at the Canning Experimental Station in Ishikari, Hokkaido. In 1878, Kenkichi Narushima and Kodo Kubo came back from France bringing with them the canning machines they bought there. Later they established two canning factories in Hokkaido. Gradually developing these pilot plants, they began to eye foreign markets for their products and manufactured canned salmon, trout, vegetables, venison, etc. They exhibited their canned salmon and trout at an industrial exhibition held in France and through a trading firm in Yokohama sold their samples to the U.K. and the U.S. In 1879 more than 2,000 cans of sarpines in oil were manufactured in Choshi, Chiba Prefecture, and in July of that year also in Tateyama, Chiba Prefecture, more than 2,400 cans of sardines in oil were manufactured. A factory was established in Kushiro, Hokkaido to produce canned oyster, herring, abalone and scallop. In August, in one

of the Kurile islands another factory was constructed to produce mainly canned salmon and trout. Thus people's interest in the canned food was aroused and was, with the result that the industry showed much development. At the second Industrial Exhibition held in Tokyo in 1881 such prefectures as Hokkaido, Tokyo, Niigata, Chiba, Shiga, Fukushima, Ishikawa, Fukui, Fukuoka, Akita, Shimane exhibited a rich variety of canned fisheries products: cod, yellowtail, salmon in vineger sauce, salmon and trout in brine, oyster, sole, scallop, herring, sardine, abalone, shrimp, clam, eel, seabream, *ayu* fish (plecoglossus altivelis), octopus, etc. Also at this exhibition were 11 kinds of canned meat and 18 kinds of canned vegetable, much to the amazement of visitors. However, it must be mentioned here that almost all these products were manufactured by the governmental agencies for the purpose of encouraging the industry, as can be seen from the variety of items exhibited. Those manufactured by the private individuals were also a trial attempt just, to satisfy their curiosity, and were not commodities on a commercial basis. The private canning industry was still in its infancy.

However, after this exhibition canning factories came to be established, with the Kansai District as the center. In 1885, 2,880 cases of canned salmon and trout were exported to France for the first time. By 1887, the governmental factories in Hokkaido were transferred to the private hands, and the canning formed a full-fledged industry. In 1889, at the Fisheries Exhibition held in England, Japan's canned crab meat was exhibited. Since that time the canning industry had strived for its expansion and improvement by importing new machines and equipment from abroad.

After the outbreak of the 1894–5 Sino-Japanese War, which was the first major war Japan drifted into with a foreign power in its history, the War Office established the Provisions Agency, and both the army and the naval departments designated canning factories for the speedier supply of the canned goods for the military personnel so that there was no need to depend upon the imported goods and the canning industry in Japan was humming.

In 1894, the first year of the Sino-Japanese War, the production amounted to 204,064 cases and the producers numbered only 87 altogether, but during the war, in order to supply the military need, the undertakers mushroomed. From that year on production statistics were made available.

In November, 1895, a meeting of the undertakers was held and they passed resolutions on exhibition of the products, control of inferior cans, encouragement of export, petition to the army to buy up the products

made by private undertakers, etc. and this meeting paved the way for establishment of the Great Japan Canning Industry League which proved greatly conductive development of the industry. In thatyear the production decreased to to 200,000 cases out of which 90 per cent was consumed in Japan.

After 1897, the industry went back to normal from the abnormal conditions of the Sino-Japanese War period and processed quantity was about 35 per cent of the peak production in 1894, 58,500 cases, but the number of the undertakers increased by 2.25 times, 197 in all. However, because of the favorable turn of the war, activities of Japan expanded overseas in fields of commerce, navigation and immigration. The undertakers tried to expand the production not only for home consumption, but for the overseas markets, and produced the canned Japanese food, such as beef cooked in soysauce, called beef *yamatoni*, broiled seasoned eel, called eel *kabayaki* or *tsukudani*, i.e., food boiled down in soysauce, not to satisfy with immitation of the foreign canned food only. The industry attained considerable expansion, and the canned products were exported to the Siberian Maritime Provinces and Formosa, which became the Japanese territory after the war.

Year	A. Output (cases)	B. Export (cases)	B/A (%)
1900	125,789	3,453	22.75
1901	214,097	6,704	31.50
1902	235,816	13,210	55.50
1903	318,970	15,551	49.00
1904	429,351	14,135	33.00
1905	800,830	27,399	34.10

As in the above table, the production increased to 125,789 cases in 1900 earning 358,000 yen (from that year the export values came to be recorded).

When the Russo-Japanese War broke out in 1904, the Ministry of Agriculture and Commercial Affairs took measures to supervise factory facilities, processing methods, etc. so that canners could smoothly supply good quality products and reduce production costs during the war.

As the production statistics show, as it drew near to the Russo-Japanese War, the production climbed up steadily. After the breakout of the war, the number of canning factories increased all over Japan and knowledge on the canning method improved, founding the solid basis of the canning industry. In 1905, production hit 800,000 cases, out of which 27,000 cases were exported and 60,000 cases were consumed at home.

Year	Production (cases)	Export (cases)
1906	333,000	
1907	372,745	78,018
1908	—	—
1909	—	—
1910	613,963	177,039
1911	749,386	204,738

By the Russo-Japanese Fisheries Pact that was signed after the war,

Year	Output (cases)	Export (cases)
1912	1,216,796	251,850
1913	1,064,577	275,136
1914	1,056,125	290,492
1915	1,005,565	354,503
1916	1,346,655	444,034
1917	1,633,075	475,758
1918	1,356,239	501,048
1919	1,799,733	324,548

the fisheries right along the Maritime Provinces in Siberia were secured and both the fishing skill and the canning technology improved rapidly. In 1907, canned crab was first exported. In Kuriles and Kamtchatka the canning factories were built one after another. In 1910, 300 cases of the canned red salmon were produced in Kamtchatka on a trial basis and were exported to London. Being encouraged by its popularity there, many undertakers entered into business, and the factories equipped with the automatic canning machines and can-making machines and the salmon canning industry in Japan was firmly founded.

In 1914, the Kumotaka-maru, the training boat attached to the Imperial Fisheries Institute, made the trial manufacturing of the canned crab meat on the western coastal water of Kamtchaka. The production showed a steady increase as shown in the above table up to 1919. The export peak was registered in 1918. And the value of the year amounted to 9,633,000 yen. However, with the end of the war, the export declined.

Year	Output (cases)	Export (cases)
1920	1,482,091	654,792
1921	1,736,612	416,998
1922	2,116,271	615,224
1923	2,392,250	415,189
1924	3,105,000	653,672
1925	3,609,000	1,027,795

In 1920, Kureha-maru, a training boat attached to Toyama Prefectural Fisheries Training Institute proved that canning of the crab meat on a factory boat was feasible. At that time, the crab meat processing in Hokkaido and Sakhalien was not developed yet. Taking advantage of the low prices of ships reflecting the depression in the world shipping industry in the post-war days, Teiji Wajima bought two sailing boats in 1921 and started manufacturing canned crab meat on board. This was the first attempt at processing on the boats by private undertakers. In 1924, 100,000 cases of canned sardine in tomato sauce were made in Nagasaki and trial exports to the south sea islands were favorably received, and in fact, from the next year exports were placed on an industrial basis. In Aomori Prefecture manufacturing

Year	Total Output (cases) (A)	Output of Fish Products (B)	B/A (%)
1926	3,722,000	unknown	—
1927	3,510,000	1,902,000	54.2
1928	4,269,001	2,538,000	57.5
1929	4,397,132	2,503,488	57.1
1930	4,937,443	2,779,266	56.3
1931	4,268,817	2,138,011	50.1

of canned salmon, using the frozen salmon, was started. An output of the whole kind of the products became about 2 million cases in 1927, and exports amounted to 13 million yen, of which 80 to 90 per cent was the canned salmon, trout and crab produced and exported directly from the Russian territory.

Year	Export (cases)	Canned Fish Products Exported	Ratio
1926	1,333,089	unknown	
1927	1,280,088	〃	
1928	1,783,834	〃	
1929	1,746,139	〃	
1930	1,759,246	1,674,171	95.2%
1931	1,447,282	1,389,318	95.9

As in the above table, the output in 1928 was about 4 million cases, the ratio of canned fisheries products to the whole kinds of canned food reached more than 50 per cent.

During the 1926—1931, there was established an export peak in 1928 and 1,780,000 cases of canned food (49,370,000 yen) were exported. It is not exactly known how much the fisheries products accounted for, but in 1930 and 1931, the exports of fisheries products accounted for 95 per cent of the total canned food exported. Major products were mainly for military use, and their chief kinds were salmon, and crab produced in the nothern sea areas and the others were sardine, mackerel, skipjack, whale, scallop, abalone, shrimp, etc. The canned tuna in oil which is a main item of the canned fisheries products today entered the trial production from 1929. However, its production expanded to 11,500 cases in 1930 and 28,500 cases in 1931; its exported amount was 27,801 cases in 1931. In 1930, 30,000 cases of canned sardine in tomato sauce were produced, and in 1931 the production increased to 35,000 cases, of which 13,900 cases were exported to France, and the southern islands areas of the Asia, 25,000 cases. However, the exports of canned salmon, and crab still ranked first and second on the export list, with 870,000 cases and 350,000 cases, respectively.

Year	Total Output (cases)	Output of Canned Fish Products	Ratio
1932	5,200,582	2,658,874	51.1%
1933	6,370,245	3,458,618	54.5
1934	7,825,842	4,297,113	55.0
1935	8,672,695	4,921,868	56.8
1936	10,192,553	5,486,160	53.9
1937	13,158,738	7,734,759	58.7
1938	15,191,308	6,680,613	44.0
1939	17,115,487	6,224,844	36.4
1940	10,786,986	4,538,018	42.0
1941	unknown		

The peak output during this period was 17 million cases in 1939, the highest before World War II.

Output of the canned fisheries products kept up its steady increase, paralleling the increase in the total output which amounted to 7,700,000 cases fisheries products in 1937; it reached more than 50 per cent of the total

Year	Total Export of Canned Goods (cases)	Export of Canned Fish Products (cases)	Ratio
1932	2,138,757	1,993,749	93.0%
1933	3,209,092	2,886,697	90.0
1934	3,561,806	2,914,901	81.8
1935	3,892,499	3,158,915	81.3
1936	5,309,915	3,949,729	74.3
1937	6,715,716	5,103,998	75.9
1938	7,157,219	4,699,222	65.6
1939	8,671,370	4,997,857	57.7
1940	4,160,771	1,712,319	41.1
1941	unknown		

Year	Total Output (cases)	Output of Canned Fish Products	Ratio
1942	3,581,625	1,812,803	50.6%
1943	2,680,854	598,041	22.3
1944	1,820,311	561,729	30.9
1945	380,566	41,643	11.0

Year	Output of Canned Food		Ratio
	Total	Fisheries Products	
1946	807,775	219,621	27.1%
1947	591,314	120,893	20.5
1948	740,509	426,736	57.6
1949	1,484,645	1,149,288	77.8
1950	4,848,994	3,529,154	81.0
1951	5,212,005	3,268,275	62.8
1952	7,183,109	4,166,641	58.2
1953	10,690,720	5,917,668	56.3
1954	14,416,083	8,041,939	55.9
1955	19,617,042	9,946,388	52.4
1956	26,633,445	13,117,732	49.4
1957	31,153,960	15,987,536	51.4
1958	36,733,711	17,852,404	48.6
1959	42,000,000*	21,000,000*	50.0*

* Estimate

canned food output. Since that year the production of fisheries products declined, while canned fruit, vegetable and meat products increased.

The export peak during this period was 8,670,000 cases in 1939 (154,000,000 yen) by the reason of the gold export ban in 1931, expansion of exports in the yen bloc since the Manchurian Incident in 1931, increased exports of canned tuna, sardine, canned mandarine orange and after the breakout of World War II in 1939, output and exports decreased rapidly. In the year, canners cooperative associations were established for tuna, sardine, shellfish, tangerine, etc., and they functioned to control their exports autonomously and endeavor to increase exports.

With the outbreak of World War II in Asia in December 1941, the production of canned fisheries products decreased very rapidly to 21.5 per cent of the peak production in 1939, and in 1943 it became impossible to produce the canned salmon, trout and crab in the northern sea area. The part and parcel of the production was for military consumption, and the supply of steel for can containers that would be used to process canned food for the civilian consumption became very few, paper or earthen ware containers were used, and used can containers were re-utilized. In 1945, the total production reached the lowest, 380,000 cases, of which the canned fisheries products were only 41,000 cases, the same figure as the pre-Russo-Japanese War. Exports had been forbidden since 1940.

After World WarII, both output

Year	Export of Canned Products		Ratio
	Total	Fisheries Products	
1946	0	0	0%
1947	95,318	23,802	25.0
1948	232,413	136,166	58.7
1949	752,798	618,038	82.1
1950	2,117,801	1,936,006	91.6
1951	1,749,939	1,254,784	77.4
1952	2,602,711	2,100,729	80.7
1953	3,193,551	2,788,554	87.2
1954	5,147,323	3,785,686	73.6
1955	7,111,966	4,783,324	61.6
1956	10,043,785	7,136,332	71.0
1957	10,592,587	7,461,481	70.5
1958	12,523,579	9,198,000	73.4
1959	13,532,122	9,878,129	75.0

and exports increased rapidly year after year. The output recovered to the prewar peak by 1955 and amounted to about 42 million cases in 1959, half of which were fisheries products. Products were exported for the first time after the war in 1947. The total exports reached about 10 million cases in 1956, topping the prewar peak for the fist time. Main importers of Japanese canned foods were the United States (22.3%), Britain (14.8%), the Philippines (7.2%), Singapore (1.7%) and Australia (1.3%) in 1959.

The state control over production and trading was removed in 1950. In 1954, the Marine Products Export Promotion Law came into effect and associations of salmon, crab meat, tuna, sardin and saury packers were formed to increase output and export and to produce good quality products. In the same year, the Smaller Enterprise Control Law was also enacted, and the Association of Mandarine Orange Packers of Japan was established with the same purpose. The major portion of output was processed in 781 canneries and 21 factory boats. There are 13 can-manufacturing companies fully equipped with automatic can making lines which meet nearly 18 per cent of packers' demands in Japan.

The landed fish totaled 4.50 million tons in 1958. The principal species for processing and their production quantities are given below:

Landed and Processed Fish of Chief Kinds in Japan (1958)

Kind	Landed (ton)	Canned* (ton)
Salmon	202,225	72,892
Crab	28,217	23,033
Tuna	325,875	60,575
Bonito	147,433	85,315
Sardine	610,479	47,971
Saury	575,087	57,534

* Processed fresh fish weight

Canned Crab Meat: The Japanese fisheries industry has been developing crab resources in the Northern Pacific and processing the catch

aboard canning boats, too.

Under the existing Soviet-Japan fisheries treaty, however, rigid restrictions have been imposed on the catch of carbs in the Northern Pacific. Principal species for processing are King crabs (Paralithodes camtschatica), Kegani crabs (Eriocheir japonicus), Hanasaki crabs (Paralithodes brevipes) and Zuwai crabs (Chionoecetes opilis). Most important are King crabs, and their production accounts for nearly 65 per cent of the total production of canned crab. Kegani crabs are also popular, occupying 25 per cent. All these crabs are processed in canneries on land. Output and exports amounted to 548,000 and 625,000 cases in 1958, respectively.

Canned Salmon: Salmon catch has been also subject to restrictions under the fisheries treaty between the Soviet Union and Japan. Main salmon species are Red salmons (Oncorhynchus nerka), Pink salmons (O. gorbuscha), Silver salmons (O. kisutch), Cham salmons (O. keta) and King salmons (O. tschawyscha). Most popular species are Red and Pink salmons whose production is 45 per cent of the total, respectively. Cham salmons account for 7 per cent. Output and exports in 1958 reached 1.92 and 2.58 million cases, respectively.

Canned Tuna: Major tuna species for processing are Albacores (Germo germo), Yellow Fin Tuna (G. macropterus) and Bonitos (Katsuwonus vagans). Albacores are highly popular on the world market as "white meat tuna" or "sea chicken". Both quality and price are high. Products of the others have been called "light meat tuna" and rather low in quality and price. Output and exports in 1958 totaled 5.48 and 3.35 million cases, respectively.

Canned Sardine: Main species for processing are Sardines (Sardinis melanostica and Etrumeus micropus) and Anchovies (Engraulis japonicus). They are in tomato sauce or in oil. Output and exports in 1958 were 1.83 and 0.69 million cases, respectively.

Canned Saury: This was produced on the commercial scale for the first time in 1952 and its development since then is tremondous. The scientific name of saury is Cololabis saira. Saury is canned with tomato sauce or oil. Production and exports in 1958 totaled 2.54 and 0.69 million cases, respectively.

Canned Whale Meat: This has been popular in the domestic market, and the consumption has been rising year after year. Fin backs (Balaenoptera physalus) and Sulphur bottoms (B. musculus) are main species being processed. The 1958 output was 1.42 million cases.

FISH JELLY PRODUCT INDUSTRY

Fish jelly product is an original product in Japan, something like meat loaf or sausages without casing, and only fish meat is used instead of cattle meat. The fish jelly product has long been favored by the Japanese, usually called "*kamaboko*" (in broad meaning). This word appears in the literature of 400 years ago.

However, it is only 100 years or so ago when so many varied forms of *kamaboko* came to be made, although at the time it was solely on the home industry basis, not mechanized, only filling the demand of the neighborhood. The fishes used for making *kamaboko* were not limited to one or two kinds of fishes like today, but any fish which was available and suitable for *kamaboko* seem to have been used.

As the demand for and production of fish jelly product grew larger, the fishes caught in the nearby seas alone were not enough, so that the raw material had to be sought from afar.

Around 1920, the trawler fishing was extensively practised, and croakers, lizard fishes, etc. which are suitable for *kamaboko*, were caught in the Yellow Sea and East China Sea. Alaska pollack, etc. which are also suitable material for *kamaboko* were caught in the Okhotsk Sea and Japan Sea. As the catch of these bottom fishes increased, the production of fish jelly product jumped naturally.

In the cities where the consumption of fish jelly product is great, these fishes caught by trawlers are shipped from the ports and fish jelly products are manufactured in big scale, by mechanized methods. Almost all the fish jelly product factories use power-driven machines.

About seven years ago, tuna, marlin and whale, which were considered unsuitable as material for fish jelly product came into use for making fish sausages, and in 1958 as much as 60,000 tons of fish sausage were produced.

How Fish Jelly Product Is Made:

Fish jelly product is manufactured by the following process: taking the fish meat out—bleaching—grinding roughly—grinding finely—seasoning—forming—heating.

Fish jelly product must have some elastic nature, so that fishes which would fill this requirement must be chosen. Croakers, lizard fish, and conger eel provide such jelly strength. Croakers are favored most because

kamaboko made from this fish has strong elasticity, which is not lowered even when the fish lost its freshness somewhat. Croakers are sought even in Tokyo, and the fish is shipped all the way from Fukuoka and Shimonoseki. The lizard fish is more delicious, but it loses its elastic nature when it is not so fresh, so that it is used only in the neigbborhood of where the fish is caught. All these fishes are caught in the seas west of Japan. Usually these fishes which are the raw material for the fish jelly product are shipped in boxes, covered with small pieces of ice, in a cold storage freight car. Since they lose their elasticity when frozen, the dealers avoid freezing them.

In the northern part of Japan, Alaska pollack is used but shark is used almost all over Japan. Both fishes are considered to be pretty good raw material. As the lower class fish jelly product jack-mackerel, sardine, pacific saury, tuna, etc. or small fishes caught by trawlers are used, and in some cases these are mixed with higher class ones. Therefore, one could say more or less all the fishes caught in Japan are used to make fish jelly products.

The fishes are first washed in water, and the visceras and heads are removed, and only the meat is used for making fish jelly product. The meat is again washed several times to eliminate the blood and others. To separate water from the washed meat, the separator is mostly used. These processes are called bleaching. Next the bleached meat is cut finely, ground and mixed with about 3 per cent of salt. The fish meat is dissolved into the saline water and brought to viscous paste. This process is necessary and important to form the elastic nature of fish jelly product. Sugar, seasoning and condiments are added to the paste and it is ground again. The paste thus prepared is called surimi. In the western part of Japan wheat starch is added and in the eastern area, potato starch is usually used, according to the taste of the consumers of the area. The addition of potato makes fish jelly product more elastic and firm.

The *surimi* thus prepared is formed into various shapes and sizes. According to the form and the method of heating many fish jelly prodncts are made. Machines are used to form the *surimi* into various type of fish jelly products. The most representative one is *kamaboko*, in its ordinary sense, the fish jelly product mount on a piece of cedar board in semicircular form. *Hmpaen* is square shaped. *Chikuwa* is in a tube form. The fish sausage recently favored is a jelly product stuffed in rubber hydrochloride or vinylidene chloride casing.

The *surimi* thus formed is heated by such methods as steaming, boiling, broiling, frying, etc. K*amaboko* is steamed, *chikuwa* is broiled, and *sa-*

tsumaage is fried. Sometimes *surimi* is heated by two methods, for instance, *yakiita kamaboko* mostly produced in the Kansai area is first steamed and then broiled.

Present Situation of Fish Jelly Product Manufacturing

In the five years between 1934 and 1936, the average production of fish jelly products amounted to 86,000 tons a year. During World War II, the production decreased drastically, but after the war it picked up gradually, and in 1958 reached 436,000 tons, five times the prewar peak. Table 1 shows the transition in the production of fish jelly products from 1953 to 1958.

Table 1. Recent Output of Fish Jelly Product

(Unit: ton)

Year	Total	Kind of Fish jelly product				
		Kamaboko	*Chikuwa*	Fried	Fish sausage	Miscellaneous
1934–1936	86,000	–	–	–	–	–
1953	227,000	103,000	81,000	–	–	43,000
1954	271,000	103,000	94,000	70,000	2,000	2,000
1955	307,000	113,000	92,000	85,000	9,000	6,000
1956	370,000	120,000	114,000	111,000	18,000	7,000
1957	434,000	145,000	114,000	128,000	36,000	11,000
1958	436,000	136,000	109,000	122,000	59,000	10,000

Because of a rapid increase in the production of fish jelly product, the raw material, especially the croakers, etc. which are caught in the sea west of 130°E longitude are getting short. This phenomenon poses an important problem to the dealers. The most popular kind of the fish jelly product is the fried one. *Chikuwa* is also a popular item, mostly produced in Hokkaido and Tohoku areas. Even though almost all coastal cities in Japan manufacture fish jelly product, Hokkaido, Miyagi, Tokyo, Kanagawa, Shizuoka, Aichi, Ishikawa, Osaka, Hyogo, Yamaguchi Prefectures are the main producing areas.

The Scale of Production

In 1955 there were 5,045 fish jelly product factories, of which 218 were combined with fisheries, and the remaining 4,827 were full-time operators.

According to the 1948 statistics, there were 4,359 factories, 62 per cent of which employed less than 5 workers, and 24 per cent were with 6–10 workers. Nearly 90 per cent of the factories were operating with less than 10

employees, proving how small in scale the industry is. More recent figures on this score are not available, but the major trend could not have changed much. The newer product, fish sausage, is produced in bigger scale factories and the representative companies in fisheries have started to manufacture fish sausage. One of the reasons for this tendency is that fish sausage can be preserved longer than other types of fish jelly products.

Future Problems

Fish jelly products are rich in animal protein, and are excellent food, but are apt to go bad quickly except fish sausage because of its high water content. Both the raw material and the products are apt to go bad so quickly that big enterprises hesitate to go into this field, and most of the fish jelly products are made by small scale enterprises.

In Japan the ice boxes and electric refrigerators are not so widely used as in Western countries, so that the fish jelly products are sold without their benefits. The need for preventing spoilage is keenly felt. Preservatives have been studied, but from the standpoint of human health, much cannot be expected from them.

The recent trend is the improvement in heating (in higher temperature) and casing and packing, but preserving fish jelly products in its present form has proved to be difficult.

If Alaska pollack, flying squid, etc. which are abundant, and less utilized for processed products, can take the place of croakers, etc. which are getting scarce, it would be ideal, but they have little elastic forming nature compared with higher class raw material presently used for fish jelly products. Stress is being laid on the study of adding the ability of forming elasticity to the meat of the fishes which have less forming elasticity. So far it has been learned that the fishes have different degrees of elastic forming nature depending upon the time after they are caught. The fresher they are, the more elastic forming nature they have. Some devices which would increase the ability of forming elasticity of fishes are needed.

In order to make fish jelly products as perfect food from the nutritional point of view, the fish jelly products are being enriched with vitamins and minerals, etc.

PROCESSED FISHERIES PRODUCTS

Outline

The processed fisheries products in Japan can be divided into 14 kinds: dried, boiled and dried, salted and dried, smoked, salted, *fushi*, agar-agar, other sea weeds, seasoned, frozen, fish paste, canned, pressed fish cake (including fish meal), and fish oil. The following is about the ten items of processing called "general" excluding the other four, i. e., seasoned, frozen, canned, and fish paste.

The general processing of fisheries products has been carried on from old in Japan since the method of and facilities needed for manufacturing them are simple, and the country is surrounded by sea. Although the exact origin is not known, as early as 718 A.D. the processing of fisheries products was practiced and the record remains today which designated 31 processed fisheries items as taxable.

The industry had its ups and downs since that time and after the fall of Tokugawa Shogunate government, the Meiji government (1868–1911) promoted the industry. The export of the processed fisheries products to China increased and the processing industry showed much development.

The steps the government took in promoting the processing industry were the encouragement of export, originating and reinstituting various methods of processing, improvement and dissemination through industry fairs, installation of the examination system, etc. of which the examination system was the most effective. With the rapid expansion of civilization and economy, the processing of fisheries products was carried out extensively, but the quality of the processed products itself was often inferior, so that it was necessary to improve the qualities.

In 1883, the examination system was initiated in Hokkaido where the processing of fisheries products was carried out most extensively. Not only the finished products were examined, but also the guidance was given to improve the processing method, so that the quality and shipping method of the processed goods greatly improved and sales increased. Although around 1764, the first of the examination system of a sort was originated the one initiated in Hokkaido was the beginning of the system applied exclusively to the fisheries products.

As the industries and economy developed, the importance of examination system was felt more keenly, and more fisheries cooperative associations began to practice it. The government encouraged this tendency

and in 1900 started to give guidance to the entrepreneurs and supervise the examination directly.

After 1912, the processing industry showed tremendous progress: processing facilities were improved and mechanized, examination system was strengthened, the technology was improved, and the export increased. However, after the breakout of the last World War, the industry was severely hit.

There are about 230,000 enterprises engaged in the general processing of fisheries products, and the amount of production amounts to 920,000 tons, 40% of the total of the processed fisheries products.

The general processed fisheries products are favored by the people, their prices are cheap, and are important supplying source of animal protein. Not only are they consumed in Japan, but are exported to Red China, and Southeast Asia, amounting to 145,000 tons (36,093,000 dollars).

The general fisheries processing industry contributes to the improved economy of the fishermen's household greatly in recent years, and plays a great role in the development of the fisheries of Japan together with the improvement in the fishing itself.

Production of Processed Goods

Production of processed goods has been increasing year after year

Table 1. Production of General Processed Fisheries Products (tons)

Year	1935	1940	1945	1950	1955	1956	1957	1958
Grand total	797,038	663,457	132,575	471,616	793,333	733,448	831,221	921,111
(A) Land factory type								
Dried products	42,026	59,273	44,828	70,448	69,675	44,040	51,049	49,312
Salted-dried products	57,683	66,461	12,953	46,601	89,265	100,606	110,785	106,720
Boiled-dried products	75,049	80,603	27,000	84,450	113,790	109,953	131,745	125,984
Smoked products	698	unknown	unknown	1,211	713	1,283	1,791	4,474
Fushi-rui	32,273	unknown	unknown	17,550	58,860	65,464	68,059	73,023
Salted products	73,046	60,015	14,865	63,765	93,653	72,011	79,179	83,712
Agar-agar	2,494	2,464	716	1,076	1,646	1,682	1,801	1,813
Dried seaweeds	62,715	97,046	20,141	50,355	56,629	56,420	61,232	55,991
Fish cake & Fish meal	374,498	156,848	11,644	70,313	141,585	134,310	156,793	212,369
Fish oil (including liver oil)	62,235	26,104	428	23,239	53,648	29,553	36,228	47,909
Total	782,717	548,814	132,575	429,008	679,464	615,322	698,662	761,307
(B) Factory ship type								
Salted products	6,963	10,505	—	13,140	32,345	23,500	23,276	22,682
Whale-oil	7,358	104,138	—	29,468	81,524	94,626	109,283	132,389
Fish meal	—	—	—	—	—	—	—	4,733
Total	14,321	114,643		42,608	113,869	118,126	132,559	159,804

since the end of the war, due to the increase in the catch. Since not all of the fishes caught can be transported, they had to be disposed of in some processed form or another.

At present, about 30 % of the catch is consumed as fresh fishes, and the rest, as much as 70 %, is turned into processed goods. Of the 70 %, about 75% is used as the raw material for the general processed fisheries products.

As the table shows, the production of the processed goods increased from 1930 on, reaching 797,000 tons in 1935, but after the breakout of the China Incident in 1937, the catch of fishes decreased, and the production of the processed goods decreased also to 663,000 tons in 1940. The fisheries were further hit after the breakout of W. W. II, due to the shortage in the kerosene, cotton thread and dye for the fishing nets, etc. and as the war became intensified, many fishing boats were commandeered. The production reached the lowest bottom in 1945, with only 132,000 tons. However, after the war, the supply of the materials for fisheries increased and more and bigger fishing boats were constructed, the fishing tackle and methods were modernized, the fishing areas were recovered and pelagic type of fishing increased. As the catch increased year after year, the production of the processed goods also increased, reaching 471,000 tons in 1950 and 921,000 tons in 1958.

Compared with the pre-war production of 797,000 tons (1935), the 1958 production was 116%, amounting to 921,000 tons, but the remarkable tendency is toward the increased processing of marine products as foodstuffs and production of such non-edible products as fish cake and fish meal decreased. The reason why these items decreased is the catch of herring and sardines, the major raw materials of fish meal and cake, has decreased to 40% of the pre-war amount. Before the war, the catch of sardines and herring was 1,600,000 tons, all of which could not be disposed of as foodstuff alone, and more than 60% was disposed of as raw material for fish cake and fish oil.

Situation of Processing Enterprises

The size of the processing enterprises varies from a very small scale, home industry one, to a big modernized factory, but the small scale ones are predominant.

The number of the enterprises was 118,840 in 1939, but gradually decreased as the industry suffered on account of the war, and was down to 84,786 in 1945. However, it increased to 145,356 in 1950, and jumped to '234,247 in 1958. Table 2 shows the number of enterprises engaged

in the general processing, broken down by the types of processing. However, most of the enterprises combine several processing types, so that the actual number of enterprises was 210,000 about 90% of the total fisheries processing enterprises. The major establishments are engaged in the processing of seaweeds since they are found all over Japan, and can be dried in the sun without needing elaborate facilities. The reason why the smoked products are the least is because our rice-eating habit does not call for this type of product much.

Table 2. The Number of Enterprises in General Fisheries Processing in 1958

Types of Processing	No. of Enterprises	Types of Processing	No. of Enterprises
Dried	40,033	Agar-agar	480
Salted-dried	13,384	Seaweeds	173,004
Boiled-dried	24,295	Fish cake, fish meal	10,934
Smoked	277	Fish oil	6,515
Fushi	4,563	Actual No. of Enterprises	210,581
Salted	5,687		

Although these enterprises engaged in the general processing are small scaled, with only primitive facilities, they are gradually improving their facilities, mechanizing some, so that they can meet the demand for more production, effectively utilizing the increased catch.

Production Methods

Although there are some areal differences in the production methods the following are the representative ones presently practiced.

1. Dried

The fishes are dried whole, or cut, removing head, bones and insides after washing. Squids are opened, and their insides eye-balls and mouth-balls are removed, washed and then dried.

Major dried items: *Surume*, dried squid
Migakinishin, dried herring
Dried sardine

2. Salted-and-dried

The fishes are dried whole, or after removing head, gills, and insides, opened, lightly salted, and then dried.

Major salted-dried items: Salted-dried sardine
Salted-dried saury pike
Salted-dried cod (including Alaska pollock)

3. Boiled-and-dried fishes

The fishes and shell-fishes are boiled and then dried. The shells from which the insides are removed and the shell-fish are washed, boiled, and dried.

Major boiled-dried items: Boiled-dried sardine
Boiled-dried sand lance
Boiled-dried scallop
Boiled-dried abalone

4. *Fushi*

The most representative method is to remove the head, tail and insides of a skipjack, cut it open, remove the backbone, and boil and dry the fillet meat with heat, and then sun-dry it, shape it, again sun-dry it, and then let it mold. When mackerel and sardines are made into *fushi*, their heads, tails, and insides are removed, the meat is boiled, dried with heat, and then let dry in the sun.

Major *fushi*: *katsuo-bushi* (dried skipjack)
saba-bushi (dried mackerel)
iwashi-bushi (dried sardines)

5. Smoked fishes

Fishes are salted either whole, or after removing gills and insides, then smoked. There are two methods for smoking; cold smoking and hot smoking. Most of them are cold-smoked.

Major smoked items: Smoked salmon
Smoked herring

6. Salted Fishes

The whole fishes or after removing heads, gills and insides or after opening them up, are washed and salted.

Major salted fishes: Salted salmon
Salted sardines
Salted saury
Salted mackerel

7. Agar-agar

The seaweed which would make agar-agar is boiled, and the agar-agar content is melted. The liquid is chilled, jelled, cut and frozen. These are melted again to take out water content, and then dried. There are two kinds of agar-agar, one is natural agar-agar, frozen and dried in cold climate, and the other, industrially made using the refrigerators. In Japan most of the agar-agar is made by the former method, and the mountainous area in Nagano and Gifu Prefectures is fit for the purpose.

8. Seaweed Products

The seaweeds are dried as they are or after being washed. Some

are cut finely or shredded. The laver is made by cutting *amanori, iwanori, aonori,* etc. finely, spreading them thinly on a bamboo mat, and then drying them.

Dried seaweeds: Dried tangle
Dried undaria
Dried gelidium amansil
Dried laver

9. Fish Cake and Fish Meal

The fishes are boiled whole, or after removing heads, bones, insides, etc., then pressed and dried. Fish meal is the ground fish cake.

Major fish cake and meal: Fish cake, herring
Fish cake, sardine
Fish cake, saury
Fish scrap cake, cod

10. Fish Oil (including liver oil)

When the fish cake is made, the oil is extracted after removing the water and dregs out of the liquid coming out of the pressed fish meat. Liver oil is extracted from the livers of Alaska pollock, cod shark, etc.

Major fish oil: Herring oil
Sardine oil
Saury oil
Alaska pollock liver oil

MARKET AND TRANSPORTATION

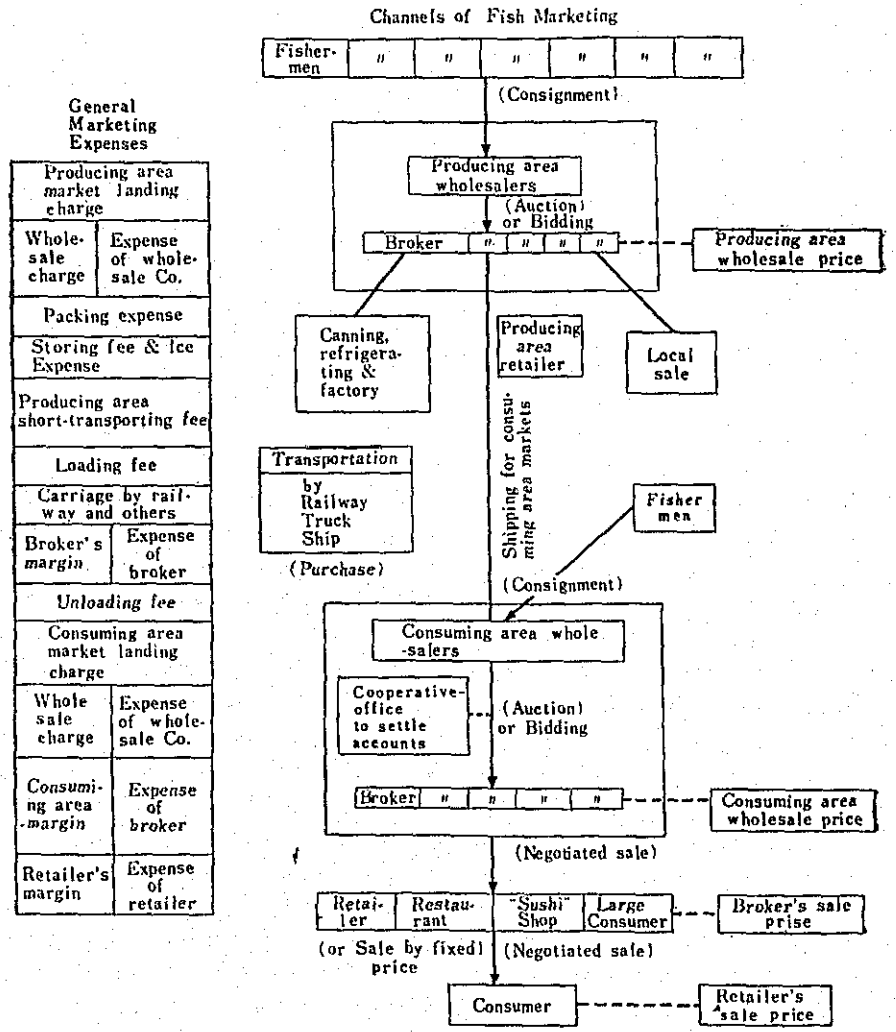
Market

In a country like Japan surrounded by the sea the position of fisheries products is far more important among the general food stuffs than in other countries because the Japanese depend upon them for almost 80% of the animal protein and the people have special liking for the fresh fisheries products. The following is an account of how they are brought to the table of the people in as fresh a state as possible.

The fisheries products are transported either fresh or in processed form. Except canned fisheries products, or *fushi*, like dried skipjack *fushi*, even the processed ones are apt to go bad quickly. As a commodity, both fresh and processed fisheries products are difficult to handle not only because of the necessity to keep their freshness, but also the kinds, shape and size vary so much. Therefore, the mechanism to cover the loss due to the drop in the price because of the lowered freshness has been established among the handlers of fisheries products.

The producers (fishermen) consign their goods to the wholesalers in the market of the producing area. The wholesalers undertake to sell to the brokers the goods for the producers. (There are several kinds of brokers, the shippers, who ship the goods to the consuming areas, those who sell to the retailers in the neighborhood, those who sell to the local agents, or those who buy the raw material for the frozen or processed fisheries products). The brokers who ship the fisheries products to the consuming areas either bid or auction for the goods within their means, considering the trend in the prices of fishes in the consuming market. The brokers take chances in naming the price, because there is the possibility of spoiling and breaking of marketability of their commodity while transported over a long distance and the merchandise being competed by other merchandise once they get to the markets of the consuming areas. The brokers, as shippers, instantly pack, wrap, ice the goods, and ship them by way of railway or trucks to Tokyo, Osaka or other consuming areas. Fresh fish and other commodities need careful ice-storage so that they will not deteriorate in their value during transportation. The goods then are consigned to the wholesalers in the markets of consuming areas, and undergoing the same sort of procedures as at the producing markets, are sold to the brokers of the consuming areas. The brokers in the consuming areas look over the size, shape, and quality of the merchandise,

and anticipate the popularity it would fetch, taking into consideration the amount of the similar and other merchandise, and name the price by auctioning or otherwise. The merchandise then is displayed at the broker's shops in the market, and the retailers come to them. The sale takes place by negotiating. The merchandise then appears in the retailers' shops from where the housewives buy either whole or sliced.



The above is the general channel through which the fishes come to the final consumers. Because of the perishable nature of the commodity the dealers try to minimize the risk by providing many steps of transaction, and selling as quickly as possible. The diagram sums up the above and tells how the general fishes come to be priced.

History of Fish Market

As stated before, there are two kinds of markets for fisheries products, i. e., those in the producing areas and others in consuming areas.

The market in the producing areas came into existence out of a group of wholesalers, who were the pre-modern commercial capitalists, in the end of the 19th century, when fishing was not yet fully developed as an industry. These wholesalers lent or advanced some money to the fishermen who needed it before they went out fishing. Through this tie they could dominate and exploited the fishermen, pocketing huge profit, when the catch was sold. Later on the fishermen started to break down this custom and at times showed their resistance by shipping the catch directly to the consuming areas. At about this time the brokers came to be highly specialized. The fishermen strengthened their position by forming co-operatives and started to sell the catch through the cooperatives, gradually eliminating the wholesalers' domination of the market. On the other hand, in the 1930s, the central wholesale market system in big consuming areas was established and the organization of the markets in the major producing areas itself was revised. Long established wholesalers and brokers became the stock-holders of the wholesale companies in the producing areas so that they would be in a better position to deal with the consuming areas. In the meantime some of the fishing capitalists had become big enough to be able to bear the cost for the shipping of their merchandise, so that they came to bypass the markets in the producing areas.

Turning back to the markets in the consuming areas, the old *Tonya* type wholesalers in these areas used to undertake all the function of the present day wholesalers, collecting the merchandise, clearing the accounts, and evaluating and shipping out the goods, which are the function of the present-day brokers, and their word went as far as the sales were concerned up to the end of 1920s. During this time the position of the producers, shippers and retailers was weak, they being dominated and in a certain degree exploited by *Tonyas*. The urban communities developed due to the centralization of population, and together with the increase in the demand, the production of fisheries products also increased, and fishing industry

went through its capitalistic development, so that each individual *Tonya* type wholesaler could not cope with the increased amount of goods they had to handle, both capital-wise and facilities-wise. This brought about the specialization of brokers. With the increased demand for fisheries products, the prices went up unwarrantedly, and the smooth supply and demand relationship was interfered with. After the breakout of W. W. I, while the commerce and industry developed tremendously, inflation occurred, and in 1918 the nation-wide mob riots were seen caused by the people who were incensed at the exorbitant rice price. The government took up the measures of selling rice cheaply and establishing public markets for the life's necessities. The urgent need for improving public markets and establishing central wholesale markets was recognized, and after many years' study and research, Central Wholesale Market Law was enacted in March, 1923. In accordance with the law, the Central Wholesale Market was first established in Kyoto, in 1927, and since then until today the central wholesale markets were established in 16 major cities, including those in 6 big cities.

Classification of Markets

The number of fish markets in the local areas (both producing and consuming areas) is estimated to be about 3,000 at present. The classification by types of markets, based upon the research made by Fisheries Agency in 1957 is as follows.

In the producing areas, out of 1,124 markets, 1,008 were established by either fisheries cooperatives or fisheries cooperatives federations, (i. e., joint sales stations), constituting about 90%, 70 were founded by corporations (6%), and 22 (2%) were opened by local public organizations. The transaction at the markets in producing areas is carried out mostly by "auction", or "bidding", and sometimes through negotiations. The consigning commission rate is 2–6%, usually 3%.

Of 545 markets in the consuming areas, 426 were established by corporations, constituting 78%, and 64 (12%) were established by commercial cooperatives and agricultural cooperatives, and 36 (7%) by individuals. The usual transaction method is by auctioning, and negotiated sales come next, and bidding is also practised. The commission rate for wholesale is 5–6%.

In the producing areas, most of the markets are operated by producers themselves, and about 70% of the markets in consuming areas are juridical persons like corporations. Although very few in number (only three cases), there are markets which were established by the public organiza-

tions and which carry on wholesale as well (i. e., public markets).

The above classification excludes the central wholesale markets. They are the ones which transact the wholesale of perishable food such as fisheries products, vegetables and fruits in big cities, in accordance with the law, and at present there are 16 of them. The founders are local public organizations (metropolitan or municipal governments). Most of the wholesalers are corporate organizations, and with the exception of two cities which have single wholesalers, the rest of the bigger markets are operated by plural wholesalers. Because of this, the competition among the wholesalers has been very intense, and gradually a few influential ones remain in the picture, the weaker and smaller wholesalers dropping out one after another. The transaction methods are usually auction and consigning, and the wholesale commission rate is 6%. The account must be cleared next day (from the wholesalers to the shippers) and usually on the third day in the case of transaction from the brokers to the wholesalers.

There is an increasing trend of the brokers cooperatives' establishing cooperative office for settling accounts (in Kyoto, Osaka, Kobe, etc.), the same trend being seen in the conventional type of markets as well, and this is significant as it will improve the position of brokers.

Related Legislation

(1) Central Wholesale Market Law

The law was enacted more than 30 years ago, and markets changed with the change of times, so that the law now appears somewhat outdated. In 1956, the partial revision of the law took place.

To touch briefly on the content of the law, the central wholesale markets are to be established in the cities with population over 150,000 or in the nearby areas which are designated by the Minister of Agriculture and Forestry (one market in one area as a rule), the founders being the local public organizations only, and the approval of the Minister of Agriculture and Forestry is necessary. The wholesalers also have to be approved by the Minister, and when necessary the brokers are to participate in the sale (the brokers have to be approved by the founders). The method of transaction is auction as a rule. In view of the importance of the wholesale, it can be put under the supervision of the governmental authorities by such means as compulsory filing of reports and inspections. Recently, too much competition has been noticed due to too many wholesalers who mushroomed up after the postwar decontrolling of fisheries products. To eliminate such excess competition, the revised law has it that the wholesalers are placed outside of the application of the Anti-Monopoly Law, if they,

previously approved by the Minister of Agriculture and Forestry, are to merge, transfer, or agree on the conditions of transaction (except on prices, quality or quantity of the products). Regulations controlling similar markets were also established.

(2) Regulations for the Local Fish Markets

There are 26 prefectures out of 46 in Japan which control the fish markets by the prefectural regulations. These regulations were enacted to take the place of Fisheries Products Control which was lifted in 1950 as a measure to regulate the fish markets, depending upon the actual conditions of the prefecture, based upon the Local Autonomy Law. At first the regulations were somewhat loose, recognizing the free market activities, but in view of the recent indiscriminate number of fish markets and their disregard of the regulations, some prefectures are finding it necessary to revise the regulations. There are variations in the local regulations concerning the fish markets, the most strict ones requiring the permit for founding of markets, for wholesalers and brokers (or buyers), while other prefectures are content just to have them registered. There are 20 prefectures which have no regulations, among which some are carrying on fishing industry actively, where the operation of fish markets is left in the hand of the operators of these markets.

Amount of Fisheries Products Handled by Central

	Tokyo		Yokohama		Nagoya	
	(ton)	(1,000 yen)	(ton)	(1,000 yen)	(ton)	(1,000 yen)
Fresh Fish	284,536	24,285,279	34,072	2,422,261	84,633	4,666,464
Frozen Fish	45,317	3,484,985	5,078	394,540	16,050	852,216
Whale Meat	11,950	807,608	2,009	141,739	5,039	307,223
Processed Fish	143,960	14,953,192	11,519	1,332,871	35,290	3,580,652
Shell-fish	15,808	1,365,706	1,538	103,010	421	34,506
Fresh-Water Fish	634	161,472	5	2,575	40	2,263
Sea-weeds	76	4,880	47	6,431	54	8,155
Total	502,281	45,063,121	54,267	4,403,427	141,526	9,451,477

The Amount Handled By the Fish Markets

The avobe table shows the amount handled by the central wholesale markets in 6 major cities. It is hard to grasp the total amount transported all over Japan, the rough estimate being about twice the amount shipped into the six major cities.

Transportation

About 70% of the fisheries products have to be transported from the north-east region (Hokkaido and Tohoku districts) and South-western region (Kyushu and Chugoku districts) farthest away from the central area. And yet the amount is consumed in the central areas, both Kanto and Kansai districts. How to overcome these almost fatal geographical conditions taxed over production and consumption is the biggest problem facing the transportation of the fisheries products. Because of this geographical condition, the fisheries products must be transported a long distance from the producing area to the consuming area. Moreover, these goods are shipped before they actually fetch the price at the markets in the consuming area. Due to the perishable nature of the goods, it is very important to maintain the quality of the fisheries products during transportation. Care must be taken so that (1) the commodities must be transported as quickly as possible, (2) the freshness is maintained as much as possible by increasing and improving the cold storage cars and (3) handling technique must be improved.

The fisheries products are mainly transported by national railways. In 1958, the total amount of fisheries products transported was 2,463,000 tons (fresh and frozen fish, 2,273,000 tons, salted, dried and processed ones,

Wholesale Markets in Six Major Cities, 1958

Kyoto		Osaka		Kobe		Total	
(ton)	(1,000 yen)	(ton)	(1,000 yen)	(ton)	(1,000 yen)	(ton)	(1,000 yen)
54,711	3,767,685	144,626	12,683,387	66,561	4,364,030	669,138	52,189,105
4,922	342,573	13,610	911,862	7,670	508,902	92,645	6,495,078
2,220	159,286	10,161	789,527	5,935	463,938	37,315	2,669,320
29,136	2,983,106	58,600	7,223,985	18,646	2,591,125	297,152	32,664,930
1,107	84,536	7,957	551,479	359	45,446	27,190	2,184,683
1,122	121,477	747	138,396	29	1,999	2,577	428,182
114	16,789	249	43,341	216	32,713	755	112,309
93,332	7,475,451	235,951	22,341,976	99,415	8,008,155	1,126,773	96,743,608

190,000 tons). The average distance transported per ton was 755 kilometers for fresh and frozen fish and 876 kilometers for salted and dried fish. These figures show the longest distance covered for the freight goods handled by the National Railways. It is desirable to use the cold storage freight cars for the shipment of fisheries products, but as of March,

1960, only 3,928 freight cars could be used, but the number is rather short needed, so that only 75% of the fisheries products are shipped by cold storage cars and the rest have to be carried by the ordinary type of freight cars.

Amount of Fisheries Products and Average Distance Shipped by Railway Freight Cars

Year	Amount of Shipment						Average Kilometers Per Ton			
	Fresh & Frozen (1,000 tons)	(Index)	Salted & Dried (1,000 tons)	(Index)	Total (1,000 tons)	(Index)	Fresh & Frozen (Kilometers)	(Index)	Salted & Dried (Kilometers)	(Index)
1936	571	(100)	289	(100)	860	(100)	434	(100)	538	(100)
1950	1,459	(255)	284	(98)	1,743	(202)	611	(141)	960	(179)
1951	1,678	(294)	254	(88)	1,932	(224)	635	(146)	966	(180)
1952	1,727	(302)	255	(89)	1,981	(230)	665	(153)	1,004	(187)
1953	1,905	(333)	268	(93)	2,173	(252)	713	(164)	1,005	(187)
1954	1,913	(335)	249	(86)	2,162	(251)	716	(165)	936	(174)
1955	1,963	(344)	226	(78)	2,189	(255)	732	(169)	912	(170)
1956	1,983	(347)	201	(70)	2,184	(254)	765	(177)	907	(169)
1957	2,145	(376)	196	(68)	2,341	(272)	750	(173)	897	(167)
1958	2,273	(397)	190	(66)	2,463	(286)	755	(174)	876	(163)

Sources: National Railway

Another means of transporting the fisheries products is by automobiles, mainly by trucks. This type of transportation is for the shipment of small amount from the producing area, carried over a short distance to the consuming area. This costs more than the railway transportation does, but it is simpler and even a small amount can be shipped, therefore, speedier. The recent trend is that more goods are shipped by the automobiles, sometimes over hundreds of kilometers. According to the research made by the Transportation Ministry in 1958, 9,256,000 tons of fisheries products were transported this way, the average transportation distance being 40 kilometers per ton. The ratio between the individually owned cars and the cars for business purposes is 61 to 39.

The transportation by ships is mainly by carrier boats, from the fishing ports to the markets in the producing area, handling the least amount of transportation.

The Problems Involving Freight and Handling Charges, and Countermeasures on Shortage of Cold Storage Cars

The present freight charges system of the National Railways is very

complicated, dividing all types of goods into 15 classes, and each class again consists of various rates depending upon the distance covered. When the cold storage cars are used, 10% has to be increased, and 15% for express transportation, 20% when particular trains are to be designated. The rate structure is further complicated because at present a policy is taken to apply reduced rate (5–10% less) for the transportation between Hokkaido to the main island, and from Shimonoseki and Kyushu to the 6 big cities markets. The transportation of fisheries products is expensive, but in view of the geographical conditions and their perishableness this complicated freight charge should be simplified and rationalized.

At present Japan Express is almost the sole agent handling the freight goods. Because of the hours of transaction at the markets the handling is carried on usually at night so that extra charge must be paid for the night work. Including the extra charge for handling the perishable goods, the loading and unloading are more expensive compared with the ordinary type of commodities, another disadvantage the fisheries products have to suffer.

Techniques Involved in Transportation

(1) Cold Storage Car

The cold storage cars presently in use are not equipped with refrigerators; only the inside walls are covered with insulaters like cork, and on top of the ceiling is placed the water tank which is filled with cracked ice. Therefore the room temperature is kept at about 10°C, not at all satisfactory for the perishable fisheries products. The refrigerated cold storage cars are bound to come up as an important problem in the near future as the frozen food gets more popular.

(2) Refrigerated Container

The cold storage freight cars are being used mainly between major producing and consuming areas, so that the local areas where they do not get many freight cars serviced, or the areas from where not enough amount for one freight car is produced, are finding it necessary to use the refrigerated containers which would enable the transportation of small amount. In 1954 subsidy was given based on the Enterprise Rationalization Promotion Law to try out the refrigeration containers. The test was successful and the National Railways bought 20 refrigerated containers of various sizes, in May, 1955. They are put to use between Sanin district and Kansai markets successfully. As of February, 1957, there are 10 one-ton size and 40 half-ton size ones in use.

(3) Simple Re-icing Machines

When the long distance is covered by the cold storage freight cars, the cracked ice in the top tank has to be supplemented once or twice. This work used to be carried out by men, very inefficiently, using bamboo baskets, usually taking 3 men and many hours. The need for re-icing machine was felt. In 1953, appropriation was granted for this purpose and re-icing machine was tried out, using motor power. The buckets, containing cracked ice is continuously lifted over the bent rail to the top tank. This has been put to practical use in some areas.

(4) *Metal Fish Containers*

The fish containers usually are wooden boxes (pine), capable of containing 10, 15, 30 kg etc. The sizes and specifications varied, much to the incovenience of those who handled the transaction. The lumber consumed amounted to 5 million *koku* (1 *koku*=0.2783 cubic meters), to make 60 million cases a year, and if iron or aluminium alloy was to be used, it meant that much of the precious lumber resources would be saved.

Since 1953 about 80,000 cases made of duralumin and 30,000 iron-made ones have been in use for the bottom sea fishes from Kyushu and Chugoku areas, some being loaned by Japan Fish Containers Co., or some are privately owned by fishing companies. Now the cases have increased to about 300,000. Containing capacities are mainly 10 kg and 25 kg. Although still few in number compared with the wooden boxes, the use of metal fish containers will spread along with mechanization of handling fisheries products.

Various conveyers are being used also, in transporting the fish from the fishing boats to the markets, or loading and unloading freight cars and automobiles, etc. Fork lifts are also used in some areas.

TRADE

Japan is the biggest fishing nation in the world, and exports over $ 200 million fisheries products a year, which is 6.8% of her total exports during 1957–59 period, exceeding the pre-war ratio of 3.7% (1935–36). The imported fisheries products amount to $7.5 million, only 0.23% of her total imports.

Export

The following table tells how the fisheries products rank in the exports. The major items exported are the canned, frozen, salted and dried sea food, oil and fat extracted, agar-agar, pearls, etc.

Table 1. Fisheries Exports (1959)

	Unit	Quantity	Value	%
Frozen Sea Food	S/T	164,317	$ 47,239,088	20.2
Frozen tuna, broadbill swordfish	//	141,806	36,640,747	15.7
Others	//	22,511	10,598,241	4.5
Canned Sea Food	c/s	9,658,734	124,299,518	53.2
Canned tuna	//	3,442,565	26,936,483	11.5
Canned salmon	//	2,758,104	64,852,267	27.8
Canned crab	//	760,663	15,114,553	6.5
Canned sardine	//	629,710	4,755,553	2.0
Canned saury	//	741,067	4,940,354	2.1
Others	//	1,326,625	7,700,308	3.3
Salted, Dried Sea Food	Pcl	147,276	5,716,036	2.4
Dried cuttlefish	//	65,478	1,374,606	0.6
Shark fin	//	17,509	953,783	0.4
Kelp	//	19,344	349,890	0.1
Others	//	44,945	3,037,757	1.3
Fishery Oils	M/T	103,564	23,549,950	10.1
Whale oil	//	100,272	18,189,969	7.8
Liver oil	//	2,810	5,253,462	2.2
Others	//	482	106,519	0.1
Agar-agar	lbs.	1,600,508	1,930,178	0.8
Pearl	gr.	43,400,306	24,218,606	10.4
Other marine products	M/T	30,610	6,451,489	2.8
Total			233,404,865	100.0

Note: S/T=Short tons; c/s=Case; Pcl=Picul; M/T=Metric tons.

Table 2. Percentage of Fisheries Exports

	Total Export (A)	Fisheries Export (B)	B/A	NB
	($1,000)	($1,000)	(%)	
1935	713,980	24,982	3.5	$1=3.5002 yen
1936	779,646	30,523	3.9	$1=3.4541 yen
1957	2,858,068	166,656	5.8	$1=360 yen
1958	2,876,320	221,472	7.7	〃
1959	3,456,492	233,405	6.8	〃

(The same exchange rate will be used hereafter)

1. Canned Sea Food

The major ones are canned salmon, canned tuna (including canned skipjack), canned crab, canned sardine, canned saury, etc.

(1) Canned Salmon

The exported amount of the canned salmon is as follows:

Table 3. Canned Salmon Exported

Year	Quantity	Value
	c/s	$
1935	1,083,928	4,626,127
1936	1,423,103	7,798,804
1957	1,385,884	33,623,069
1958	2,482,843	68,608,442
1959	2,758,104	64,852,267

(c/s=case)

Around 1935–36, 70 to 80% of the canned salmon was exported to the UK and the rest to France, Australia, Africa, etc., but in 1954–55, 50% went to the UK and the rest to Ireland, Australia, the US, etc.

The canning of salmon was badly hit by the war and did not recover its pre-war level of production and export until 1953. Only 80,000 c/s were exported in 1953. However, after 1954, as the fisheries in the northern seas were resumed, the production of canned salmon increased, and exports reached 1,385,884 c/s in 1957. The British measure of September 1958 to ease import restrictions on canned salmon introducing the Open General License helped boost Japan's canned salmon export sharply. They finally reached 2,480,000 c/s or $68 million, 70 per cent of which were shipped to Britain. Other destinations were the United States, Australia, Belgium, the Netherlands, etc. Most of the salmon canning is done in the factory ships at northern sea ports, and partly in Hokkaido.

(2) Canned Tuna and Skipjack

Table 4. Canned Tuna and Skipjack Exported

Year	Quantity	Value
	c/s	$
1935	556,700	1,426,178
1936	508,844	1,346,963
1957	3,077,923	22,850,356
1958	3,035,910	23,266,806
1959	3,442,565	26,936,483

In 1959, exports of the canned tuna and skipjack in oil were about 1,361,074 c/s ($8,877,611), and those in brine, 2,063,244 c/s ($17,936,166). Of those in oil, 268,453 c/s ($2,209,236) were mainly canned albacore, and 1,092,963 c/s ($6,668,385) were either skipjack or yellow-fin tuna. Of those in brine, 1,004,822 c/s ($10,296,844) were albacore, and 1,058,422 c/s ($7,-639,322) were skipjack or yellow-fin tuna. Most of these are produced in Shizuoka Prefecture, and Miyagi Prefecture comes next. The canned tuna and skipjack in brine are exported to the U.S. and those in oil are mostly exported to Germany, Canada, Lebanon, U.K., Syria, Saudi-Arabia, Belgium, the Netherlands, etc.

(3) Canned Crab

King crab, *Hanasakigani*, *Kegani*, *Zuwaigani*, etc. are used.

Table 5. Canned Crab Exported

Year	Quantity	Value
	c/s	$
1935	1,353,993	5,617,095
1936	1,142,546	4,979,582
1957	647,506	11,344,539
1958	681,758	12,814,686
1959	760,663	15,114,553

In 1959, 578,530 c/s ($12,283,992) were made with king crab, out of which 55% were exported to the U.S., and the rest to the U.K., Belgium, France, Australia, etc. About 112,780 c/s ($1,738,572) were *kegani* cans, of which 50% were exported to the U.K., and the rest, to the U.S., Canada, Australia, etc. Most of the canned king crab is produced on factory ships operated in the northern seas, and canned *kegani* are produced on the coast of Hokkaido.

(4) Canned Sardines

In 1959, the canned sardines in tomato sauce amounted to 609,395 c/s, and those boiled, 19,404 c/s. They are mostly produced in Shimane, Tottori, Yamaguchi, Chiba, Aomori, Miyagi, Ishikawa, Fukui, and

Nagasaki Prefectures.

About half of that canned sardines are exported to the Philippines, next to Africa, Belgium, Burma, Southeast Asia and Europe.

Table 6. Canned Sardines Exported

Year	Quantity	Value
	c/s	$
1935	1,069,726	1,590,989
1936	1,497,974	2,165,907
1957	919,010	6,932,636
1958	687,789	5,236,814
1959	629,710	4,755,553

(5) Canned Saury

Table 7. Canned Saury Exported

Year	Quantity	Value
	c/s	$
1953	377,179	3,017,432
1954	483,277	3,141,300
1957	502,881	3,727,491
1958	957,144	6,385,272
1959	741,067	4,940,354

Since 1950 the catch of saury increased, so that much of it came to be canned and exported. About 212,222 c/s are in tomato sauce, and 364,398 c/s are boiled. Major producing areas are Chiba, Miyagi, Aomori, Shizuoka Prefectures and Hokkaido. The canned saury in tomato sauce are mostly exported to Burma, Ghana, the Netherland, New Guinea and Philippines and boiled one to Egypt, Philippines, Ceylon, territory of New Guinea and Papua.

2. Frozen Sea Food

The major frozen sea food exported are tuna, broadbill swordfish, and common scallop, prawn, bullfrog, rainbow trout, etc. follow.

(1) Tuna

The 1959 figures show that 30% were albacore, 70% yellow-fin tuna, besides the small quantities of big-eye tuna, skipjack, and blue-fin tuna. Major producing areas are Tokyo, Shizuoka, Kanagawa, and Miyagi Prefectures.

Of the canned albacore, 95% are exported to the U.S., and the rest, 5%, to Canada. Of yellow-fin tuna, 70% is exported to the U.S., and 30% to Italy, Yugoslavia, etc. Since 1958 the catch of albacore in Japanese

Table 8. Frozen Sea Food Exported (1959)

	Quantity	Value	Average Unit Price
	S/T	$	$
Tunas	*134,088*	32,753,239	244
Skipjack	1,244	210,903	170
Albacore	39,020	11,655,711	299
Yellowfin tuna	90,535	20,242,692	224
Bluefin tuna	48	11,258	235
Others	3,241	632,675	195
Swordfish, marlins & sailfish	7,718	3,887,508	504
Broadbill swordfish	6,629	3,590,364	542
Others	1,089	297,144	273
Other frozen sea food	22,511	10,598,341	471
Sea bream	684	283,981	415
Salmon	1,736	1,407,286	811
Red salmon	1,380	926,539	671
Common scallop	885	676,069	764
Shrimp, lobster & prawn	*3,604*	*4,878,147*	*1,354*
Edible frog	338	397,403	1,176
Others	13,883	2,028,916	146
Total	164,317	47,239,088	287

Table 9. Frozen Tuna Exported

Year	Quantity	Value
	S/T	$
1935	3,578	342,292
1936	1,885	178,418
1957	74,735	19,403,033
1958	104,380	27,080,624
1959	134,088	32,753,239

waters has been declining, and the ratio of albacore in tuna exports has been dwindling. On the other hand, however, large tuna boats began to operate in fishing grounds in the Atlantic from the latter half of 1958 and export their catches to the U. S., Italy, Yugoslavia and other European countries and Africa in increasing quantities. Yellow-fin tuna exports have increased to take over the position of albacore exports.

(2) Broadbill Swordfish

Miyagi Prefecture produces about 50% of the frozen broadbill swordfish, and Tokyo follows with few other prefectures. The US is the sole importing country.

3. Salted-dried Sea Food

Exported salted-dried sea food amounted to $5,716,036 in 1959, major ones being dried cuttlefish, kelp, dried scallops, dried abalone, dried shark fins, etc.

Table 10. Broadbill Swordfish Exported

Year	Quantity	Value
	S/T	$
1953	5,666	3,479,951
1954	6,282	3,834,354
1957	7,031	4,512,358
1958	8,166	4,911,323
1959	7,718	3,887,508

Table 11. Dried Marine Products Exported

Year	Dried Cuttlefish		Dried Scallops		Kelp	
	Quantity	Value	Quantity	Value	Quantity	Value
	Pcl	$	Pcl	$	Pcl	$
1935	77,415	1,011,431	24,652	608,310	567,173	941,968
1936	57,740	831,506	20,957	640,751	572,075	1,056,729
1957	65,526	1,588,194	2,526	490,186	32,663	525,803
1958	52,181	1,284,494	3,176	573,844	74,792	853,856
1959	65,478	1,374,606	3,330	613,942	19,344	349,890

Major countries these are exported to are Formosa, China, Hongkong, Singapore, etc.

4. Agar-agar

Table 12. Agar-agar Exported

Year	Quantity	Value
	lbs.	$
1935	3,328,571	1,217,595
1936	3,900,264	1,613,860
1957	1,430,638	2,013,978
1958	1,458,055	1,801,706
1959	1,600,508	1,930,178

Agar-agar is taken from a certain kind of seaweed, is produced mainly in Nagano Prefecture (about 50%), next in Gifu and Osaka Prefectures. It is exported mainly to the UK and the US, next to Western Germany, Italy, Red China, France, etc.

5. Pearls

Table 13. Pearls Exported

Year	Quantity	Value
	gr.	$
1953	7,982,914	4,930,247
1954	12,154,457	7,398,625
1957	26,493,831	16,747,819
1958	34,450,966	17,938,114
1959	43,400,306	24,218,606

The major producing areas are Mie and Nagasaki Prefectures and about 50% of the pearls are exported to the US, next to Switzerland, India, West-Germany, France, etc.

6. Whale Oil

Table 14. Whale Oil Exported

Year	Quantity	Value
	(M/T)	$
1935	3,166	179,602
1936	2,843	267,490
1957	71,552	16,446,336
1958	102,206	19,783,686
1959	100,272	18,189,969

Most of the whale oil is produced on the whaling boats in the Antarctic, and partly in the whaling boats in the northern seas, and by the coastal whaling.

In 1959, 89,217 L/T of fin whale oil, 12,505 L/T of sperm oil were produced, and fin whale oil was exported to the Netherland, the U.K. and West Germany, and sperm oil, to the U.S.

7. Fish Liver Oil

Fish liver oil is taken mostly from the liver of cod, Alaska pollack and shark.

Table 15. Fish Liver Oil Exported

Year	Quantity	Value
	(M/T)	$
1935	5,910	974,527
1936	5,061	1,288,470
1957	3,217	6,141,770
1958	2,690	4,793,450
1959	2,810	5,253,462

In 1959, about 75% of fish liver oil was exported to the U.S., and the rest, to Belgium, Norway, the Netherland, Canada and the U.K.

Import

The percentage the fisheries import holds in total Japanese imports is as in Table 14.

Table 16. The Ratio of Fisheries Import in Total Imports

Year	Total Import (A)	Fisheries Import (B)	B/A
	$1,000	$1,000	%
1935	706,353	2,143	0.30
1936	801,067	2,199	0.27
1957	4,283,590	7,354	0.17
1958	3,033,124	9,309	0.31
1959	3,599,490	7,587	0.21

The import during 1935–36 period was as in Table 17, the conch-shells which are the raw material for buttons, etc. being the major import item, and salted fish and other sea food came next. Major countries these were imported from were Canada, the US, Australia, China, etc.

Table 17. *Imported Fisheries Products, 1935-36*

	1935	1936
Salted fish	$ 464,975	$ 419,913
Other sea food	609,490	408,877
Shells	976,582	1,275,333
Tortoise shell	73,467	73,899
Sponge	18,778	21,517
Total	2,143,292	2,199,539

However, after the war, both the imported items and the exporting countries are entirely different from the pre-war ones as shown in Table 16.

More than 90% of the fresh or frozen sea food is imported from Korea, greater portion being rather higher class fishes such as yellow tail, spanish mackerel, etc. Most of the salted and dried sea food are imported from Korea also, such as dried laver, other edible seaweeds, etc. From China, Japan imports frozen prawn etc.; from Ryukyu, dried skipjack shells and whale oil, and from Canada, salmon roe. Other imported fisheries products are shells and non-edible sea weeds. The shells are processed and re-exported, and the non-edible seaweeds are used for construction purposes.

Table 18. Imported Fisheries Products, 1957-59

	1957	1958	1959
	$	$	$
Fresh or frozen sea food	2,475,044	3,203,450	1,184,344
Salted or dried sea food	822,633	1,959,203	1,738,069
Canned sea food	43,253	24,189	64,517
Fats and oil	173,189	468,289	766,194
Agar-agar	933	343,239	325,672
Pearls	48,986	267,750	331,772
Shells	2,437,603	1,885,300	1,869,131
Other fisheries products	1,352,817	1,158,067	1,310,219
Total	7,354,458	9,309,487	7,589,919

The agar-agar, fats and oils are mostly imported from Korea in crude form, and these are refined in Japan, to be re-exported.

Table 19. Imported Fisheries Products by Exporting Countries

	1957	1958	1959
	%	%	%
Korea	32	39	39
China	27	27	27
Ryukyu	10	9	9
U.S.	10	6	
Others	21	19	19
Total	100	100	100

EDUCATIONAL AND RESEARCH INSTITUTIONS

Introduction

For the sake of increased fisheries production, the trained fishermen and many technicians are required, so that the fisheries education and research facilities in Japan are well organized.

Before the war during 1930-34 period, the average consumption of protein food per capita per day was 66.7 grams, out of which 11.7 grams was animal protein–9.5 gram fisheries animal protein (81.1%) and 2.2 grams land animal protein (18.8%). If a Japanese is to eat 200 grams of fish (100 grams edible part, 18 grams average protein content), for the present population of 89, 280,000, 6,500,000 tons of fish a year would be needed.

At the end of the 19th century, the mechanization and industrialization of the Japanese fisheries set in necessitating the modern fisheries education. In 1898 and again in 1908 the steam whaler "Orga" (125 gross tons) and the steam trawler "Henne Castle" (169 gross tons) came to Japan from Norway and Great Britain respectively. In 1913 the number of the Japanese trawlers reached 139. In 1912 the powered fishing boats were 1,000, in 1922, 7,000 and in 1932, 40,000. The most recent figure, in 1955, showed they were as many as 385,000.

As early as in 1895 the local fisheries schools were opened, such as Obama Fisheries School in Fukui Prefecture and Miyako Fisheries School in Iwate Prefecture, which still exist today, as well as the other schools which were opened later. In 1897 Fisheries Training Institute, attached to the Ministry of Agriculture and Commerce, was established which was the predecessor of the present Tokyo Fisheries University. In 1907 Fisheries Department was established in Sapporo Agricultural College, now the Fisheries Department of Hokkaido University. In 1908 Fisheries Course was opened in Agricultural Department, Tokyo University.

Usually the fisheries schools curriculum includes three courses, fisheries, manufacturing and culture. Needless to say these courses were developed into the present status due to the actual necessities of the Japanese fisheries industry.

The Japanese fishing grounds have changed. The trawling type of fishing was first operated in East China Sea and the Yellow Sea but since 1928, this was expanded to the South China Sea, the Bering Sea, etc. and in April, 1934 the first Japanese whaler was operated in the Antarctic. After World War II, the tuna boats usually make trips longer than 2 months

to the Southern Pacific and the Indian Ocean. Under the circumstances, many of the fisheries higher schools have the training boats bigger than 100 gross tons. In the fisheries courses at college level, the seamen of the highest class are trained in accordance with the Ship Staffs Act, and the colleges are equipped with still bigger training boats.

In the manufacturing course, the technicians are trained who are needed in the factories which produce not only for domestic market but for the export markets. In 1910 the first salmon canning factory was built by the Japanese in Kamtchatka, and the export of salmon cans amounted to more than a million cases a year. Since 1923, the frozen fisheries products came to be consumed gradually in Japan and became a major export item.

The culture course stresses on fisheries biology and is an important course in view of the fact that the protection of the fisheries resources has acquired the world wide importance. The pearl culture, of which export reaches US$1,000,000 a year, or the development of *nori* culture the skill of which was disseminated among the Koreans so much that we now import from that country US$1,000,000 of it, owe very much to the graduates of this course.

Recent development in chemical industry, radio and atomic science influenced the development of fisheries industry and its research. The social and international problems of fisheries also showed development. The educational and research institutes on fisheries are entering the new fields to accommodate to these changes, as is perhaps the same in the other countries.

Higher Schools

The Japanese school system makes it compulsory to finish 6 years of primary school course and 3 years of junior high school course. Those who finished these courses enter the 3-year senior high schools, and the graduates of this course are mostly 19 years old.

Some of the high schools have fisheries course, and some are called fisheries high schools with considerable number of courses on fisheries. These two types of high schools number 56 in all (as of October, 1953). Except a few, all are established by the local governments. Some of the larger ones have branch schools or night schools. These fisheries high schools are established in the major fisheries centers all over Japan, and many of the students come from the fishermen's families.

The objective of the fisheries education carried out in the high schools is to train the students in the technical knowledge and practical skill,

as well as the general education, so that they would become independent entrepreneurs or young technicians with awakened consciousness and pride in their occupation. The definite objectives include the following:

1. To let the students understand correctly the role the fisheries play upon the development of the Japanese industrial economy and the improvement of the national living.
2. To let the students understand the geographical environment of Japan and the importance of the fisheries in such conditions, and make them realize how important it is to understand and protect the fisheries resources based upon the scientfiic reasons.
3. To let the students acquire basic knowledge and practical skill in all the fields of fisheries industry.
4. To let them understand the legislation concerning fisheries, and cultivate in them the spirit of abiding by these laws.

Usually the graduates of fisheries high schools are engaged in fisheries either directly or indirectly after graduation. Among the living graduates, those who are engaged in fisheries, either as entrepreneurs, staffs of fisheries companies, or as officers of the fisheries organizations, were in the case of Otaru Fisheries High School, 52.4%, Yaizu Fisheries High School, 34.9%, and Obama Fisheries High School, 29.2% (in 1953).

List of Fisheries High Schools

(Data from Education Ministry)

Aichi Prefecture	Miya Fisheries High School
Akita 〃	Funakawa FHS
Aomori 〃	Hachinoe FHS
Chiba 〃	Awa FHS, Choshi FHS, Isumi High School
Ehime 〃	Uwajima South High School
Fukui 〃	Obama FHS
Fukushima 〃	Onahama FHS, Yotsukura High School
Hokkaido	Abashiri Koyo High School, Atsukeshi FHS, Hakodate FHS, Hiroo High School, Kitahiyama High School, Otaru FHS, Mori High School, Urakawa High School, Shiboribetsu High School
Hyogo Prefecture	Kazumi High School
Ibaragi 〃	Nakaminato FHS
Ishikawa 〃	Nanao HS, Usetsu FHS
Iwate 〃	Hirota FHS, Kuji HS, Miyako FHS,
Kagawa 〃	Tadotsu FHS

Kagoshima 〃	Kasasa HS, Makurasaki FHS, Nishiminamikata HS, Yamakawa HS
Kanagawa 〃	Misaki FHS
Kochi 〃	Murotomisaki FHS, Takaoka HS
Kumamoto 〃	Amakusa Agricultural HS
Kyoto 〃	Kyoto Prefectural FHS
Mie 〃	Owase HS
Miyagi 〃	Miyagi Prefectural FHS, Kesenuma FHS
Miyazaki 〃	Miyazaki FHS, Nichinan HS
Nagasaki 〃	Nagasaki FHS
Niigata 〃	Nou FHS
Oita 〃	Usuki HS
Osaka 〃	Osaka FHS
Shimane 〃	Hamada FHS, Oki HS
Shizuoka 〃	Inatori HS, Yaizu FHS
Tokushima 〃	Hiwasa FHS
Tokyo Metropolis	Oshima HS
Tottori Prefecture	Sakai HS
Toyama 〃	Toyama FHS, Ariso HS
Yamagata 〃	Kamo FHS
Yamaguchi 〃	Yamaguchi Prefectural FHS

Number of Students at Fisheries High Schools (as of April 30, 1951)

Courses	Male	Female	Total
Full-Time			
Fishing	3,109	13	3,122
Fisheries manufacturing	3,463	104	3,567
〃 culture	505	7	512
Fisheries	656	30	686
Others	126	14	140
Total	7,859	168	8,027
Part-time			
Fishing	237	–	237
Fisheries manufacturing	9	–	9
〃 culture	–	–	–
Fisheries	366	104	470
Others	26	–	26
Total	638	104	742
Grand Total	8,497	272	8,769

Universities

The university courses on fisheries and agriculture are four years. The entrants are selected out of those who finished the high school course, but because of the examination system and the economic conditions of the students' families, there are few graduates of fisheries high schools or the children of the fishermen's families attending these universities.

In Japan there are 72 national universities, 33 public and, 123 private ones, totalling 228 universities at present (June, 1956), of which 12 have the fisheries courses. There is one Fisheries college, attached to the Ministry of Agriculture and Forestry. In the old school system the fisheries course was included in the agricultural department.

Each university has its own unique curriculum for the fisheries course in the Agricultural Department, usually laying stress upon the fisheries biology, fisheries chemistry, etc. There are 15 Fisheries Experimental Stations by the sea which aim at teaching and making research on the fisheries biology, even excluding those attached to the Physics Department of universities. The fisheries chemistry has been independent from other fisheries courses. For instance in the graduate course of Kyoto University the course specializing in the fisheries chemistry is set up apart from the fisheries course.

Fisheries course was set up for the first time after the war, and what makes it different from other university courses is the big size training boat it possesses for the purpose of teaching and studying oceanography and fisheries. The Umitaka-maru of Tokyo Fisheries University, Oshoro-maru of Fisheries Department, Hokkaido University, Kagoshima-maru of Fisheries Department, Kagoshima University, Shunkotsu-maru of Fisheries Training Institute, MAF, are over 500 gross tons, and train the seamen of the highest degree as prescribed by the Vessels Staffs Law.

The fisheries courses are set up in Hokkaido, Tohoku, Tokyo, Kyoto and Kyushu universities usually divided into fisheries biology and fisheries chemistry, but as was stated before in the post-graduate course of Kyoto University. When the college graduates take course from 2 to 5 years or over and acquire the required units, they are given the master's or doctor's degree, respectively. At Hokkaido University, Master of Fisheries, or Doctor of Fisheries, and in other universities, Master of Agriculture or Doctor of Agriculture are accorded.

It is customary that those who took fisheries course at universities are engaged in fisheries either directly or indirectly. The research was made on 809 graduates of Tokyo Fisheries University who reside in Tokyo and

it was found 244 were working at the companies connected with fisheries, 100 were public service men concerned with fisheries administration, 95 were with the fisheries universities or research institutes, 49 were officers of fisheries organizations, and a few others were entrepreneurs in fisheries and some were Diet members representing the fisheries industry. Out of 2,496 graduates of Fisheries Department, Hokkaido University, 736 worked in the companies connected with fisheries, 93 were officers of fisheries organizations, and 18 were entrepreneurs in fisheries.

List of Universities Where Fisheries Courses Are Given

Universities	Faculty	Courses	No. of Students Authorized	Note
Tokyo Fisheries U.	Fisheries	Fishing Culture Manufacturing	220	National
Hokkaido U.	Fisheries	Fishing Pelagic fishing Culture Manufacturing	200	National
Kagoshima U.	Fisheries	Fishing Manufacturing	120	National
Nagasaki U.	Fisheries	Fishing Manufacturing	90	National
Mie Prefectural U.	Fisheries	Fisheries	90	Public
Tokyo U.	Agriculture	Fisheries	20	National
Tohoku U.	〃	〃	30	〃
Kyoto U.	〃	〃	45	〃
Kyushu U.	〃	〃	10	〃
Miyazaki U.	〃	〃	20	〃
Hiroshima	Fisheries & Cattle Raising	〃	30	〃
Nippon U.	Agricultural & Vet.	Fisheries	150	Private
Fisheries Inst.	–	Fishing Engine Culture Manufacturing	160	National (MAF)

Examples of Curriculum at College Level
(Tokyo Fisheries University)

1. Fishing Course

Subject	Required Units	Optional Units
General fisheries	4	–
Mathematics	12	–
Physics	3	–
Physical experiments	2	–
Dynamics	4	–
Drawing	2	–
Organic chemistry	–	4
O. c. experiments	–	2
Zoology	–	3
Botany	–	2
Principle of fish. I	2	–
Fisheries zoology	4	–
Fisheries resources I	2	–
〃 II	2	–
Mechanical engineering	–	4
Hydraulics	4	–
Electric engineering	4	–
Machine drafting exercise	–	1
Fishing boats	4	–
Fishing machinery	–	2
Fishing meteorology	4	–
Fishing legislation	–	4
Fisheries economics	–	4
History of fisheries	–	4
Fishing gear	3	–
Gear physics	–	2
Gear material	–	2
General fishing	–	4
Oceanography	6	–
O. exercise	2	–
Principle of fishing II	2	–
exercise of the above	2	–
Navigation	9	2
N. exercise	1	–
Navigation gauges	4	–
N. g. exercise	2	–
Operation of vessels I	6	–
〃 II	2	–
〃 exercise	5	–
Liquid dynamics	2	–
Elect. wave engineering	4	–
Hygienics in vessels	2	–
Seminar	2	–
Graduation thesis	6	–

2. Manufacturing Course

Subject	Required	Selective
Fisheries general	–	4
Math.	10	–
Physics	4	–
〃 experiments	2	–
Inorganic chemistry	2	–
Biochemistry	2	–
〃 experiments	2	–
Industrial chemistry	4	–
Seasoning	2	–
Accounting	–	4

(*continued*)

Organic chemistry	4	–
〃 experiments	2	–
Analytical chemistry	4	–
〃 experiments	2	–
Mechanical engineering	–	4
〃 experiments	–	1
Electric engineering	–	4
Manufacturing machinery	–	2
Manufacturing m. exercise	–	3
Machinery drafting	–	1
Thermo engineering	–	2
Chemical engineering	–	4
Fisheries material	–	2
Applied physics	–	4
Physics	4	–
〃 experiments	2	–
Bookkeeping	2	–
Fisheries legislation	–	4
Fisheries economy	–	4
Fisheries management	–	4
Fisheries history	–	4
Manufacturing machinery	–	2
Microbiology	4	–
〃 experiments	2	–
Applied microbiology	–	2
Freezing, cold storage	5	–
〃 exercise	2	–
Fisheries manufacturing I	7	–
〃 experiments	2	–
〃 exercise	3	–
Fisheries manufacturing II	5	–
〃 experiments	2	–
〃 exercise	2	–
Seminar	2	–
Graduation thesis	6	–

3. Culture Course

Subject	Required	Selective
General fisheries	–	4
Mathematics	6	4
Physics	–	4
〃 experiments	–	2
Organic chemistry	–	4
〃 experiments	–	2
Zoology	4	–
〃 experiments	2	–
〃 exercise	1	–
Biogenesis	4	–
〃 experiments	2	–
〃 exercise	1	–
Botany	4	–
〃 experiments	2	–
〃 exercise	1	–
Land water	–	2
〃 exercise	–	1
Geology	–	2
〃 exercise	–	1
Microbiology	–	4
Genetics	–	4
Biology of floating livings	–	2
〃 exercise	–	1

(continued)

Engineering for culture	–	2
〃 exercise	–	1
Fisheties zoology	4	–
〃 experiments	2	–
〃 exercise	1	–
Fisheries botany	4	–
〃 experiments	2	–
〃 exercise	1	–
Oceanography	2	–
〃 exercise	1	–
Fisheries legislation	–	4
Fisheries economy	–	4
History of fisheries	–	4
Physiology & ecology	4	–
〃 experiments	2	–
Fisheries resources I	–	5
〃 II	–	4
Culture I	7	–
〃 exercise	2	–
Culture II	4	–
〃 exercise	2	–
Culture III	2	–
〃 exercise	2	–
Feed	2	–
〃 experiments	1	–
Pathology	2	–
〃 experiments	1	–
〃 exercise	1	–
Seminar	2	–
Graduation thesis	6	–

Research Organs

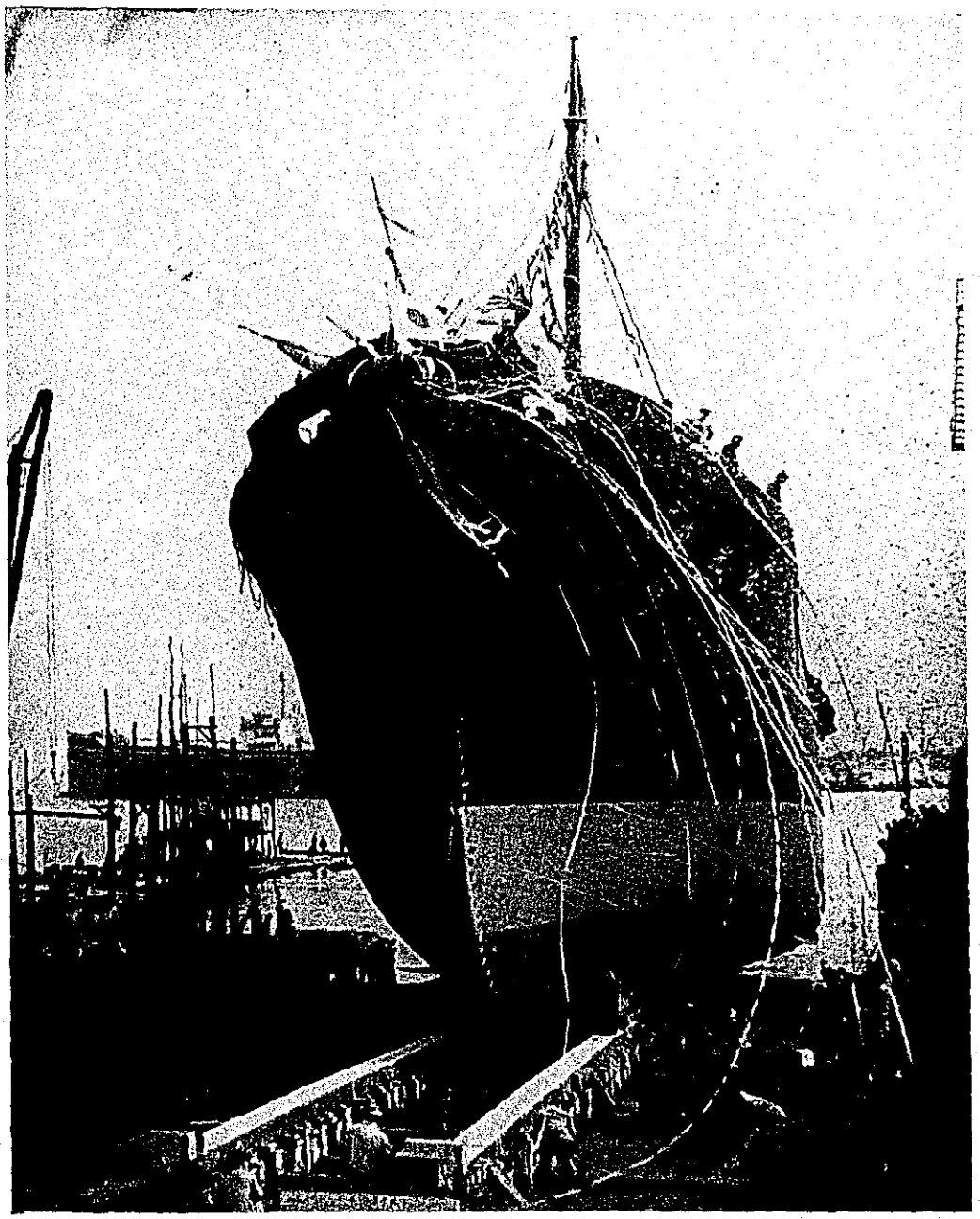
A. National Research Laboratories

Fisheries Experimental Station was established in 1929 by the Ministry of Agriculture and Forestry, separating the experimental branch of the Fisheries Training Center, the first independent research organ on fisheries in Japan. In 1949, to take its place, the following fisheries research institutes were established and next in 1952 Pearl Research Institute was newly established. All of these are attached to the Fisheries Agency.

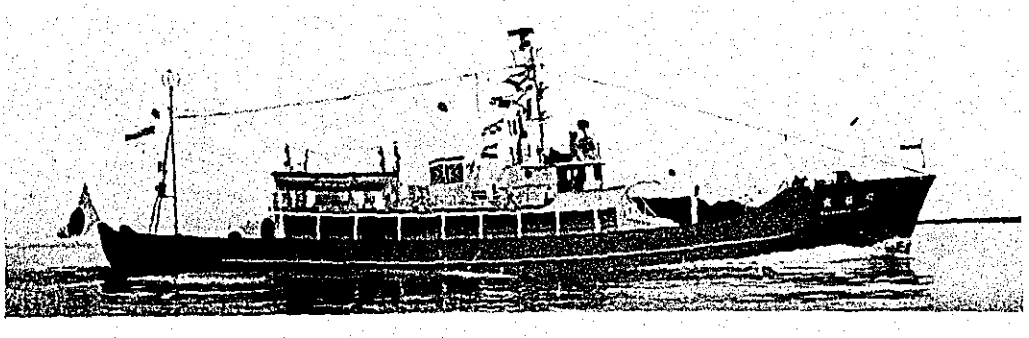
Hokkaido Regional Fisheries Research Laboratory	Yoichi, Hokkaido
Tohoku Regional Fisheries Research Laboratory	Shiogama
Tokai Regional Fisheries Research Laboratory	Tsukishima, Tokyo
Nankai Regional Fisheries Research Laboratory	Kochi
Seikai Regional Fisheries Research Laboratory	Nagasaki
Nippon Sea Regional Fisheries Research Laboratory	Niigata
Inland Sea Fisheries Research Laboratory	Hiroshima
Non-tidal Water District F. R. I.	Hino, Tokyo
Pearl Research Institute	Ago, Mie Pref.

These laboratories have their own special field of research. For instance, Tohoku District F. R. I. lays stress on the study of skipjack, and Nankai District F. R. I., pelagic tuna, and Seikai District F. R. I., bottom fishes in East China Sea and the Yellow Sea. With the cooperation of the other

Research boat *launched*



Fisheries patrol boat



Launching of the Ceylon Maru donated by Japan to Ceylon under Colombo Plan

Asian trainees practising operation of fixed nets

fisheries research laboratories and universities the Tsushima Warm Current Development Project is underway. In the fields of processing and chemical study, these laboratories have their own features. For instance, Inland Sea F. R. I. centers its study on the prevention of pollution of Inland Sea water. On the other hand, such common subjects as vitamins in oil and fat, protein, retaining of the freshness, biochemical study of resources, etc. are tackled concertedly by these laboratories.

B. Local Fisheries Experimental Stations

The prefectural governments established the fisheries experimental stations and fisheries guidance centers in order to carry on the research closely related to the special conditions of the area and to give guidance to the areal fisheries. There are 59 of this kind of facilities altogether, with 2,296 staffs. Many of these organs carry on research and give guidance on such fields as fishing, culture and manufacture. Especially those in Hokkaido, Chiba and Tokyo are equipped with considerable number of facilities and about 100 to 160 staffs each, while in such prefectures as Tochigi, Gunma, Saitama which have no coastal line, the major activities of this kind of organ is limited to culture and consequently the number of the staffs is less than 10 (as of Jan., 1952, Manual of Fisheries Experimental Stations).

Aichi Prefectural Fisheries Experimental Station is the oldest one, established in 1894. The ones in Ehime and Fukuoka were established in 1898, and those in Miyagi, Chiba, Niigata and Mie, in 1899, the majority of them having been established in Meiji era.

The first powered fishing boats equipped with internal combustion engine was constructed for the experiment of skipjack fishing, by Shizuoka Fisheries Experimental Station in 1906, and was named Fuji-maru, a sailing boat of 25 gross tons, with 20 horse power. The first powered trawler was operated in 1912 when Shimane Prefectural Fisheries Experimental Station constructed the Yachihoko-maru (17 gross tons, 25 horse power), and experimented on hand-operated netting off the coast of Oki Island. The first mother-boat type of crab fishing was carried on in Kamchatka and Alaska in 1920 by the Kureha-maru, of Toyama Prefectural Fisheries Training Institute. Kureha-maru succeeded in the experiment of canning of crab using sea water to wash the crab meat. The contribution made by these local fisheries experimental stations is indeed very great.

C. Private Research Organs

Such big fishing companies as Taiyo Gyogyo, Nippon Suisan, and

Nippon Reizo have their own research institutes. The research institute of the Lion Oil and Fat Co. is engaged in the research somewhat connected with fisheries. Besides the above, there are Fuji Pearl Co. Research Institute, Matoya Bay Oyster Culture Research Institute, etc.

The Whales Research Institute was established in 1941, making its start as Chubu Research Institute at first, and was reorganized in 1946 to become the present institute. Since 1948 it publishes annual reports which are known by the countries connected with whaling.

Fisheries Research Association was established in 1947 with the help of Fisheries Agency, and specializes in the economic study of fisheries. Nippon Jomin Bunka Research Institute is known for its study of data on the history of fisheries.

Educational Facilities for Students from Abroad

Asian countries have one common problem, i. e., how to increase the production and consumption of fish in order to improve the dietary life and living standards of their peoples. With the concerted effort of the United Nations and its specialized agencies, they are striving hard to mechanize and organize their fisherie.

The training of personnel is one of the basic needs for the development of the fisheries industry. Fisheries education and an international exchange of students and technical trainees are recognized as being of tremendous value in training personnel.

In various industrial fields, Japan received a total of 2,249 trainees from Southeast Asian countries by the end of April 1960, of which 160 were in fisheries. They underwent training and education at the Government's Fisheries Reserch Laboratories and universities. Japan also dispatched 255 experts to Asian countries during the same period, of which 25 were engaged in technical guidance in fisheries.

Such exchange of trainees and specialists is done through the Asia Kyokai. The Asia Kyokai was established on April 9, 1954 as a private, non-profit and non-political organization purported to promote friendly ties with other Asian nations in social, cultural, economic and technical fields. It enjoys the full support of the Japanese Government and the cooperation of a preponderant majority of Japan's major industrial and economic organizations and firms. The Japanese Foreign Ministry entrusts the Asia Kyokai with all the economic technical cooperation facilitation.

One of the major problems foreign trainees experience is that of language. In order to overcome language barriers, they are recommended

to attend the Japanese language class at the International Students Institute. This Institute is a private organization aiming at promotion of international goodwill, makes arrangements for foreign students to study at suitable schools, conducts Japanese classes and operates a hostel. The institute received 1,623 students and 496 trainees from abroad by the end of April 1960. Many young students from abroad took Japanese lessons for a year and then studied fisheries at various universities and laboratories, from which they graduated with honors.

Some of the Japanese universities show special interest in receiving students from abroad, and there is a tendency among university authorities to welcome those students who wish to major in fisheries in Japan.

Foreign Trainees Specializing in Fisheries
(Period: April, 1954~April 30, 1960)

Country		*Country*	
India	27	Viet-Nam	16
Pakistan	5	Cambodia	4
Ceylon	10	China	20
Burma	1	Nepal	1
Thailand	16	Egypt	2
Indonesia	26	Korea	1
Philippines	13	Sarawak	1
Malaya	3	Other	8
Singapore	6	Total	160

RESEARCH SYSTEM OF FISHERIES RESOURCES IN JAPAN

Outline of Research System

Fisheries products held an important position as food in Japan from old days. Although livestock production has been encouraged since 1900, because of the geographical condition in Japan, 70% of animal protein the people consume is still derived from the fisheries products. Therefore innumerable number of species is being utilized as food and the number of fishermen is also great. For these fishermen, all of the seas surrounding Japan furnish important fishing grounds. Both the government and the people are keenly interested in the status of fisheries resources. The biologists specializing in fisheries are conducting researches on major fishes with the cooperation of fishermen.

Methods of Research

The research methods are divided into three groups: 1) Statistics of the catch 2) Biological research and 3) Oceanographical investigation. Each group is further divided into many sections, but description of detail is omitted here since it is along the same line of theories advanced by many scholars in the world. The extensive data are collected from the following sources.

a) At hundreds of markets at fish landing places the members engaged in either statistical or biological researches conduct the research.
b) Scores of governmental research boats and hundreds of fishing boats specially designated for the research purpose are accomodated for the biological researchers.
c) Tens of thousands of major fishing boats send in reports which are collected and tabulated.
d) Temporary reports are filed by the general fishermen, marine products processing dealers and sales people from time to time.
e) Reports are sent from the research institutes, laboratories, and culture ponds

The above data are examined and collected at each stage by research agencies and then organized at the Fisheries Agency, finally. The Agency can take whatever step called for to conserve the fisheries resources after examining the reports and supervising the status of resources.

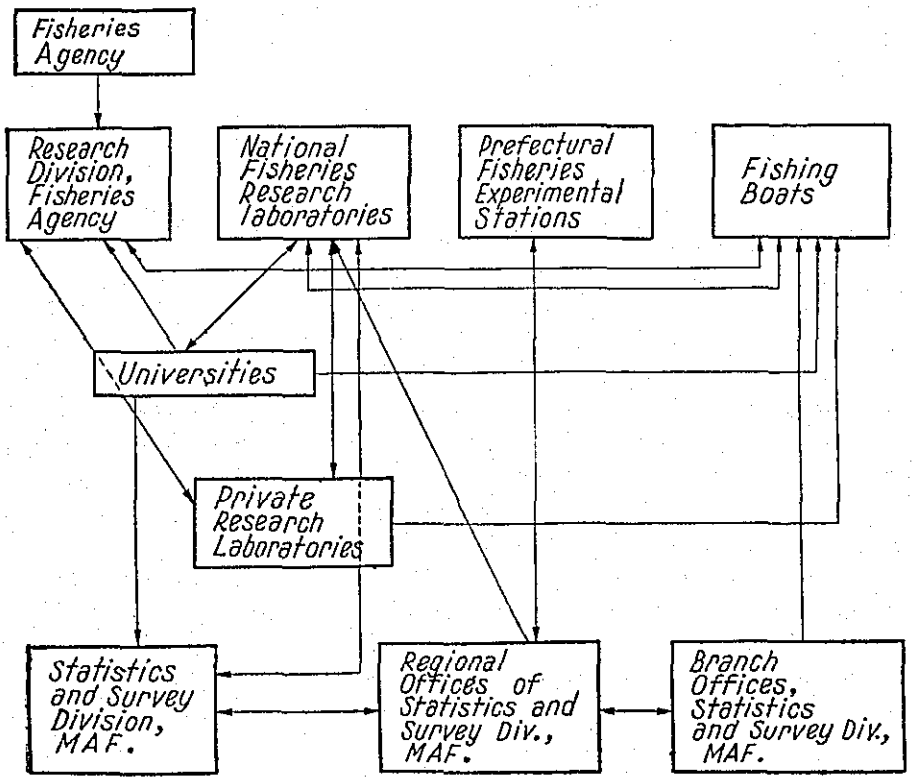
The reports, by each specie, are given out for further examination and study.

Research Organization

There are 8 National Fisheries Laboratories (one of them is for fresh water fisheries, another for inland sea fisheries) under the Research Division, Fisheries Agency, and the fisheries universities and private laboratories which cooperate with them. Also at local level, there are 45 prefectural fisheries experimental stations which are engaged in the study of local species, but keeping in close contact with each other.

The Statistics and Survey Division, Ministry of Agriculture and Forestry has 49 local offices and hundreds of branch offices at major fish landing places engaged in research on the amount of catch and the efforts of catch, providing great contributions to research in fisheries resources.

Organization Chart of Fisheries Resource *Researches*



The above research organs have their research boats as follows: Fisheries Agency, three research boats, 11 boats belonging to the National Fisheries Laboratories (which include a 257 tonner, 225-ton, 220-ton, 183-ton and 10–83-ton boats), besides the twenty boats were rented. Local governmental offices, experimental stations and universities have more than 100 boats altogether. The Toko-Maru, of the Fisheries Agency, is as big as 1,000 tons. These boats are engaged in the special phase of the study, either on the conditions of the sea or biological status, and major data on the resources are derived with the cooperation of the fishing boats throughout Japan. Scientific analysis of fisheries activities of these boats constitute the major part of research on resources.

A Few Examples of Research on Fisheries Resources

The following are a few examples of the research conducted on the resources of fishes, not only those found in the Japanese waters, such as sardines, herring, mackerel, yellowtail, Pacific saury, squid, etc. but also those found in pelagic seas such as tuna, whale, king crab, salmon, trout, etc.

Sardine

The sales slips at fish landing markets are collected by the statistical researchers of the Ministry of Agriculture and Forestry, to be organized into the Catch Statistics. The biological research is also conducted by both national and local fisheries laboratories and experimental stations. In the major fish landing markets the statististics by sampling method is compiled, not only by collecting slips of sales.

On the sea, 11 research boats belonging to the national fisheries institue and the prefectural experimental stations boats cooperate in conducting the biological and oceanographical researches. The members of the fisheries laboratories and experimental stations who get on board the fishing boats also collect scientific and statistical data. Periodical research is conducted at spawning grounds.

General oceanographical research, combining objectives other than fisheries is conducted by the Hydrographic Division and Marine Meteorological Observatory of Transportation Ministry. The statistics on catches is compiled by the Ministry of Agriculture and Forestry and the data on general oceanographic research, by Transportation Ministry. The national fisheries laboratories and the prefectural fisheries experimental stations make report on the fisheries resources to the Fisheries Agency. The fisheries

universities and colleges participate in these studies, while conducting their own researches independently.

Salmon

The salmon fisheries in the North Pacific are operated by factory-ship type fleets. The biological researchers of Research Division, Fisheries Agency, who get on board the factory-ships conduct the statistical survey and oceanographical and biological researches. The research boats of Fisheries Agency and national fisheries laboratories conduct the biological and oceanographical researches separately. The data are collected by the fisheries laboratories and Fisheries Agency, to be organized by Fisheries Agency finally.

In the neighboring waters in Hokkaido the National Fisheries Laboratory and Hokkaido Fisheries Experimental Station cooperate in operating the research boat, and the research members also get on board the fishing boats and conduct the biological and oceanographical investigations.

The National Fisheries Laboratories and the salmon and trout hatcheries cooperate in the study of salmon and trout which come upstream in the Japanese rivers determining the number, by collecting the roes and letting them hatch, so that number of the young salmon and trout going back to the sea can be estimated.

The number of catch in the nearby seas of Hokkaido and the parent fish caught in the rivers are collected by the Statistics and Survey Division of Ministry of Agriculture and Forestry and are published.

The staffs of fisheries universities and colleges and private researchers participate in the above research and they also conduct their own reseaches on fisheries resources.

Whale

The members of Research Divison, Fisheries Agency, and the private research institutes who are dispatched to the coastal depots where the bodies of whale are disposed of conduct the biological study and statistical survey of whales caught in the Japanese coastal waters. The whales in the pelagic waters are caught by the factory-ship type of fishing, and their statistical and biological studies are made by the members of the Research Division, Fisheries Agency, and private research institutes who get on board these factory-ships.

Universities also conduct their own biological researches along with the above.

Bottom Fish in the East China Sea and the Yellow Sea.

The samples which were selected by the random sampling method out of the catch of about 800 fishing boats which go out to the East China Sea and the Yellow Sea are sent to the national fisheries laboratories, where the universities and the prefectural fisheries experimental station staffs also participate in biological study.

mental stations and universities are also engaged in the biological and oceanographical studies at the fishing grounds.

The catch statistics are compiled by collecting the sales slips and sampling of the catches landed at the fishing ports.

Outline of Fisheries Resources in the Adjacent Waters of Japan

The following is an outline of the recent studies made on the 10 important fisheries resources along the coast of Japan. Naturally the resources are not limited to these ten, but it is difficult to give sufficient explanation on the rest of them using only the data collected in Japan. The following account is given on a few necessary items only.

(1) **Sardine**

Sardinia melanosticta (TEMMINCK et SCHLEGEL)

A. Conservation Management Units.

Population: *Sardinia melanosticta* is handled as one population in the controlling of fisheries resources.

Age Composition: Percentage of the age composition of catches is shown in Table 1.

B. Size of Conservation Management Units

Geographical range: Sardines are caught in the coastal waters all around Japan.

C. Life history, ecology and behavior of the fish constituting the resources

Age of maturity: Their maturity begins in full one year birth (body length 12–16 cm) and is completed in full two years (body length 18 cm). The sex ratio is almost 1 : 1.

Spawning: The most important spawning grounds are located around the Goto Islands off the north-western coast of Kyushu. There are also other spawning grounds, in the Japan Sea south of Noto Peninsula and along the Pacific coast south of Boso Peninsula. The spawning season comes earlier in the south (December) and later in the north (June). The optimum water temperature for spawning is 13°–17°C. In spawning season the fish move deep in the day time, but they come to the surface in the evening twilight. Spawning takes place from 8 to 10 o'clock in the evening.

Number of eggs spawning: The number of eggs spawned by 1-year old (16 cm) is about 20,000, but a bigger ones (over 20 cm) spawn approximately 100,000 eggs.

Development and Growth: Eggs are hatched in about 60 hours (2–3 days). Hatched larvae are 3.2 mm in length. In 3–4 days later, they grow to be 5 mm, and at the time of scale formation, 35 mm; in 3 months, 50–60 mm; at the time of taking adult shape, 75 mm; in 6–7 months after the birth, about 100 mm; in one year, 120–160 mm; in 2 years, around 180 mm, in 3 years, around 200 mm, in four years, around 210 mm.

Longevity: The longevity is considered to be 4 years or there about.

Migration: Eggs spawned and larvae hatched in the adjacent waters south of Japan are carried along by the current. When they grow strong enough to swim (5–6 cm) they begin to run up northwards to look for food till August or September. In autumn and winter they come down southwards. When they grow more than one year old, they again go up northwards to look for food in spring and summer. They then come down south to spawn in autumn and winter.

D. Fishing Intensity

Production: The production of sardine, with a peak of 1,600,000 tons in 1936, gradually declined. But since 1945 it has been showing an increasing trend. As to the reason for such phenomenon, it is said that their spawning grounds, which once moved to the north causing the reduction in the suitable spawning grounds have now been extended to the south.

Effect: The total decreasing rate of a group is 60–70%, of which 17% is estimated to be the effect of fishing. (1942)

E. Feeding

Food: Larvae and juvenile fish feed on zooplankton. When they grow a little older, they eat phytoplankton in addition to zooplankton. Adult fish intake chiefly diatom plankton in the waters.

Literature:

1. *Progress Report on Sardine* Population Investigation (1949–1951). Tokai Regional Fisheries Research Laboratory, 1953.
2. Progress Report on Sardine Population Investigation (1952). Tokai Regional Fisheries Research Laboratory, 1954.
3. Elements of Fisheries Resources (1949). By Hiroaki Aikawa.
4. Concerning Stock of Sardine (1942), by Morisaburo Tauchi, in *Bulletin of the Japanese Society of Scientific Fisheries* (10) 5.
5. Fishing Conditions of Yellowtail around the Goto Islands, Nagasaki Prefecture and Ajiro, Izu (1934). By Uda and Honda. *Bulletin of the Japanese Society of Scientific Fisheries* (2) 5.

Table 1. Age Composition of Sardines Caught in Pacific Side in 1953

A. Northeastern Coastal Waters of Japan

(In metric tons)

Age	0	1	2	3	Total
Catch	6,873	3,236	8,396	76	18,547
Catch ratio	37.1%	17.5%	45.2%	0.2%	100%

B. Middle Coastal Waters of Japan

(In metric tons)

Age	0	1	2	3	Total
Catch	755	532	1,155	5	2,447
Catch ratio	30.9%	21.7%	47.2%	0.2%	100%

Table 2. Sardine Catch by Type of Fisheries in 1958

Type of fisheries	Metric tons	Percentage
Surrounding net	76,586	56.04
Beach seine and boat seine	3,084	2.25
Gill net	42,693	31.24
Set net	8,355	6.12
Lift net	5,866	4.30
Angling and long-line	—	—
Drag net	—	—
Others	70	0.05
Total	136,654	100.00

(2) Herring

Clupea pallasii (CUVIER et VALENCIENNES)

A. Conservation Management Units

Population: Herrings are found in all waters around Honshu, Hokkaido and South Sakhalien, but they are treated as one population for the purpose of conservation management. There are two or three small populations, although small in number, which migrate into lakes to spawn.

B. Size of Management Units

Geographical range: They are caught in the waters around south Sakhalien and Hokkaido, especially in waters north of Shikotan, Hokkaido. But they used to be caught in waters north of Yamagata Prefecture on the Japan Sea before and in waters north of Miyagi Prefecture in the Pacific as well.

C. Life History, Ecology, and Behavior

Age of maturity: The mature individuals occupy 10% of 3-year old group; 30–60% of 4-year old group and 100% of 5 and older age groups.

Table 3. Age Composition of Herrings in Recent Years

Year	Age 3	4	5	6	7	8	9	10	11	12	13	14	15	16 over	Total
1939	42.9%	49.1	3.3	2.0	0.9	1.8									
	43,508 tons	49,809	3,296	1,991	883	1,826									101,312
1940	2.0	72.4	22.0	1.4	0.3	1.9									
	3,395	116,710	35,510	2,940	506	3,050									161,174
1941	0.9	10.8	80.4	5.9	1.2	0.8									
	1,552	18,096	135,128	9,902	2,099	1,234									168,011
1942	16.1	14.1	10.7	51.6	7.3	0.0									
	27,601	24,329	18,362	88,504	12,564	46									171,405
1943	0.2	74.1	7.7	5.5	12.2	0.2									
	650	221,778	22,907	16,521	36,610	713									299,253
1944	0.1	0.6	86.7	4.9	2.9	4.7									
	311	2,081	314,986	179,150	10,643	17,426									363,345
1945	5.8	0.3	0.5	86.3	2.5	4.7									
	19,413	505	1,711	289,032	8,459	15,831									334,950
1946	1.2	15.2	1.1	3.4	68.2	6.3	2.1	2.5							
	3,386	40,955	2,889	9,258	183,810	16,904	5,724	6,644							269,569
1947	0.6	2.8	14.3	0.9	13.8	59.8	6.4	1.5							
	1,219	5,409	28,227	1,900	26,930	117,825	12,509	2,994							197,012
1948	0.4	6.5	8.6	15.9	1.3	3.6	59.5	4.1							
	711	11,463	15,200	29,593	2,372	6,413	104,855	7,144							176,250
1949	17.9	7.4	9.2	4.9	10.2	1.3	1.9	47.2							
	31,904	13,049	16,400	8,756	18,140	2,381	3,385	84,042							178,056
1950	2.7	37.1	3.2	3.4	3.1	8.3	0.6	1.4	39.3	0.9					
	4,310	59,328	5,117	5,418	4,998	13,163	962	2,269	62,777	1,465					159,806
1951	10.6	6.5	31.8	0.9	3.5	3.2	4.3	2.0	0.9	36.3	1.0				
	17,780	10,928	53,399	1,440	4,150	5,367	7,275	3,454	1,556	60,990	1,748				168,088
1952	0.7	61.0	3.2	8.9	0.7	1.1	2.2	1.9	0.6	0.9	18.5	0.3			
	1,835	163,664	8,447	23,804	1,916	2,903	5,983	5,211	1,675	2,403	49,457	840			268,139
1953	1.1	0.6	80.3	1.8	3.8	0.5	0.4	1.8	0.9	0.1	0.1	8.5	0.1		
	2,510	1,454	186,798	4,251	8,743	1,082	1,013	4,154	2,045	358	158	19,682	300		232,580
1954	0.9	1.6	0.7	69.1	0.8	33	0.3	1.0	0.5	3.1	0.8	0.5	17.2	0.2	
	1,053	1,826	740	76,998	941	3,651	392	1,103	508	3,443	923	520	19,184	191	111,471

Note: Figures in the upper line for each year, show percentage of catches of respective age.
Figures in the lower line show catches of respective age in metric ton.

Their body length in maturity ranges 26–30.5 cm.

Spawning: The spawning season lasts from March to May, earlier in the south and later in the north. The water temperature for spawning is higher in the south (5°–6°C) and lower in the north (3°C). As the spawning season approaches, herrings gradually come up to the surface of water and move on toward the shore. In the spawning season they approach the shore in shoals and spawn on sea-weeds and others.

Number of eggs spawned: The number of eggs spawned by a 4-year old is around 40,000. However, bigger fish generally spawn more eggs than smaller one, even if they are of the same age group.

Development: At water temperature of 7.3°–8.4°C, eggs are hatched in 20–22 days. In 5–7 days after birth, their yolk is consumed and they grow up to be 9–10 mm in length. They grow to be 2.5 cm in one month, 4 cm in 2 months, 7 cm in 3 months, 10 cm in 6 months, 15 cm in one year, 22 cm in 2 years, 26 cm in 3 years, 29 cm in 4 years, 30.5 cm in 5 years, 32 cm in 6 years, 33 cm in 7 years, 34 cm in 8 years, 34.5 cm in 9 years, 35 cm in 10 years.

Longevity: Their longevity is 8 years, but some were found to be around 16 years old.

Migration: The young herrings grow up in the Okhotsk Sea. Then they come down south in autumn along the Pacific coast. Next year they go up northwards and enter into the Okhotsk Sea in summer. In autumn, they migrate south along the Pacific coast (the northern part of Honshu) again, and then return to the Okhotsk Sea next summer. Some of them (3 years old) come to the coast of Hokkaido and south Sakhalien are called spawning or spring herrings, but most of them stay in the Okhotsk Sea. After spawning season they migrate to the northern Okhotsk Sea, and then come down south into the Japan Sea in January and February. During the migration, they are caught either as spring (spawning) herring or as summer (immature) herring.

D. Fishing Intensity

Production: About 780,000 metric tons of herring catch in 1913 was the highest record in the past, and about 40,000 tons was the lowest. The recent production ranges 35,000–38,000 tons.

Effect: Herrings are caught by set-nets and gill-nets. The numbers of set-nets and gill-nets are given in Table 4. The catch of herring depends upon the recruitment amount and various environmental factors. The recent poor catch is considered to be due to the shift of the optimum spawning ground in Hokkaido up to the north.

E. Feeding

Food: The herrings feed chiefly on zooplanktons such as Copepoda and Euphaucia. Most of the stomachs of herrings which come up from bottom and middle strata of sea are empty. Then they begin to look for food and eat a great quantity until about 6 days before spawning. In about 16 days after spawning they begin to feed again and become fat, and are called fat herring. Akta mackerel, greenling and starfish like to eat herring eggs.

Table 4. Type of Fishing Gears Used for Herring Fishing

Kinds	1940	1950	1955	1956	1957	1958
Number of set nets	602	1,025	1,061	897	608	415
Number of gill nets	475	917	9,555	10,969	10,536	8,948
Total	1,077	1,942	10,596	11,866	11,144	9,363

Literature:

1. Herring Fishing and Its Biological Study (1952), by Akio Ishida.
2. *Recent Poor Catch of Spawning Herring* in Hokkaido (1942), Japan Scientific Society Report (17) 1.

(3) Yellowtail

Seriola quinqueradiata (T.S.)

A. Conservation Management Units

Population: As the unit of conservation management, they are considered to belong to one population.

Age composition: The age composition of yellowtail caught annually in Sagami Bay is as follows: 1 year old, 16%; 2-year old, 21%, 3-year old, 30%, 4-year old, 25% (Aikawa, 1949).

B. Size of Management Unit: The size of population is estimated to be 125,616–805,625 tons (Aikawa).

C. Life History, Ecology, and Behavior

Age of maturity: Some mature after two years, but mostly after 3 years.

Spawning: The spawning grounds are located in coastal waters of the southern Japan. Spawning season begins in February in the south and ends in June in the north.

Growth rate: They reach 3 cm in length in 2 months after birth; 15 cm in 4 months; 20 cm in 6 months; 30 cm (1 kg) in one year; 40–50 cm (3–4 kg) in 2 years; 60–70 cm (6–7 kg) in 3 years; 70–80 cm (8–9 kg) in 4 years.

Migration: Optimum water temperature is 14°–17°C. They swim fast when they seek for food, slow down in spawning season. The highest

speed averages 49 sea miles per day, and in ordinary times they swim about 10 sea miles a day.

D. Fishing Intensity

Catch: The total catch in 1890 was 15,000 tons. The recent record is approximately 50,000 tons. (See Graph)

They are caught all the year round in southern part of Japan and in northern area bigger ones are chiefly caught in summer. The set-nets, trap-pockets, long-lines, and pole-and-line fishing are used.

E. Feeding

Food: They are animal feeders. The adult feed on anchovy, sardine, horse mackerel, and mackerel. The larvae and juveniles eat pelagic crustacea. Since the larvae and juveniles live under floating-weeds they are often eaten by other fish. On the other hand the adult are eaten by porpoise and dolphin.

Literature:

1. Yellowtail and Its Fishing (1953), by Tomonari Matsushita. Fisheries Science Library Series No. 6.
2. Concerning Stock of Yellowtail (1940), by Morisaburo Tauchi. *Bulletin of the Japanese Society of Scientific Fisheries* (9) 3.

(4) **Mackerel**

Mackerel includes the following two species: Japanese mackerel (*Pneumatophorus japonicus houttuyn*), and Japanese spotted mackerel or southern mackerel (*Pneumatophorus tapeinocephalus* BLEERER).

A. Conservation Management Units

Population: Japanese mackerel are caught in all coastal waters around Japan, in the Yellow Sea and the East China Sea. Japanese spotted mackerel or southern mackerel are abundant in waters around southern Japan. As the unit of conservation management, each of the two species is regarded to constitute one population.

B. Life History, Ecology and Behavior

Age of maturity: Some of them mature in 2 years after birth and the rest after 3 years.

Spawning: The spawning area ranges all the coastal waters of Japan. The spawning seasons covers from April to June, earlier in the south and later in the north. Spawning water temperature ranges from 13.5° to 21°C, the optimum temperature being 18°C.

Number of eggs spawned: The number of intra-ovarian eggs of a mackerel is etimated to be 300,000–400,000, and they are spawned in 4 or 5 times.

Development: At 20°C. the eggs are hatched in around 50 hours.

In 6 months or one year they grow to be 12–20 cm in length, and in 2 years, 25–30 cm; in 3 years, 30–34 cm; and in 4 years, 34–38 cm. Most of the commercial fish belong to 2–4 years old, but quite often 5 and 6 years old are included.

Migration: Japanese mackerel live in waters of 7° to 23°C. and the optimum water temperature is around 10°–20°C. Japanese spotted mackerel live in warmer waters of 15°–28°C. Young fish of both species live in warmer waters than the adult. When the Japanese mackerel leave the southern waters, the spotted mackerel show up there. Both of the species migrate in shoals. Those under 1 year old and 1-year old groups swim in separate shoals, while 2-year old and above live together. In the spawning season they form dense shoals and come to the surface of water. Japanese mackerel go up north during spring and summer, swimming through the surface layer; and late in autumn and early in winter they come down southwards through the bottom strata. They winter in coastal waters of southern part of Japan. Japanese spotted mackerel mostly leave the Japanese coastal waters in winter and go down southwards.

C. Fishing Intensity

Catch: In the pre-war years mackerel catch exceeded 100,000 tons, but after the war in 1946 it dropped to 60,000 tons. However it improved gradually, amounting to 268,000 tons in 1958. The percentage of spotted mackerel was less than 30% of the total (See Graph).

Effect: Stick-held dip-nets used to be used, but now fishing motor vessels with improved surrounding nets and with Hane-zuri (a type of angling) are being used. With regard to the fishing effect, there is no fear of over-fishing of Japanese mackerel. It is also believed that Japanese spotted mackerel can be exploited without harm in the East China Sea and the Yellow Sea.

D. Feeding

Food: They live on pelagic crustaceans, small squids and small fishes such as sardine and sandlance.

Literature:

Ecology of Mackerel (1953), by Hiroshi Kasahara and Hideo Ito, Fisheries Science Library Series No. 7.

(5) **Pacific saury**

Cololabis saira (BREVOORT)

A. Conservation Management Units

Population: Pacific saury in Japan are regarded as a single population in the conservation management.

B. Size of Population Management

Geographical range: In the Pacific they are caught in waters from the Kurile Islands down to the Okinawa Islands (25°N, 136°E).

C. Life History, Ecology, and Behavior

Age of Maturity: They mature in 3 years after birth and saury over 27 cm (3–4 years old) can spawn.

Spawning: In the the spawning season they come near the coast. They spawn 700–900 eggs at a time, twice or three times during the season The spawning takes place in the south of central Japan, from November to the next June. In the northern part of the spawning area it takes place in November and June and in the southern part, in March. The optimum water temperature for spawning is 15°–18°C.

Development: At 15°–16°C. eggs are hatched in 10 hours. Juveniles (7 mm in length) and young fish are carried northwards by sea current as far as norshern waters of Japan.

Migration: Those under 1 year old in adult form are found nearly always in coastal and offshore waters. They gradually move northwards from there. During southward migration of adult fish (25 cm or more) along the Pacific coast, they form dense shoals. In August, they appear in the northern waters. They gradually come down southwards and reach the central part of Japan around November. These large shoals are mainly fished on a commercial basis. But in the Japan Sea, the migration of adult fish (25 cm or more) is very small in scale. They appear in the southern waters of the Japan Sea in spring, then they migrate northwards and reach the waters off the west coast of Hokkaido in summer. The optimum temperature is 15°–24°C. They are typical pelagic species and rarely descend deep even in the daytime.

Length composition: Before the war there were two classes in the size distribution of Pacific saury, those reaching 25 cms and the other 29 cms. But after the war these distinctions disappeared and there is now a new single class which reach 26–27 cms, mainly due to the increase in production of the younger groups (25 cms).

D. Fishing Intensity

Catch: Their photoaxis is strongly positive. But in their spawning season their reaction is weakened to some extent. Before the war, the production by drift net with fish lamps amounted to 10,000–20,000 tons, but after the war the use of stick-held dip-nets with fish lamps taking advantage of the strong photoaxis nature increased the production by fifty times, reaching 575,000 tons in 1958.

The amount of catch per boat by drift nets for 1932 averaged 17.5 tons,

but under the stick-held dip-nets method it averaged 114.6 tons in 1951 and 250 tons in 1958.

Effect: Despite the increased exploitation by the dip-nets fishing method the present production can be maintained without fear of overfishing.

E. Feeding

Food: Adult fish predate pelagic crustaceans, mainly diatoms.

Literature:

Study of Pacific Saury (1952), Hiroshi Kasahara and Norio Otsuru, Fisheries Science Library Series No. 3.

(6) Tuna in Japanese Waters

Dominant species among tuna caught in the Japanese waters are the following two species:

(1) Albacore; *Germo germo* (LACEPEDE)

(2) Tuna or Bluefin tuna; *Thunnus orientalis* (TEMMINCK et SCHLEGEL)

Although there are a few more kinds of tuna caught in the Japanese waters they are small in production.

A. Conservation Management Units

Population: Albacore and Bluefin tuna in the Japanese waters are now considered to be a single population respectively, from the point of management unit.

B. Size of Management Units

Geographical range: (1) Albacore—They are caught in almost all waters between the east coast of Japan and 180°E and also between 40°E and 25°N. (2) Tuna (bluefin)—They are caught in all the coastal waters of Japan and in the high seas surrounded by the lines of 150°E and 25°N and the coastal line of the Islands of Japan.

C. Life History, Ecology and Behaviour

Fishing season: (1) Albacore—In the waters near the Midway Islands, big Albacore are caught during November to March and in the Japanese northern waters small albacore are caught in July and August. (2) Tuna—Along the Pacific coast of Japan, big tuna are caught in winter in the waters south of the central part, and in summer, in waters north of the central Japan. In the Japan Sea tuna of medium size are caught in spring and summer. Small tuna are caught in all coastal waters all the year round.

Body weight: The body weight of commercial fish is as follows: Albacore—small type, under 10 kgs, big type, 10–30 kgs. Tuna—small type, under 20 kgs, medium type, 20–100 kgs, big type, over 100 kgs.

Spawning: The number of intra-ovarian eggs of a fish is exceedingly large: Albacore, 300,000 eggs and tuna, 1,000,000 eggs. The spawning ground

of albacore is considered to be in the waters off the Midway Islands and that of tuna located in the waters south of the sub-tropical front.

D. Fishing Intensity

Catch:

	Average of 1921-1925	1953	1958
Albacore	11,250 tons	51,675 tons	46,327 tons
Tuna	22,500 tons	17,560 tons	21,092 tons

Effect: No remarkable increase can be foreseen in the production of tuna, but with improved techniques and gears the catches of albacore have greatly increased in recent years.

E. Feeding

Food: Both albacore and tuna are animal feeders, eating many species of fish and others. In the stomachs of the adult, there can be found a considerable number of juveniles and young fish of several species.

Literature:

1. Chart of Annual Fishing Conditions by Tuna Long-line Fishing (1954), Nankai Regional Fisheries Research Laboratory.
2. Fish Market Data No. 1, 1951, Nankai Regional Fisheries Research Laboratory.
3. Fish Market Data No. 2, 1952, Nankai Regional Fisheries Research Laboratory.

(7) Bottom Fishes in the East China and the Yellow Sea

A. Conservation Management Units

Population: Fishery resources in the East China Sea and the Yellow Sea consist of more than 250 economically important bottom fishes, but as far as the units of management is concerned, they are treated as a single unit.

B. Size of Management Units

Geographical range: Bottom fish resource as a whole in these waters behave independently from those in the adjacent waters, and do not practically mix with other resources.

C. Life History, Ecology and Behavior

Most of these species spawn in the coastal waters, and their larvae and juveniles grow there. Adult fish shows feeding migratory habit going toward the open sea, each species adhering to its own route. Movements of bottom fish as a whole are very complicated and all of them are caught all the year round in all the fishing grounds.

D. Fishing Intensity

Production: The production in 1940 was 200,000 tons, but it dropped to less than 20,000 tons in 1945. The present production has been restored to the pre-war level. Catches in 1958 by otter trawlers were 17,000 tons

and by two-boat trawlers 334,000 tons, totalling 351,000 tons. The number of actual fishing units operated and the catch per unit for 1958 were as follows:

	Unit number	Catch per unit
Otter trawlers	46	383 tons
Large trawlers	398	840 tons

Effect: Most of the fishing boats stay in ports in July and August. The Japanese fishing fleet operating in these waters has reached the level of pre-war years. Since the total production amount has not decreased, the level of production can be maintained, but it will be more profitable not to increase the number of boats. Biological research on the species of fish constituting the research is being carried out.

E. Feeding

Food: Most of bottom fishes are either necton or benthos feeders and generally animal eaters. Larvae and juveniles of any species are largely predated by adult fish of other fishes. Among the bottom fishes the competition for existence is so great that the population is interdependent of each other.

Literature:

1. Study of Bottom Fish Resources in the East China Sea and the Yellow Sea, 1953. Seikai Regional Fisheries Research Laboratory.
2. Present Situation of Bottom Fish Resources, Fisheries Research Association, 1954.

(8) Bottom Fishes in Japanese Coastal Waters

A. Conservation Management Units

There are a great many species of fish in the Japanese coastal waters and dominant species vary according to the fishing grounds. But as the unit of management, they are treated as a single population.

B. Size of Management Units

Geographical range: They are distributed in waters less than 200 meters in depth around Japan, although in some areas in waters of 500 meters deep.

C. Life History, Ecology and Behavior

They come near the shore in their spawning season and then leave there after spawning. They are resident inhabitant showing little migration. Most of them mature in one or two years after birth and spawn in spring or summer, 1–3 year old are the important class for the commercial fisheries.

D. Fishing Intensity

Production: Fishing is being carried out mainly by medium-sized

trawlers. Production in 1944 was 45,000 tons, the lowest in the past 20 years, but it gradually improved to exceed 500,000 tons recently.

Fishing intensity: After the war, the total production and the catch per boat has increased. The number of fishing boats in the Japanese waters was 2,836 in 1951, gradually decreasing to 1958's 1,409.

Effect: Medium trawlers in Japanese coastal waters is apt to cause friction with the other types of fishing so that the government discourages the increase of and curtails the number of the fishing boats of this type.

Literature:

Statistics on Fisheries Production by Trawlers in the Japanese Waters (1952), Ministry of Agriculture and Forestry, Statistics and Survey Division.

(9) **Squid**

Ommastrephes sloain pacificus (STEENSTRUP)

A. Conservation Management Units

Population: They are caught in all the coastal waters of Japan, but are treated as one unit of conservation management.

B. Size of Management Units

The unit consists of both summer and winter spawning group. The size of the summer spawning group is only 10–20% of the winter spawning group.

C. Life History, Ecology and Behavior

Spawning: Males and females in the spawning group are almost equal in number. The number of eggs spawned by a squid is around 500,000. The summer group spawn during June to August in the south and during July to September in the north. The water temperature is around 23°C. Winter group spawn during January to March in the south of central Japan and the water temperature is over 10°C. They do not spawn in the north. The body (mantle) length reaches 7 cms in 2 months after birth; 15 cm in 6 months; 20 cms in 8 months; 21 cms in 9 months; 22 cms in 10 months; 23 cms in 11 months and 25 cms in 12 months. They mature in one year and die after spawning.

Migration: In the daytime they swim in a layer of about 100 meters deep and come up to the surface layer at night. During autumn and winter they go southwards from Hokkaido down to Kyushu. In spring they move northwards from the south and reach Hokkaido in summer. Some groups are resident and do not migrate. The maximum speed of their migration is known to be 10 sea miles a day.

D. Fishing Intensity

Production: The productivity of the population has increased recently. Formerly the average annual catch was around 100,000 tons, but it has

reached 400,000–600,000 tons, which would be 5–15% of the total population.

E. Feeding

Food: They are animal feeders and live chiefly on sardine, small mackerel and pelagic crustaceans, mostly on sardine meat, but no bottom fishes. They frequently prey on each other.

Literature:

Research Report on Squid Population, No. 1 (1953), Hokkaido Regional Fisheries Research Laboratory.

(10) King Crab

King crabs in Japanese waters include the following three species:

Paralithodes camtshatica (TILESIUS)

Paralithodes brevipes (BRANDT)

Paralithodes platypus (BRANDT)

A. Conservation Management Units

Population: King crabs are caught in the Japan Sea concentrating in the waters of the northern part of Hokkaido as one center as well as in the Okhotsk coast (Sakhalien group); and the other group is distributed in the coastal waters around the South Kurile Islands and in the Pacific coast of Hokkaido. But these groups are treated as a single conservation management unit.

B. Size of Management Units

Georaphical range: The important area of their distribution covers the whole offshore waters around Hokkaido and also the Japan Sea waters.

C. Life History, Ecology and Behavior

Spawning: Both male and female crabs attain their maturity when their carapaces get to be 10–12 cms or more in breadth. The sex ratio is 2 (male) to 1 (female). They spawn late in April—mid-May in the south and a little later in the north. The berried crabs carry 100,000–270,000 eggs. The fishing season in the northern part of Hokkaido is from March to July, while it is from March to August in the southeastern coast of Hokkaido. In the first half of the fishing season, females discharge their zoeas. Then after copulation, females leave offshore embracing fertilized eggs. This period is the best fishing season.

Development: Zoeas molt several times and metamorphose. They attain their minimum adult size at 10 mms in carapace breadth. As a result of culture experiments it is estimated that it takes 47–84 days to attain this size, and that their survival rate is about 2%.

Movement: When larvae attain the minimum adult size through pelagic life, they begin to descend to the bottom of the sea. As they

grow they migrate to deeper waters and come up again to shallower waters in spawning season.

D. Fishing Intensity

Production: The average annual production before the war (around 1940) was 20,000 tons. But after the war it declined greatly. The production in coastal waters in 1958 totaled 8,000 tons.

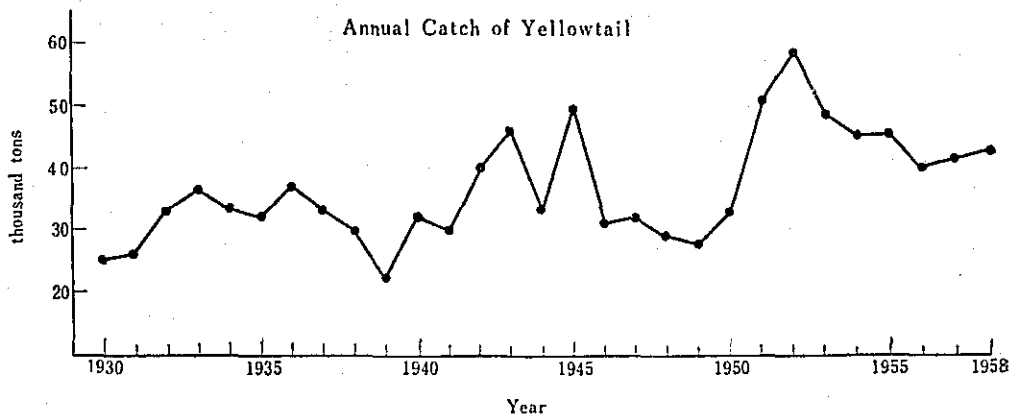
Effect: For the purpose of conservation, fishing of male crabs of under 150 mm in carapace breadth and all female crabs are prohibited in the waters around Hokkaido, and at the same time, the use of gill-nets with meshes of 45 cm or less is restricted.

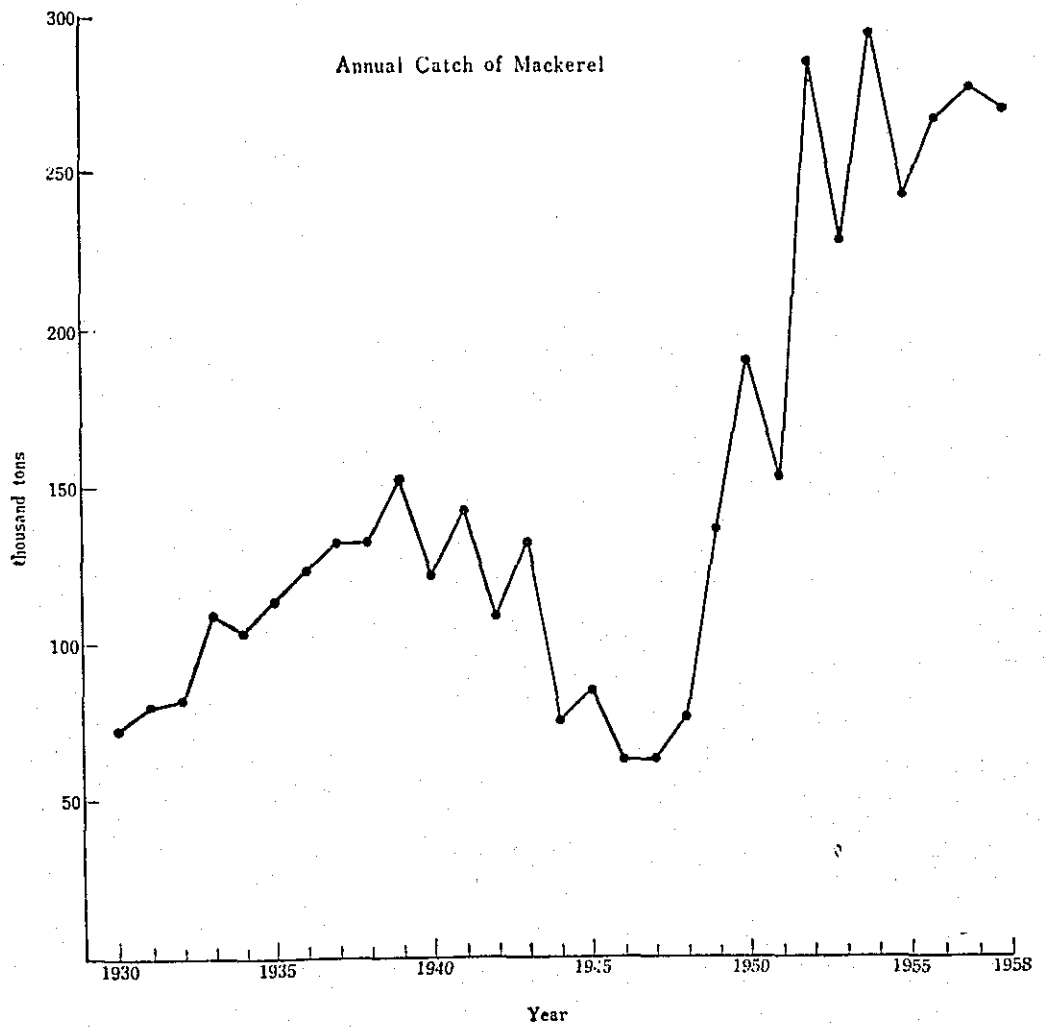
E. Feeding

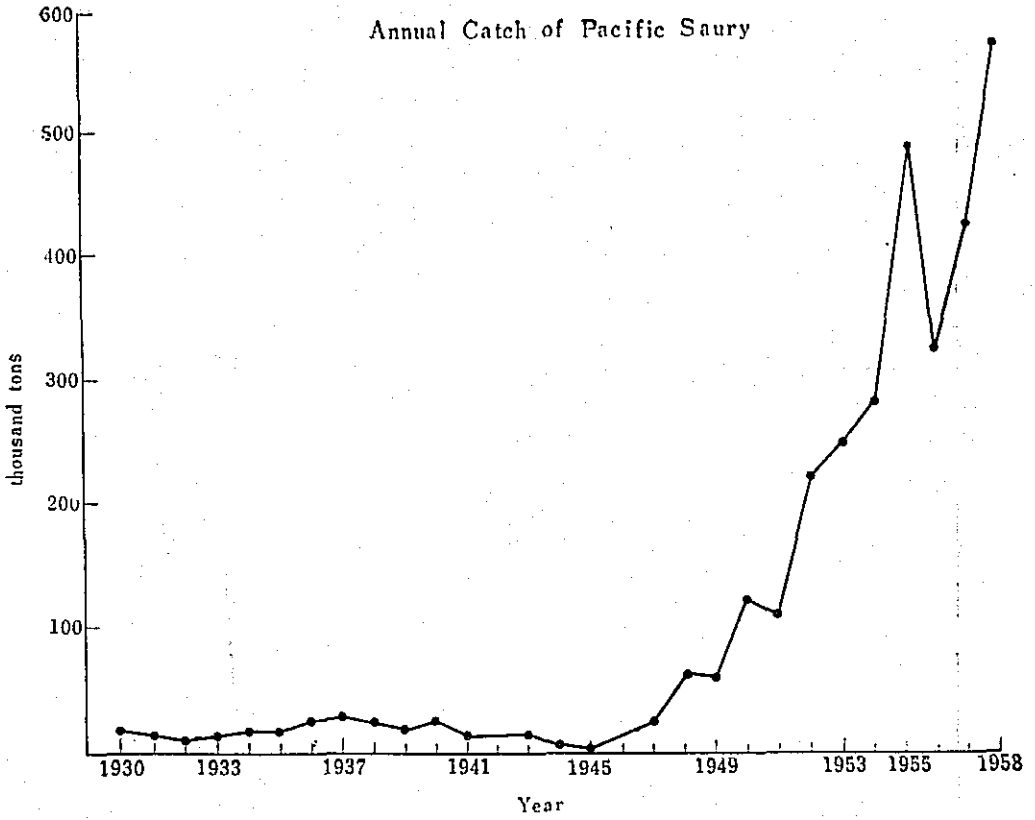
In zoea and glaucothoe stages they live on pelagic organisms, but when they attain the adult size, they feed on organic matter near the bottom such as sea cucumber, shellfish and seaweeds.

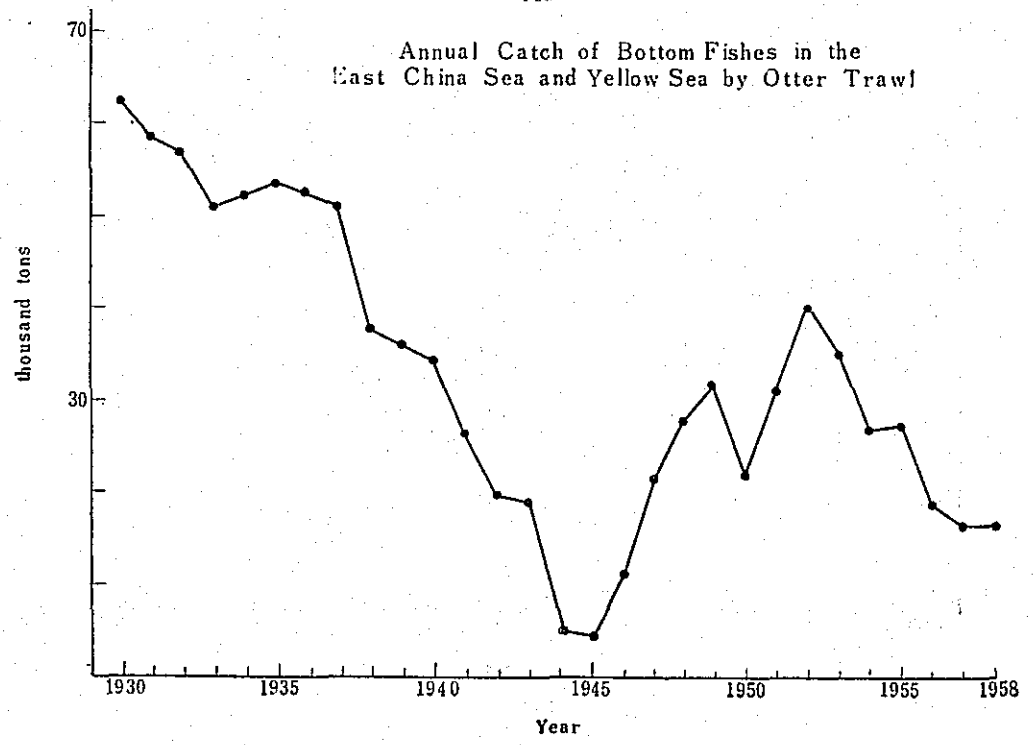
Literature:

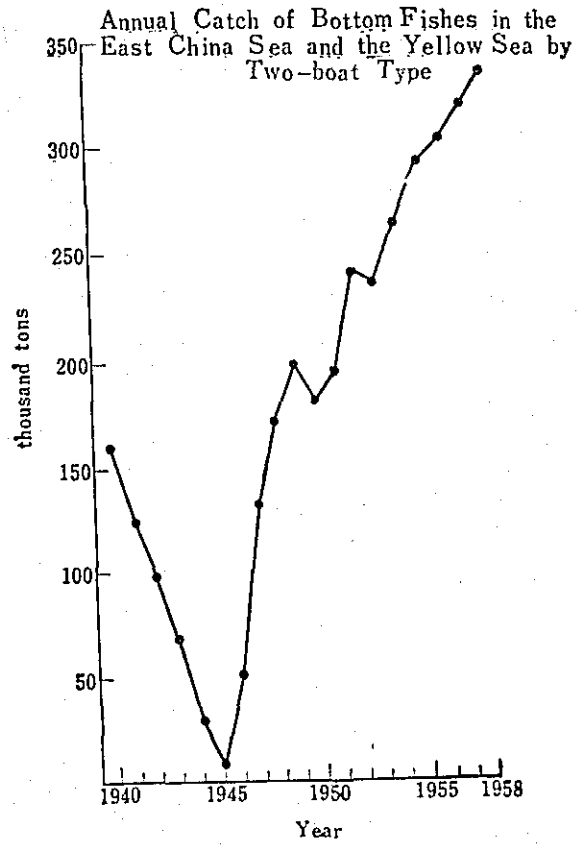
King Crab and Their Fishing (1949). Sakae Sato, Fisheries Science Library Series.

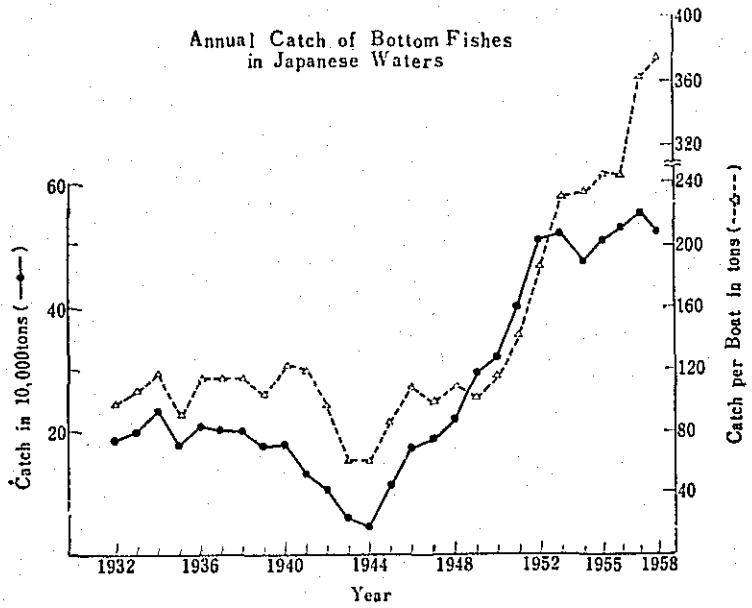

Annual Catch of Yellowtail
thousand tons
60
50
40
30
20
1930
1935
1940
1945
1950
1955
1958
Year

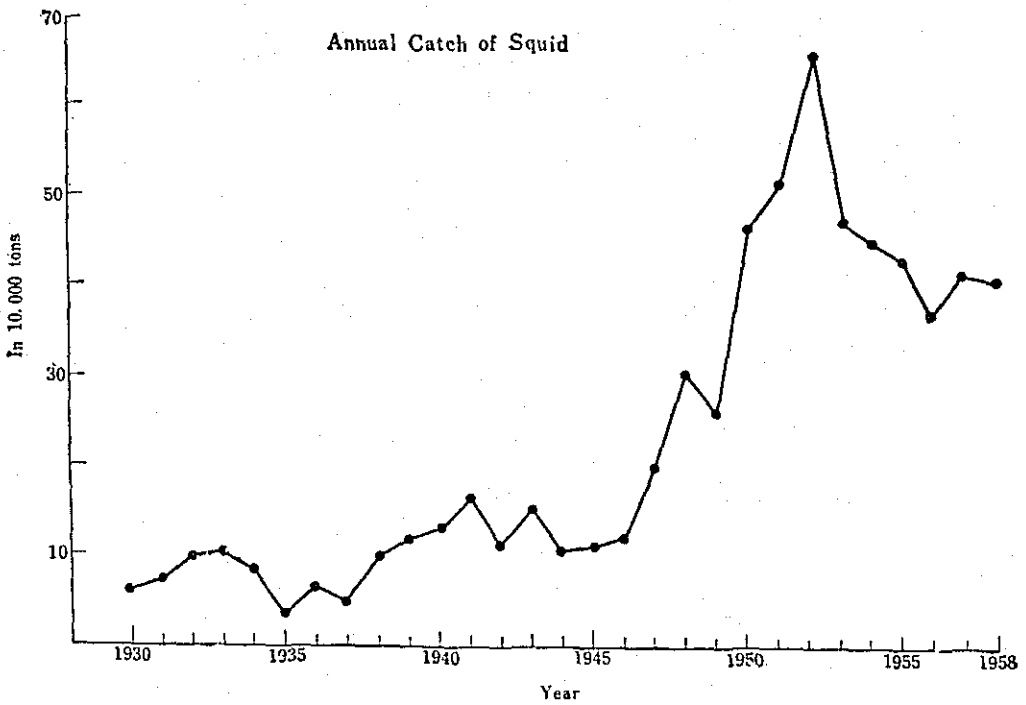

Annual Catch of Mackerel
thousand tons
300
250
200
150
100
50
1930
1935
1940
1945
1950
1955
1958
Year


Annual Catch of Pacific Saury
600
500
400
300
200
100
thousand tons
1930
1933
1937
1941
1945
1949
1953
1955
1958
Year


Annual Catch of Bottom Fishes in the
East China Sea and Yellow Sea by Otter Trawl
70
30
thousand tons
1930
1935
1940
1945
1950
1955
1958
Year


Annual Catch of Bottom Fishes in the East China Sea and the Yellow Sea by Two-boat Type
thousand tons
350
300
250
200
150
100
50
1940
1945
1950
1955
1958
Year


Annual Catch of Bottom Fishes in Japanese Waters
Catch in 10,000tons (—●—)
Catch per Boat in tons (--☆--)
60
40
20
400
360
320
240
200
160
120
80
40
1932
1936
1940
1944
1948
1952
1955
1958
Year


Annual Catch of Squid
In 10,000 tons
70
50
30
10
1930
1935
1940
1945
1950
1955
1958
Year

THE OUTLINE AND THE PRESENT SITUATION OF THE FISHERIES FINANCE

Outline of Fisheries Finance

The following four types of finance are being adopted in the fisheries:

1. City banks, long term credit banks, local banks and other commercial type of finance by the general financing organs.
2. Central Bank for Agriculture and Forestry—Prefectural Fisheries Co-operative Federations—City, Town, Village Fisheries Cooperatives.
3. Development Bank and Agriculture, Forestry and Fisheries Finance Corporation.
4. The pre-modern private financing by brokers, mutual and financial guild or association, usurers, and friends and relatives, etc.

The first type of financing is given mainly to big enterprises or those belonging to the upper class of medium and small scale fisheries entrepreneurs (usually in juridical person). The equipment fund is financed by the two long-term credit banks, and the operational capital is supplied by other banks, but the loan is made only when the enterprise is paying.

The second type of financing aims at the medium and small scale entrepreneurs who are not on the level of the commercial financing. Both equipment and operational fund are loaned to them by these organs. This type of financing has shown remarkable development after the war, and plays a big role for the modernization of the fisheries financing. However, there is the limit in the amount of capital to be accomodated by these organs and their ability to shoulder the risks, and their financing policy may not necessarily be in accordance with the national policy, so that to some extent this is not much different from the first commercial type of financing.

That was the reason why another type of financing, the third one was needed. The Development Bank finances the big enterprises or those which are up to the level of big enterprises. The Agricultural, Forestry and Fisheries Finance Corporation finance the medium and small scale fisheries entrepreneurs and the organizations operated by them, and supplies the long-term, low interest facilities fund, in accordance with the national policy.

Lastly, the private type of financing is practiced for those who belong to the lower class of the medium and small scale fisheries entrepreneurs. Although this type of financing is gradually on the wane due to the

development of the cooperative type finance, etc., it is still strongly rooted among the fishermen because this individual and traditional type of financing is closely connected with the social structure of the fishing villages.

The two governmental measures, the Medium and Small Fisheries Finance Guarantee Insurance System and the Accidents Finance System, based on the law, are worthy of special mention. The former is the re-insurance of the finance guarantee to the members of the prefectural fisheries credit fund associations operated by the medium and small fisheries entrepreneurs with the help of the financial fund, contributing greatly to strengthen the credit standing of the smaller fisheries entrepreneurs. The latter is the system whereby the government and local communities supply the fund for the payment of interest or compensate for the loss of the fishermen and their cooperative associations when they are aflicted by such natural calamities as storms, earthquakes, etc. to have more fund to enable the fishermen to recover from such losses.

The situation of fisheries financing at the end of March, 1959, was as in Table 1.

Table 1. Balance of Finance to Fisheries by Financing Organs (Mar. 1959)

(In million yen)

	Total Amount of Loan (A)	Loan to Fisheries (B)	B/A %
Commercial Finance	7,560,106	99,026	1.3
Development Bank	460,264	1,138	0.25
Agr., For., Fisheries Finance Corporation	148,581	20,531	13.8
Central Bank for Agr. & Forestry	174,041	19,323	11.1

Commercial Financing

The bank loans to fisheries amounted to the following as in Table 2, at the end of March, 1959.

As seen in the table, the loan to fisheries by the commercial financing is only 1.3% of the total loan, but its amount reaches 88,825 million yen, and all of the big enterprises and most of the medium and small fisheries entrepreneurs whose business is stabilized are in the hand of the commercial finance. The big enterprise comprises four or five companies, which are engaged in whaling, northern sea salmon,

Table 2. Bank Loan to Fisheries

(In million yen)

	Total Amount of Loan (A)	Loan to Fisheries (B)	B/A %
Long-Term Credit Banks	640,201	16,374	2.6
Big Cities Banks	3,497,330	26,443	0.8
Local Banks	1,609,293	29,076	1.8
Other Financing Organs	1,813,282	27,133	1.3
Total	7,560,106	99,026	1.3

trout, or crab fishing, pelagic tuna and skipjack fishing, bottom sea trawling west of 130°E, and is equipped with processing facilities, possessing huge capital and thousands of employees. The upper class of the medium and small scale fisheries entrepreneurs are those who are engaged in some of the above types of fisheries, or bottom trawl east of 130°E, purse seine fishing, big scale fixed net fishing, etc., and whose business is stabilized. The banks lend them the money solely because it pays. As was stated before, Japan Industrial Bank and Japan Long-Term Credit Bank accomodate their facilities fund and the other banks mainly the operational fund. At the end of March, 1959, these loans amounted to the following:

Table 3. Loan to Fisheries by Sizes of Enterprise (Mar. 1959)

(In million yen)

	Total Loan to Fisheries	Over 10mil. capital (Under 10mil. capital)	Facilities fund (Operational fund)
Long-Term Credit Banks	16,374	15,568 (806)	13,872 (2,501)
Big Cities Banks	26,443	23,606 (2,837)	4,841 (21,601)
Local Banks	29,076	11,018 (18,058)	3,272 (25,804)
Other Financing Organs	27,133	11,771 (15,362)	10,307 (16,826)
Total	99,026	61,963 (37,063)	32,294 (66,732)

Cooperative Finance

It is only a limited number of management units which can be financed by the commercial finance, and most of the medium and small scale entrepreneurs are out of the range of these commercial banks because their industry is so easily influenced by the natural conditions, their income unstable, and without solid security. For these reasons they have to depend upon such pre-modern finance method as usurers or brokers, on extremely disadvantageous terms. Or sometimes they have absolutely no means of raising the money. The need for financing system

through the cooperative associations has been felt for a long time. In 1933 the related laws were revised so that the fisheries cooperative associations were enabled to make loans to the members. In 1938, the Agriculture & Forestry Central Bank, which had been the central organ solely for the agricultural organizations, came to be affiliated by the fisheries cooperative associations as well so that the latter's financial status improved. However, it was after 1948 when the Fisheries Industry Cooperative Association Law was enacted, reorganizing the cooperative system when the financing through the cooperative associations definitely improved. The processing entrepreneurs came to be included.

At the end of March 1959, of 5,438 fisheries cooperative associations 2,249 were engaged in credit activities. The unit cooperative associations can get loans from prefectural federations when they are short of the fund necessary to buy and sell for the cooperatives, or with the guarantee of the federations, from the Agriculture and Forestry Central Bank. The prefectural federations borrow from the Agriculture and Forestry Central Bank. The capital of these cooperatives are put up by the members' investment and their saving. The government is superintending over the operation of the fund so that these cooperative associations are directed to deposit in the superior organizations to a certain extent and will not operate the saving for the operational fund excessively. The Agriculture and Forestry Central Bank gets the fund from the agricultural organizations' saving or the loan from the Bank of Japan when the saving from fisheries organizations is not sufficient.

Table 4. The Status of Saving and Loan at Three Financing Organs (March, 1959)

(In million yen)

	Saving	Deposit	Loan (Borrowed)
Fisheries Coop. Ass'n	10,342	10,732	17,989
Federation	15,244	5,948	13,801
Central Bank	156,381	3,140	174,014

(Source: Agr. & For. Central Bank)

The loan from the Central Bank and the federations includes those which are loaned to the fisheries entrepreneurs through the fisheries cooperative associations and those which are used by the fisheries cooperative associations themselves for their own operational fund, the fund for the joint facilities, etc. Recently, the federations have improved source of fund, so that they are now in the position of furnishing short-term

Table 5. Savings of Fisheries Organizations at Central Bank of A. & F. and the Bank's Loan to Fisheries Organizations

(In million yen)

	Total Savings	Savings from fisheries organizations	%	Total Loan	Loans to fisheries organizations	%
End of March, 1954	59,797	3,465	5.8	75,157	12,676	16.9
// 1955	60,534	4,010	6.6	81,607	12,821	15.7
// 1956	98,267	4,209	4.3	120,546	13,265	11.0
// 1957	119,374	4,726	3.9	129,129	15,554	12.0
// 1958	118,999	4,137	3.5	128,670	18,184	14.1
// 1959	156,381	6,432	4.1	174,014	19,323	11.1

operational fund, and the Agriculture and Forestry Central Bank lays more stress on the facilities loan, or long-term operational fund. In order to increase the loan from the Central Bank to fisheries, the fisheries organizations are called on to increase their savings at the Central Bank.

With the development of the cooperative type of finance, the usury type of finance along the coastal fishing villages is disappearing although not too rapidly. It must be completely driven away with the joint effort of the cooperative organizations and the supplementary functions of the finance guarantee insurance system, etc. to which reference will be made later. How to sever the medium and small scale fisheries entrepreneurs from these usurers and get them financed by the modern financial organs, with understanding and drive on the part of the supervising people, is the problem to be solved in the future.

Fisheries Finance

In the post-war days the loans were made to the fisheries from Reconstruction Finance Bank, Agriculture, Forestry and Fisheries Reconstruction Finance Corporation, and US Counterpart Fund, etc. in order to rehabilitate the production means for the increased production of food and recovery of economy.

However, the government had to adopt the Economic Stabilization Nine Principles in 1949 and finance in this field had to be restricted. As there was acute need for the self-supply of food the need for financing agriculture, forestry and fisheries was recognized and in 1951 Agriculture, Forestry, and Fisheries Finance Law was enacted and Special Account for agriculture, forestry and fisheries fund was established, to give long term and low interest credits to the operators in these industries so that they

could maintain and increase their productivity. In 1953 the Agriculture, Forestry and Fisheries Finance Corporation, to become the long term financing organ for agriculture, forestry and fisheries, the government's long-standing pet plan, was finally realized, so that special account was discontinued and its business was taken over by the corporation. The new organ started from April, 1953.

In 1951, Japan Development Bank was established to finance the industry to play an important role in the reconstruction of post-war economy and in promoting new industries. In August, 1953, Small Industry Finance Corporation was established, and took over part of the business the Development Bank carried out, i. e., giving loans to small industries. As a result, most of the present Development Bank credit is given to bigger enterprises.

1. Financing of Japan Development Bank

(1) Summary of Development Fund

Japan Development Bank aims at expediting reconstruction of economy and promotion of industry by supplying long-term fund, while supplementing and encouraging the financing carried out by the general financing organs.

According to the government's fund's Basic Operational Policy on the industrial equipment for 1956, the government aims at (a) strengthening and stabilizing the basic industry, (b) promotion of export and expediting rationalization of industry which would contribute to the improvement in the domestic supply and demand relationship, (c) fostering and strengthening of new industry and expediting industrialization of new technology, etc. In selecting industry to be financed, it holds the policy of limiting the loan to such industry which cannot solely depend upon commercial loans. The government also takes pains to put the loan to the fullest use by keeping close contact with the commercial banks so that there will be no surplus and idle facilities.

(2) Financing the Fisheries

Financing of fisheries has been carried out since 1951, and until 1958, 4,211 million yen was loaned to the following four enterprises, but this amount is very small compared with the loan by the Development Bank in the same period.

Whaling In order to earn foreign currency by exporting whale oil, the loan was made to facilitate the factory and catcher boats.

Pelagic Tuna Fishing For the construction of bigger tuna fishing boats to catch tuna which would be frozen for export

Northern Sea Fishing To facilitate construction of factory boats for salmon and trout fishing in the northern sea so that the salmon and trout

cans can be exported.

Refrigeration and Cold Storage Facilities To expand the refrigeration and cold storage facilities which are needed for refrigerating fish for export and cold-storing the fish later to be canned.

The loans made to fisheries by Development Bank are as in the next table.

Table 6. Development Bank Loans to Fisheries

(In million yen)

	1951	1952	1953	1954	1955	1956	1957	1958
Whaling	522	606	480	200	80	200	70	—
Pelagic tuna fishing	—	301	254	—	—	—	—	—
Northern sea fishing	—	100	—	—	200	—	150	150
Cold storage & Refrigeration	155	303	157	—	70	105	—	113
Total	677	1,310	891	200	350	305	220	263

2. The Agriculture, Forestry and Fisheries Finance Corporation

(1) Characteristics of Agriculture, Forestry and Fisheries Finance Corporation Fund

The loans are made by the Corporation to the entrepreneurs in agriculture, forestry and fisheries (including the juridical persons organized by those in these fields) to facilitate them in maintaining and promoting the productivity, giving them long-term and low-interest loans when it is difficult for them to get the loans from the Agriculture and Forestry Central Bank or general financial organs. Therefore, the term is usually over 5 years, maximum being 25 years, and the interest rate is from 4 to 7.5%, giving very favorable conditions compared with other financial organs.

(2) Loans to the Fisheries

Since the start of special account system in 1951, loans were made to improve the fishing ports facilities, construct fishing boats and synthetic fibre nets, develop culture fields, refrigeration, cold storage and ice-making facilities, and other joint facilities, etc. By 1958 the total of the loans reached 26,017 million yen, the yearly breakdown of which is in the following table, showing a rise almost every year. Compared with the total of the loans made to agriculture, forestry and fisheries, the loans made to fisheries exclusively was 11% until 1953, but after 1954 the ratio changed, reaching 14% in 1955 and 15.4% in 1957. This was due to the increased loans for the construction of fishing boats.

The loans were made since 1952 for the *construction of fishing boats*, although at first it was restricted to the boats owned by the fisheries co-

operatives or fisheries producers cooperatives. After the partial revision in the Agriculture, Forestry, and Fisheries Financing Corporation Act in August, 1953, loans could be made to the individual persons and firms as well. Since the fishing grounds expanded after the Peace Treaty became effective, the fishing boats had to become larger, and changes had to take place in the types of fishing, and the age composition of fishing boats had to be adjusted. The loans for fishing boats increased rapidly, reaching 18 billion yen in 1958, or 69% of all the loans made to fisheries. Of the loans made on the fishing boats, 6,918 million yen, about 38%, was for the construction of tuna boats. Thus the loans played a big role in the advance made in the field of pelagic fishing. The other types of loans include those made for:

Ice-making and refrigeration facilities The loans on ice-making and refrigeration facilities are also an important item as well as those on the construction of fishing boats. Since 1958, such loans total 5.7 billion yen, about 22.0% of those made to fisheries, so that together with the loans made on the fishing boats, they constitute 60% of the loans made to fisheries. After the decontrolling on the fisheries products and fishing material in 1950, loans were made to enable the fisheries cooperatives to carry on Five-Year Program for icemaking and refrigeration facilities so that the price of fish would be stabilized and the operation of fishing industry would be rationalized.

Fishing ports facilities Loans were made to enable the cooperative members to pay in their share of expenses incurred in construction of or repairing the damages suffered by the fishing ports, or constructing the special facilities of the fishing ports, so that the fishing ports could better be accomodated for the larger fishing boats.

Synthetic fibre fishing nets Loans were made on the synthetic fibre nets from 1955 on so that the fishermen need not depend on the nets made with natural fibres, to help rationalizing the fishing operation.

Development of fishing grounds Loans were made to develop unexplored fishing grounds and resources in Hokkaido and especially with the aim of relieving the fishermen repatriated from the Kuriles and Sakhalien but such loans were discontinued after 1956.

Culture facilities Loans are made in order to maintain the important resources and foster the shallow sea culture, hatchery of salmon and trout, culture in inland water, and culture of pearls.

Other joint facilities Loans are made to the joint sale and processing facilities, construction of warehouses owned by fisheries cooperatives.

The above is the outline of the loans made to the fisheries, out of

Table 7. Loans Made to Fisheries

(In million yen)

	1951	1952	1953	1954	1955	1956	1957	1958
Ports	236	406	454	279	386	224	185	223
Boats	—	434	1,240	2,130	2,704	3,376	4,304	3,892
Synthetic fiber nets	—	—	—	—	231	295	161	168
Development of fishing grounds	77	80	5	23	3	—	—	—
Culture	66	141	110	63	33	64	79	23
Ice-making & refrigerations	955	1,196	1,212	802	536	497	372	182
Other facilities	—	155	184	203	123	78	146	146
Total	1,334	2,412	3,205	3,500	4,016	4,534	5,247	4,634
Total Loans to agr., forestry, fisheries	12,000	20,299	28,724	26,180	28,884	30,803	34,087	36,995
Ratio %	11.1	11.8	11.2	13.3	13.9	14.6	15.4	12.4

which the loans made to the individual persons and firms are mostly those on the fishing boats and synthetic fibre nets, and the rest of the loans are mostly made to the fisheries cooperatives. Out of the total loans made to the fisheries most part of it was lent to the cooperatives, greatly contributing to the strengthening of cooperative businesses and stabilization of the member enterprises.

Financing the Repairing of Damages

To facilitate the rehabilitation of fishermen from the damages on the fishing boats, gear and facilities owned by the fishermen caused by the typhoon Ruth of October, 1951, and the succeeding ones, special measures were taken so that the government subsidized the interest to the financial organs which made the loans for the rehabilitation and also undertook to compensate for the loss. Similar measures were taken to cover the losses suffered by the earthquake on the offshore of Tokachi, in 1952, storms on the Okhotsk Sea, the earthquake on the offshore of Kamtchatka, etc. so that the facilities damaged could be restored quickly.

The measure aimed at giving credit to the fishermen afflicted whose financial standing was lowered because of the damages. The government made the contract with the financial organs, subsidizing the annual interest upto 4 to 5%, and if the fishermen were unable to pay back the loan by the fixed period on account of other accidents, the government was to take on the responsibility of paying back from 30 to 50% of the loans. However, even after the government undertook to pay the capital and interest and delayed interest the financial organs were obliged to endeavor

Table 8.

Kinds of Calamities	Amt. of Loans (in ¥1,000)	Maturing Period	Interest Rate	Rate of Subsidy	Maximum to be covered	N. B.
Typhoon of Oct., 1951	852,851	Fishing boats 5 yrs. Gear, culture facilities 3 yrs.	Average 7%	4%	30% of total loans	
Earthquake off Tokachi Shore	179,290	Fishing boats, joint facilities 5 yrs. Gear, culture facilities 3 yrs.	Average 7%	4%	30% of total loans	
Storm in the Okhotsk & earthquake off Kamtchaka Shore	1,128,793	5 yrs.	Average 6%	5%	30–50% of the loans made by prefectures	50% by the nation when local government Subsidized 30%
Typhoon No. 2, 1953	50,042	3 yrs.	Within 6.5%	Average 5%	40% of total loans	½ subsidized
Storms during June–Sept., 1953	1,387,574	Culture 3 yrs. Others 2 yrs. Facilities, equipment 5 yrs. Fishing ports 2 yrs. Operational fund 5 yrs.	Within 3.5% for designated areas & to individuals others, within 6.5%	Average 8% for designated areas, others average 5%	40% of total loans	½ subsidized, rate of interest subsidized 5.5% in designated arers
Storms in the south-eastern coast of Hokkaido, May, 1954	599,600	5 yrs.	Within 6.5%	Average 5%	60% of loans made to fishing boats & 40% of loans on nets	½ subsidized
Typhoon of 1954	976,074	5 yrs.	Within 6.5%	Average 5%	60% of loans on fishing boats plus 50% of loans on other facilities	½ subsidized
Storms in Sept. & Oct., 1955	95,043	Fishing gear 3 yrs. Others 2 yrs.	Within 6.5%	Average 5%	50% of total loans	½ subsidized
Storms & high tides in Dec., 1955	331,736	Gear, culture facilities 3 yrs. Others 2 yrs.	Within 6.5%	Average 5%	50% of total loans	½ subsidized

to collect the money from the fishermen and pay back to the government for what was advanced.

Besides the above measures taken by the national government, local organizations made similar contracts with the financial organs to pay the interest on the loans advanced to the fishermen and guarantee for the loss suffered by them, half of the expenses to be borne by the national government, for the damages caused by floods and typhoons, after 1953. The following chart gives the amount and conditions of the loans made so far as 1956.

Small Fisheries Finance Guarantee System

(1) Development and Significance of the System

The major part of the hardship of the small enterprises in the post-war days was the difficulty they encountered in raising the fund. Because they are small-scaled, the banks do not trust them. Secondly, since the loans are in small amounts and the number of cases too many the banks do not welcome them and thirdly, the financial organs themselves had difficulty in getting sufficient fund, although the situation improved recently. Especially the smaller fishing enterprises are at the mercy of natural conditions which influence the catch, to add further difficulty to their operation compared with other types of small-scale enterprises.

In order to break down their finacial difficulties and develop their enterprises, "Small Fishing Enterprises Financing Guarantee Act" (Law No. 346, 1952) was enacted in December, 1952.

According to this system, the small fishing enterprises and the fishermen make an investment in the form of fisheries rights bond, etc., forming a fisheries credit fund association in every prefecture. The related local public organizations can also become members and participate in the activities of the association as big investors.

This association gives guarantee to the smaller fishing enterprises' loans from the financial organs. The government reinsures the association's guarantee.

(2) The Present Situation of the Association

The first of its kind was Hokkaido Association established at the end of March, 1953, and there are now 39 of its kind all over Japan (at the end of 1958).

1) Amount Invested and Membership are as in Table 9, reaching 4,021 million yen and 4,233 respectively.
2) Amount Guaranteed by the Associations.

The amount broken down by the types of membership is as in Table 10, totalling 30.9 billion yen between March, 1953 and March, 1959.

The balance reached 6,577 million yen (operational fund, 70.8%, facilities fund, 29.2%), which is 1.6 times of the total invested by the Associations and 1.9 times of what has been invested by private citizens. The breakdown of the balance is fisheries cooperatives, 68.7%, individuals, 21.0%, juridical person, 10.3%, again the fisheries cooperatives predominant.

The delayed payment or non-payment: The average rate of delay is 13.7%, and when broken down by the types of membership, they comprise juridical persons (14.4%), individuals (15.3%), fisheries cooperatives (12.7%).

The average rate of non-payment is 5.7%. Breakdown by the year showed: in 1953, 20.1%, 1954, 12.6%, 1955, 1.0% and 1958, 3.6% so far. In 1953, when the associations started the rate of hazard was high, but it has been decreasing year after year. The breakdown by types of membership: fisheries cooperatives (4.1%), juridical persons (2.6%), individuals (4.0%).

(a) By types of financial organs: The breakdown by types of financial organs is given in Table 11. Agricultural and Forestry Central Bank and Credit Association hold 68.4%, and the local banks come next with 20.0%. The balance of the credit shows the same ratio, the Agricultural and Forestry Central Bank and Credit Association holding 65.0%, local banks, 33.6%, the rest of the financial organs holding only 1.4% In both

Table 9. Members and Amount Invested

(As of March 31, 1959)

	Fisheries Cooperatives	Individuals	Juridical persons	Local Public Organs	Total
Members	2,133	1,355	153	592	4,233
Amount Invested (In million)	2,030	501	254	1,229	4,021

Table 10. Amount Insured by Types of Members

(In ¥ 1,000)

	Total (amount)	Balance	Amt. Overdue	Amt. Subrogated	Overdue ratio (%)	Hazard ratio (%)
Fisheries Cooperatives*	28,841,615 (3,264,036)	4,511,528 (1,142,280)	573,726 (142,606)	1,161,995 (161,393)	12.7 (12.5)	4.1 (1.4)
Individuals	5,847,752 (1,659,520)	1,381,449 (590,597)	221,746 (89,953)	179,895 (37,898)	15.3 (15.2)	4.0 (3.5)
Juridical Persons	2,928,321 (515,380)	784,913 (184,115)	112,718 (37,157)	55,053 (8,733)	14.4 (20.2)	2.6 (2.6)
Total	30,921,688 (5,438,936)	6,577,880 (1,916,524)	899,190 (269,716)	1,396,943 (208,024)	13.7 (14.0)	5.7 (5.9)

Figures in brackets are facilities funds.

* Including Fisheries Production Associations.

Table 11. By Types of Financing Organs

(In ¥ 1,000)

	Total	Balance	Amt. Overdue	Amt. Subrogated	Overdue ratio (%)	Hazard ratio (%)
Agr. & Forestry Central Bank	5,871,979 (1,774,483)	1,508,340 (562,338)	97,361 (66,668)	128,788 (76,052)	6.5 (11.9)	3.0 (6.3)
Federation of Credit Agr. Coop.	15,273,294 (1,368,526)	2,771,661 (549,011)	460,758 (74,335)	1,008,708 (79,711)	16.6 (13.5)	8.1 (9.7)
Local Banks	9,158,640 (2,092,933)	2,217,156 (769,597)	320,040 (126,127)	240,467 (49,511)	14.4 (16.4)	3.5 (3.7)
Others	617,775 (202,994)	80,723 (35,578)	21,631 (2,586)	18,980 (1,850)	26.0 (7.3)	3.5 (1.1)
Total	30,921,688 (5,438,936)	6,577,880 (1,916,524)	899,190 (269,716)	1,396,943 (208,024)	13.7 (14.1)	5.7 (5.9)

Figures in brackets are facilities funds.

Table 12. By Types of Fisheries

(In ¥ 1,000) (As of March, 1959)

		Total	Balance	Amt. Overdue	Amt. Subrogated	Overdue ratio (%)	Hazard ratio (%)
Deep-sea, Off-shore Fisheries	Trawl, operating west of 130°E	1,603,080	396,227	10,927	6,500	2.8	0.5
	Medium trawl	1,498,906	258,233	24,171	23,200	9.4	1.2
	Purse seine nets	2,394,182	691,221	152,930	150,983	22.0	8.9
	Salmon	3,260,098	560,987	52,983	141,612	9.4	5.2
	Skipjack, Tuna	8,287,717	2,002,069	96,965	88,901	4.8	1.4
	Others	1,964,610	411,893	99,248	253,759	24.1	16.3
Coastal Fisheries	Fixed nets	2,337,250	422,158	150,417	346,059	35.1	18.1
	Culture	976,443	266,951	30,280	13,617	11.4	1.9
	Others	5,613,400	1,146,622	236,109	266,689	20.6	6.6
Fisheries Cooperatives Business		2,986,002	416,519	45,160	75,623	10.8	2.9
Total		30,921,688	6,577,880	899,190	1,396,943	13.7	5.7

Table 13. Payment and Collection

(In ¥ 1,000)

	1954	1955	1956	1957	1958	Total
Insurance Money	104,604 (98,682)	312,134 (243,661)	134,817 (77,258)	36,441 (8,802)	89,097 (3,080)	677,093 (431,483)
Money Collected	8,581 (8,581)	43,075 (42,504)	78,481 (53,538)	100,665 (93,679)	61,046 (51,961)	291,848 (250,263)
Penalty	238	3,600	10,537	24,672	7,208	46,255

The figure in brackets are those of Hokkaido Association.

the delayed payment and the hazard in the insurance the Credit Association heads the list.

(b) By Types of Fishing

The breakdown by types of fishing is given in Table 12.

(3) Payment of Insurance Money

In accordance with the "Special Account for the Smaller Fisheries Financing Guarantee Act" which was enacted at the same time as "Smaller Fisheries Financing Guarantee Act," special account was established for carrying out the insurance business, and the fund necessary for it was carried over from the general account, now reaching 600 million yen.

The payment of insurance and claim is as in Table 13. In June, 1954, the first payment of insurance was made to Hokkaido Association and until the end of March, 1959, the total paid out was 677,893 yen, out of which the Hokkaido Association's share accounts for 63.6%. Yearly breakdown is: 1954, 94.3%, 1955, 78.1%, 1956, 52.5%, 1957, 24.2%, 1958, 3.5%, decreasing each year, showing that more money was paid out to the areas other than Hokkaido year after year. The Shikoku district's share has been growing large, and by February 1960, insurance payments reached 153 million yen.

The collection on the other hand totalled 291,848 yen at the end of March, 1959, showing 43% of the total loans extended. Since at the end of 1955 the rate was 13.7%, 1956 saw an improvement, due to the better showing of the Hokkaido Association.

(4) Future Trend of Fund Association

In view of the recent financial situation the credit to be given out by the Association should be expanded.

FISHERIES COOPERATIVES

The Outline of Development of Japanese Fisheries Cooperatives

The fisheries cooperatives today are organized in Japan in accordance with the Fisheries Cooperatives Law enacted in 1949, however, their predecessors, fisheries associations, were organized as early as in 1886.

They were established in accordance with "Regulations on Fisheries Association," based upon the Ministry of Agriculture and Commerce Ordinance, which regulated: (1) those who are engaged in fishing industry shall establish fisheries association after settling on an appropriate area, establish its rules and get the approval of the governmental agency concerned, (2) the fisheries associations shall determine the season for catching fish and collecting the sea weeds, and get the permit for the fishing area and on the kinds of fishing and (3) the fisheries associations shall establish a federation, and the constitution of the federation shall be approved by the Ministry of Agriculure and Commerce through the administrative agency.

The fisheries associations thus made their start as an organization aiming at establishing fishing areas, protection of fishes, and otherwise.

Afterwards, in accordance with the Fisheries Act enacted in 1901, (1) the fisheries association shall be set up with the fishermen's communities as its center, (2) it shall aim at enjoying and execution of the fisheries rights. The law authorized fisheries associations to give out the permission to the members to fish in the sea of the certain areas, and the subsequent development showed that the fisheries associations functioned in this respect.

In 1910 the Fisheries Act was revised in order to improve the fisheries associations system, and they now came to function as cooperatives as well besides being the organization to which the fisheries right was granted. After the revision, the associations were enabled to set up joint facilities, such as sale, purchase, manufacturing, transportation, encouraging the side lines, promotion of industry, relief of disaster-stricken people, etc. The number of the cooperatives having these joint facilities was very few compared with the number of the associations, and even in the joint sale facilities, which was carried on most extensively, only less than 20% of them participated in it, the majority being just the organization for administering and controlling the fisheries rights. However, since the enactment of the Fisheries Act, the government positively pushed the establishment of the associations so that the number increased rapidly. In

1889 there were 392 associations, but in 1906 the number increased to 3,134 and in 1911 to 3,528. After 1912, the activities of these associations underwent considerable changes. The associations which carried on sale, purchase, loan, etc. gradually increased and the associations acquired more of an economic organization characteristic than before.

The fishing villages could not remain unaffected by the panic in the early 1930s, but they tried to overcome the crisis by strengthening and improving the structure of their organization and in 1933 the legislation was revised for that purpose, i. e., the fisheries association became an organization to which an investment was made, and the limited, unlimited and guaranteed responsibilities of the association were clarified. The invested fisheries associations were differentiated from the non-invested fisheries associations by calling them "fisheries cooperatives." The invested ones carried on such economic activities as processing, storage, transportation and sales of the goods producted by the members, and were now in the position to make loan to the members and maintain fishing industry independently. After the revision of the law, the federations of the associations came to be firmly established, and the law now prescribed all the federations of fisheries associations should be the invested ones. In 1938, the Fisheries Act was again revised, and the fisheries cooperatives and fisheries cooperatives federations could now handle deposits of the members and guarantee for the debts of the member associations or federations. Also at the same time, the "Industrial Associations Central Bank" which had been established centering around the agricultural cooperatives (industrial associations) was now open for the fisheries associations, so that the credit institution for the fisheries industry was systematically organized.

The reorganization of the fisheries associations into the fisheries cooperatives went ahead rapidly since 1936 and the number of the associations carrying on the economic activities and amount handled by them gradually increased also. On the other hand, the federations were established along all the coastal prefectures between 1937 and 1938, and the National Fisheries Cooperatives Federation was established in 1938.

After several revisions of the law, the fisheries associations came to be organized as modern cooperatives. Although this kind of development was induced by the national guidance and encouragement, not arising spontaneously out of the members' will, their activities have made remarkable progress, enabling the fishermen to shake off the yoke of the feudalistic *Ton-ya* domination, and grow up into the more modern, and capitalistic fisheries producers.

The fisheries cooperatives movement thus made an auspicious start,

but the war which started from 1937 necessitated Japan to prepare for the all out war, changing from the semi-war preparedness and as one link in that preparedness the fisheries cooperatives were placed under the national control.

As far as the fisheries cooperatives activities were concerned, they could not carry on the purchasing activities for the members any more because the priority was given to the military need, and the cooperatives were merely made an instrument for the distribution of these goods. The credit activity had to undergo a drastic change also, becoming a finance controlling organ for the purpose of saving and investing for war industries, and the joint sale activities now turned into controlled rationing of fish, as one lnk in the controlled economy. In 1941 the amalgamation of all the industry-wide cooperatives was carried out and the "Fisheries Industry Organization Act" was enacted, and many of the organizations were ordered amalgamated or went out of business. The traditional fisheries cooperatives now became the fisheries association and the prefectural federations became prefectural fisheries association and the National Fisheries Cooperatives Federation was now Central Fisheries Association, and all the characteristics as independent economic organizations were wiped out, being reduced to become an organ operated by appointees of the government.

The Organization of Fisheries Cooperatives

1. Characteristics of the Organization

As was stated before, the "Fisheries Industry Organization Law," enacted in 1941, made the fisheries associations just an instrument for the arbitrary national control, and as soon as the war ended, measures were taken to disband them. The present Fisheries Cooperatives Act enacted at the end of 1948 prescribes that the fisheries cooperatives shall carry out their primary objective first, as an independent organization for economic activities participated by the fishermen and the processers of the fisheries products. As to the organization and the operation of the cooperatives, the classic principles for the cooperatives were now applied, the same as for the other cooperative such as agricultural cooperatives.

The characteristics of the new cooperatives were first of all that the common workers in fishing industry were enabled to become members. From the point of the function of the cooperatives, those responsible for the fisheries economy would have sufficed as members, and actually the pre-war cooperatives had as their members only the heads of the families. The purpose of having the workers in fishing industry as members of the

cooperatives was that the cooperatives would maintain their democratic characteristics more firmly and at the same time it was a step conforming to the change in the family system in the fishing villages.

The second characteristics was the system of non-regular membership and the juridical person was not allowed to become a member. The fishermen now take the initiative in the independent operation of the cooperatives, and, therefore, it is necessary to eliminate the domination of the cooperatives by somebody other than the cooperative members. However, in view of the actual conditions of the fishing villages, it is not practicable to limit the utilization of the cooperative activities to the fishermen only, and since the qualification of members is regulated by the agreement of the association, some of the fishermen do not qualify as members. Taking this point into consideration, the non-regular membership system is recognized opening a way for those having the occupations other than that of fishermen. However, in order to maintain the independent position of the fishermen, these non-regular members are not granted the equal rights as the regular members, barring them from the right of being elected as officers and the right to vote. Since the fisheries cooperatives aim at the free association of the individual fishermen, in order to maintain the independent characteristic of the individual fishermen, the fisheries producers associations and the juridical persons of which permanent employees are less than 300 and the total tonnage of the fishing boats used is less than 300 tons, are granted to become the non-regular members, and those juridical persons bigger than this and the fisheries cooperatives are barred from membership.

2. Situation of Organization

The fisheries cooperatives can be divided into (a) the fishing cooperatives of which members are the fishermen, (b) their federations, (c) those of the fishing producers association origin, (d) the fisheries processing cooperatives of which members are the processers, and (e) their federations. The fishing cooperatives are again divided into the coastal and inland water ones, and they can be broken down by areas and by kinds of fishing. As of the end of March, 1959, the organization of the fisheries cooperatives was as in Table 1. The areal associations numbered 4,082, of which 3,125 were coastal and invested fishing cooperatives constituting 76% of the total, 630 were inland water invested fishing cooperatives, constituting 15%, and these two hold more than 90%. The other cooperatives were 290 fishing cooperatives formed by type of fishing, 868 fishing producers associations, and 226 fisheries products processers cooperatives. There were 176 fishing cooperatives federations in a few prefectures, in prefectural units

Table 1. Fisheries Cooperatives (including Federations)

(March 31, 1959, Fisheries Agency)

Organizational				No. originally approved	No. approved	No. dissolved	No. amalgamated	Present number
Cooperatives	Areas	Invested fisheries cooperatives	Coastal	3,152	15	10	32	3,125
			Inland waters	618	20	8	—	630
		Non-invested fisheries cooperatives	Coastal	26	2	—	—	28
			Inland waters	307	9	2	—	314
		Total		4,103	46	20	32	4,097
	Business Classification	Fishing cooperatives federations		283	10	12	—	281
		Fisheries non-invested cooperatives		8	1	—	—	9
		Total		4,379	57	32	32	4,387
	Fishing producers cooperatives			853	61	41	5	868
	Fishing processing cooperatives			225	7	6	—	226
	Total			5,472	125	79	37	5,481
Federations	Fishing cooperatives federations			142	2	1	—	143
	Fisheries non-invested cooperatives			30	3	—	—	33
	Fisheries credit cooperatives			34	—	—	—	34
	Fisheries products processing cooperatives			11	—	—	—	11
	Credit fisheries products processing cooperatives federations			1	—	—	—	1
	Total			218	5	1	—	222

or regional units in one prefecture, 11 fisheries products processing cooperatives federations, 34 credit fishing cooperatives federations, one credit fisheries products processing cooperatives federations, totaling 222. The mainstay of the federations are two kinds, the fishing cooperatives federations and the credit fishing cooperatives federations. Figure 1 illustrates the kinds and system of the fisheries cooperatives.

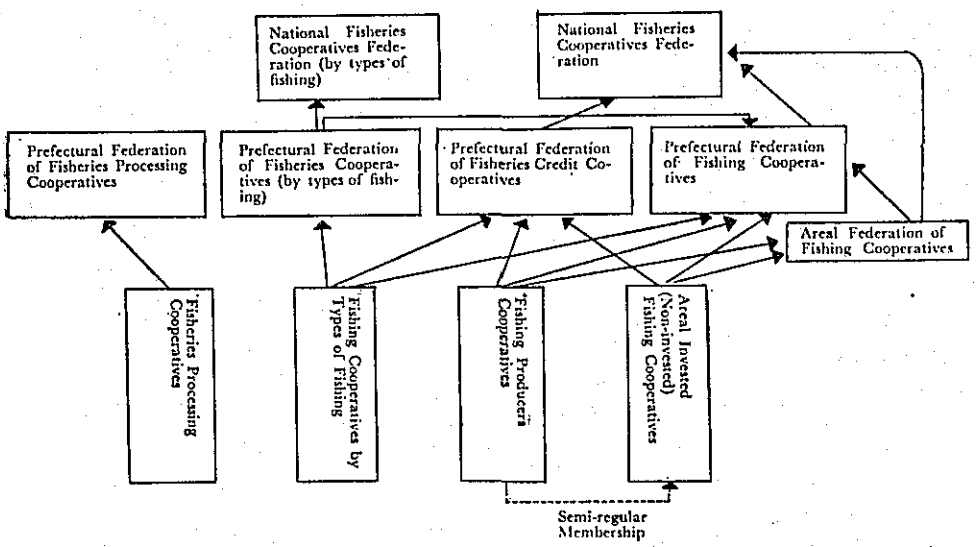
The Structure of Cooperatives

1. Coastal Fishing Industry Cooperatives

Since there are only 28 non-invested cooperatives among the coastal fishing cooperatives, the following account is about the invested ones only.

The total membership is about 664,000, one cooperative having aver-

Kinds and System of Fisheries Cooperatives



age 232 members. As in Table 2, the breakdown of the cooperatives by the sizes of the membership shows that 29.7% are those with less than 100 members, 46.7% with from 100 to 200 members, 16.9% with 200 to 300 members, and the more members the cooperatives have, the less they are in number, and only 1.7% have over 1,000 members.

Table 2. The Breakdown of Cooperatives by Sizes of Membership

	No. of cooperatives surveyed	~100	~200	~300	~500	~1,000	1,001~	Unknown
Actual No.	3,045	904	902	517	419	229	53	21
Percentage	100.0	29.7	46.7	16.9	13.7	7.5	1.7	0.7

Source: 1958 Census.

The structure of the members show that of the total 664,000 members, about 150,000 are fishermen. There are about 80,000 non-regular members who are fishing operators, fishermen, processing operators, brokers, producers cooperatives, etc.

Table 3 shows the areal breakdown of the cooperatives. The numbers of cooperatives covering areas smaller than a city, town or a village hold as many as 58.4%, city, town, or village wide ones are 35.3%, and those bigger than these communities are only 6.3%.

Lastly, of 6,467 million yen invested, the average per cooperative is 2,258,000 yen, and per member, 9,700 yen. As Table 4 shows, 40.7% of

the cooperatives are with less than 300,000 yen invested fund, showing many minute economic units are spread all over Japan.

Table 3. Fisheries Cooperatives by Areas They Cover

	No. of cooperatives surveyed	Smaller than city, town, village	City, town, village-wide	Bigger than city, town, village
Actual No.	2,797	1,632	989	176
Percentage	100.0	58.4	35.3	6.3

Table 4. Fisheries Cooperatives by Invested Amount

(In ¥ 1,000)

	No. of cooperatives surveyed	~300	~1,000	~2,000	~3,000	~4,000	~5,000	5,001~	Unknown
Actual No.	3,015	1,225	720	387	215	103	77	267	21
Percentage	100.0	40.7	23.9	12.8	7.1	3.4	2.5	8.9	0.7

2. Inland Water Fishing Cooperatives

Of the inland water fishing cooperatives, 630 are invested ones with about 343,000 members, averaging 547 members per cooperative, the amount of invested fund totalling 186 million yen, and with per cooperative average of 299,000 yen. The members are mainly farmers and foresters. The function of the inland water fishing cooperatives is to control the fishing ground and culture industry and usually the economic activities are entrusted to the agricultural cooperatives. Only 23 carry on credit activities, 44 sales, and 59 purchasing. Since most of the inland sea fishing cooperatives are satisfied with only controlling of fishing ground, many of them are not the invested ones.

3. Fishing Cooperatives by Types of Fishing

A few special type fishing operators organize the fishing cooperatives of their own, such as skipjack and tuna, or bottom sea netting. These are 290 in number including 9 non-invested cooperatives, with about 22,000 members, and invested total of 1,226 million yen, per cooperatives, being 5,665,000 yen. This type of cooperatives are found in comparatively bigger fishing base ports, most of the members being the operators of these special types of fishing. The coastal fishing cooperatives which are the centers of the fishing cooperatives are organized with one particular community or city or village as the center, so that this type of cooperatives include both the operators and the employed workers, but the cooperatives formed by

types of fishing deviate this class distinction, and are postwar organizations of those who have mutual interest.

4. Fishing Producers Cooperatives

The producers cooperatives were given the priority in the fishing rights and financial measures as an organ responsible for the collectivization of the production as one of the targets in revising the fishing industry system but contrary to the expectation, the producers cooperatives did not quite develop as originally intended. Even those which succeeded to a certain extent, have turned out just like any other business enterprise, far from being the true producers cooperatives. With this problem still unsolved, there are 868 producers cooperatives at present.

The Business Activities of Cooperatives

The fishing cooperatives must perform numerous activities as an organization of fishermen. Besides the economic function as a cooperative, they have to carry out control of the fishing rights, guidance of fishing technique, and representation of fishing interest. The following is an outline of these activities.

As economic activities of fishing cooperatives, the cooperatives are engaged in credit, sales, purchase, and utilization activities. About 86% of the coastal areas fishing cooperatives which are the center of the fishing cooperatives, are carrying on some form or another of these activities, as is seen in Table 5.

Table 5. The Number of Cooperatives by Types of Economic Activities

(As of March, 1959)

Credit	Purchase	Sales	Ice-making, refrigerations	Independent fishing	Utilization
2,107	1,973	2,134	305	612	887

The following is a brief account of these economic activities the cooperatives are engaged in.

1. Credit Activities

The role of the credit activities is that of mutual credit function whereby the fund is raised and adjusted within the fishing villages and industry and another is to introduce the fund from outside of the fishing industry or villages.

There are 2,107 fisheries cooperatives which carry on credit activities and the prefectural credit fisheries cooperatives federations which consist

of these cooperatives number 34. These cooperatives and federations handle such businesses as deposit, loan, saving, etc. as in the next table.

Table 6. Capital of Fishing Cooperatives and Federations

(In ¥ 1,000)

	Saving	Loan (Borrowed)	Deposit	Loan
Cooperatives	10,329,810	19,487,630	10,724,847	26,959,238
Federations	15,243,779	13,801,276	5,947,846	2,649,429

2. Sales Activities

The cooperatives undertake to sell the members' catch and also what they produced, and this is the basis of fisheries cooperatives activities. The cooperatives first buy up the catch from the members and sell them to others, or the cooperatives are consigned to sell by the members and after the sale the commission from them. The former method is apt to bring on the loss to the cooperative because of the price changes, so that the consignment method is more prevalent recently. The sales activities are engaged in by the fisheries cooperatives federations also. The amount handled is shown in Table 7.

Table 7. Amount of Sales

(In ¥ 1,000)

	Federations*		Cooperatives**	
	Consignment	Purchase	Consignment	Purchase
Fresh fish	10,342,526	75,527	72,007,052	1,395,721
Others	12,411,150	22,841,617	29,165,468	1,107,241
Total	22,753,676	22,917,144	101,171,520	2,502,962

Note: * November, 1958
** March, 1959

3. Purchase Activities

The cooperatives undertake also to buy the things necessary to the members' business or their life's necessities and there are various methods of supplying these goods. The first is to arrange the supply of goods for the members. By receiving the request from them the cooperatives talk things with the manufacturers, wholesalers or superior organizations, etc., and make arrangement for the purchase. In this type of transaction, the cooperative itself is not a party to the deal, but charges the commission for the arrangement of the deal. The second method is just straight purchase, whereby the cooperative buys the commodities on its own

responsibility and supplys them to members. This has been the typical of the cooperative activities. The third type is the combination of these two methods, and is called order (reservation) purchase system. This method corrects the defects of the former two methods. After receiving the order from the members, the cooperatives issue the order to the supplier of the goods, and see to it that the cooperatives will not be burdened with overstock. Table 8 shows the amount of purchase handled by the cooperatives.

Table 8. Amount of Purchases

(As of Nov. 1958) (In million yen)

	Federations	Cooperatives
Fuel oil	3,489	3,870
Materials for fishing	906	3,255
Others	906	3,963
Total	5,301	11,088

4. Services of Cooperatives

There are various types of service activities the cooperative undertake, the types are seen in Table 9, such as joint collection, warehouse, charging, etc.

Besides the above, 334 fisheries cooperatives and 46 fisheries cooperatives federations own refrigeration and ice-making facilities, and the capacity combined amounts to more than 10% of the facilities all over Japan. The facilities were subsidized by the national fund.

Table 9. The Types of Service Activities of Cooperatives

Activities	(As of 1958) No. of coop.
Joint collection depots	489
Warehouse	434
Charging (electricity)	406
Loading	276
Transportation (vehicles)	260
Net drying	170
Net dyeing	154
Joint processing	151
Transportation (boats)	117
Drying of products	71
Fishing boats and tackles	25
Repair of engines	20
Rice and wheat polishing	13
TOTAL	1,104

PUBLIC ADMINISTRATION IN FISHERIES

General Structure of the Administration

Before describing some of the features of the administrative service in fisheries, explanation on the general administrative framework, and relations between the central Government and local Government, must be given. The structure of the administration as it existed before the war has in general undergone very little change during Japan's political transformation. The same Ministry–Ministry of Agriculture and Forestry—remains, though a Fisheries Agency as an independent Agency under the control of the Minister of Agriculture and Forestry, is now newly established independently from the old Fisheries Bureau.

Japan is still divided into forty six prefectures though there have been adjustments and changes in the methods of control in the postwar days. In effect, the administration carries on its day-to-day function more or less unaffected by politicians or by the changes in the central Government; though politicians, of course, make final decisions on major policies, and many Civil Service posts are not unaffected by political influence.

1) Central Organization

The Fisheries Agency as independent administrative organization, under the control of the Minister of Agriculture and Forestry, is responsible for fisheries administration as a central administrative body. The arrangements of the Agency into divisions (4 division) and sections (14 sections) are given in the following.

Though a certain amount of independence is given to Director-General of the Fisheries Agency, the Director-General is responsible to the Minister of Agriculture and Forestry, through the permanent Vice-Minister, for the functioning of the Agency. He must obtain ministerial approval on all questions of important policy, on all proposed new legislation, on staff increase, and so on. The Minister, if he considers it expedient, refers some of such matters to the Cabinet meeting before granting his approval. Or, if the problem is a complicated one, the Minister may first appoint a special committee to investigate the matter and make report to him.

Structure and Functions of the Fisheries Agency:

I) Minister of Agriculture and Forestry

II) Director-General of the Fisheries Agency

III) Deputy-Director-General

IV) Administrative Division:

Five sections are included under this division to take charge of personnel, documental and financial matters, and adjustment of functions of the respective sections. In addition to the above functions, coastal and inland fisheries administration, cooperative societies, fisheries credit, fishing boat insurance, etc. are under jurisdiction of this organization.

V) Production Division:

Five sections are included under this division to take charge of pelagic sea fisheries administration, fishing boat and fish marketing matters.

VI) Research Division:

Four sections are included under this division to take charge of planning of technological research of fisheries, administration of research and experimental stations, improvement and extension of fisheries techniques, economic and analytical study of statistics and research data, collection of fundamental data, etc.

VII) Fishing Port Division:

This division consists of two sections, handling matters concerning fishing ports.

VIII) Fisheries Research Laboratories:

Eight fisheries research laboratories are now established independently; each of them carries out the study and research of fisheries resources, fishing gear, fishing techniques, propagation of fish and shellfish and processing of fisheries products.

IX) Pearl Research Laboratory:

Research and experiments of pearls.

X) Shimonoseki College of Fisheries:

Comprising four courses; fisheries, processing and engines.

XI) Hokkaido Salmon and Trout Hatcheries:

Artificial hatching and stocking of salmon and trouts and research thereof is carried out in this organization.

XII) Nikko Fish Hatchery:

Breeding, propagation and distribution of such species of trout as rainbow trout and brock trout, etc.

2) Local Organization

1) Prefectural organization

The Fisheries Agency is represented in the local government. The local officials are subordinate to the Governer of the prefecture in which they are stationed, though for certain specific matters they are directly responsible and report to the Director-General of the Fisheries Agency.

Most of the administrative functions in fisheries are transfered from the central Fisheries Organization to the prefectural governments. At the prefectural level the division in charge of fisheries matters under the prefectural Governor carry on the established national fisheries programme, as well as their own (prefectural) fisheries development plan.

2) Local fisheries offices of the Agency

Seven local fisheries offices are established, in which several local staffers of the Fisheries Agency are grouped under the senior officer whose job is to organize and inspect a certain amount of works of the Agency (fisheries adjustment, operation of patrol boat, and surveillance of fishermen's operation) in his jurisdiction, and to act as liaison between the prefectural officials and the Director-Generals of the Fisheries Agency. In addition to the above several matters related to fisheries, labor, education, etc. are brought under the supervision of the several ministries as follows:

Ministry of Transportation:

a. Seamen's Bureau

This bureau takes charge of labor administration of seamen of ocean going vessels and fishing boats over thirty gross tons, determination of seamen's qualifications and granting of licences to qualified seamen.

b. Maritime Safety Agency

This Agency takes charge of matters related to maritime safety, prevention from violation of laws and orders, salvage, enforcement of the Ship's Safety Law and the Law for Collision Prevention on Sea.

Ministry of Welfare:

Insurance Bureau

This office takes charge of enforcement of the Seamen's Insurance Law under which the seamen of fishing boats over thirty gross tons are insured against disaster, disease, and unemployment, and enforces the National Health Insurance Law and the Welfare Pension Insurance Law by which the seamen of fishing boats under thirty gross tons are benefited.

Ministry of Labour:

a. Labour Standards Bureau

This office takes charge of enforcement of the Labor Standards Law concerning the seamen of fishing boats under thirty gross tons, and the Workmen's Accident Compensation Insurance Law.

b. Employment Security Bureau

This office takes charge of the affairs relating to unemployment measures and the Unemployment Insurance Law under which the seamen of fishing boats under thirty gross tons are insured at their own will.

Ministry of Education:

University Education and Science Bureau

A few national Universities have the fisheries course where occanography, biology, chemistry and other related subjects to fisheries are taught to the students. Besides these, there is Tokyo Fisheries University.

Many prefectures have fisheries high schools and also several high schools which hold fisheries courses.

Features of the Administrative Service in Fisheries.

It would be wearisome to catalogue one by one all the various ministerial functions on fisheries administration; it seems desirable to explain the set-up and the functions of some of the more important of the social and administrative services, especially where they exhibit points of particular interest in the design of the Japanese administration in fisheries or where they are characterized by features uncommon in the systems of the other governments.

The adminstrative services which seem to fall within these categories and thus call for further examination are:

(1) Fisheries adjustment and protection of fisheries resourses
(2) Improvement of production facilities
(3) Promotion of the co-operative movement
(4) Measures for accidents including fishing boat insurance
(5) Fisheries finances
(6) Fisheries education system
(7) Fisheries research

These will be dealt with in the following paragraphs. Other services, similar in other countries, present no special points of interest to the readers.

One feature of Japan's fisheries administration calls for special remarks. The Governmental controls on fisheries are varied, which are powerfully enforced. Some of the fishing methods are prohibited and some areas are off-limit for the protection of natural resources.

"The experience learned in fisheries clearly indicate that fisheries controls as enforced at present are quite effective in order to maintain

ever-lasting maximum catch and to keep fishermen's social and economic standard as high as possible."

1) Fisheries Adjustment and Fisheries Resources Protection.

The Fisheries Law provides the maintenance of order of fisheries: i. e., adjustment of using rights of fishing grounds, maintenance of balance between conservation of fisheries resources and improvement in fishing gear or fishing techniques, and self-control of the Japanese fishing boats operating on high seas, particularly observance of the international fisheries agreements. In other words, under the Fisheries Law, fisheries rights in coastal fisheries areas are given to fishermen engaged in coastal fisheries (to fishermen's cooperatives as a rule) in order to protect them from other commercial type fisheries or in order to ensure fishermen engaged in coastal fisheries to operate fully. Fishing boats using higher efficient fishing techniques are not allowed to intrude into coastal fishing areas. On the other hand, a licencing system is applied to the off-shore fisheries to prevent from operating intensified fishing operations in excess of the productivity in the fishing area. Number and tonnage of fishing boats, operating areas and period, etc., are subject to the approval of the Ministry of Agriculture and Forestry or prefectural governors.

Number, tonnage, and operation frequency of fishing vessels operating on high seas are brought under the direct control of the Ministry of Agriculture and Forestry.

The above measures have been taken for the purpose of conserving Japan's fisheries resources in accordance with the Fisheries Resources Conservation Law. Such measures are taken after hearing the opinion of regional fisheries adjustment commissions representing fishermen so that the opinions of commissions may be reflected in the fisheries administrative measures. In view of a great number of fishing boats operating in the Japanese fishing areas, the government has made efforts for developing new fishing areas on coastal sea and pelagic sea, and for increasing fisheries production by giving financial aids for installing equipment (including young fish stocking) to secure fish seeds in inland water and shallow seas, and for improving fishing grounds. Further efforts have been made to reduce or order them to be put for other uses the excessive number of small type trawlers which affected seriously the fisheries in the Japanese fishing areas by sinking, thus restraining competition among the fishermen.

2) Improvement of Production Facilities

Under the Fishing Port Law, measures have been taken to improve the management and operation of fishing ports, complete their facilities, and raise efficiency. There are 2,700 fishing ports in Japan, and 604 of them are now under expansion. Improvements on fishing vessels and fishing implements are being attained by the adoption of the registration and inspection systems introduced in accordance with the Fishing Boat Law and other regulations on fishing vessels. Instructions have been given by the government to make the required improvement and to equip the boats with the wireless communication system.

In addition, financial measures have been taken for expediting installation of ice-making, cold-storage, and refrigerating equipment used for fish strorage in fishing boats and on landing places.

3) Promotion of Co-operative Movement

One of the most serious problems the Government encountered has been how to improve the social and economic status of the small fishermen's household which constitutes the bulk of the fishing population. The practice of the fishermen's households, too often, is to pledge his catch in advance to brokers and middlemen in return for immediate loans at usurious rates of interest.

To overcome this problem of rural indebtedness a co-operative movement has been extended gradually over all the fishing villages of the country and there are now well over 4,000 fisheries co-operatives.

Formerly the operating capital for these associations was not ample enough to meet the fishemen's requirement. In order to put the co-operative movement on a sound financial basis, the Government aid funds were successfully floated in the cases where the co-operative associations can enlarge their own capital.

The local co-operative associations whose operation and accounting is assisted and closely supervised by the prefectural governments whose administrative budgets in these field get counterpart subsidy from the central government.

The cooperative movement has been an outstanding success. It has greatly increased the happiness and prosperity of the fisherman class. It is today in possession of a constantly growing and substantial catital. The records of the movement show that only a few of them have turned out to be a financial failure.

In accordance with the Fisheries Cooperative Law, fisheries cooperatives or federations are formulated. They include associations for cooperative financing; for cooperative marketing of produce; for cooperative purchasing of fishing materials; and for cooperative production.

4) Measures for Accidents Including Fishing Boat Insurance

In case where fishing boats are submerged or damaged on account of disasters or accidents, they are insured under the government reinsurance system in accordance with the Fishing Boat Loss Compensation Law. It is compulsory for smaller fishing boats of less than 100 gross tons to be insured under a certain condition and a part of the premium is paid by the government. In addition, a fishing boat insurance system comparable to the endowment insurance system has recently been enforced and is expected to be a success. A special insurance is brought into practice against undue capture of fishing boats by the foreign authorities and the wages of the seamen in the captured fishing boats is insured in accordance with the Fishing Boat Seamen's Pay Insurance Law.

Fishermen suffer serious damage from typhoons or other natural disasters every year. In order to facilitate the rehabilitation from damages, legislative measures have been taken on each occasion. To ease the supply of rehabilitation funds, the government ensures loss compensation to banking institutions and a part of interest on the loans provided from them is defrayed from the national treasury.

In 1957, the fisheries mutual relief system was introduced, and fishermen, in case their revenue diminishes below the costs as a result of a poor haul, can get insurance money.

5) Fisheries Finances

The majority of Japanese fishermen are on small scale, and their managements are highly susceptible to fluctuations in fish catches or natural disasters. They can hardly procure necessary funds and some of them have to borrow high-interest money from merchants. In order to find a solution to fishermen's financial problems, the cooperative financing system under the Central Cooperative Bank for Agriculture and Forestry has been strengthened. In addition, the long-term credits are provided from the Agriculture, Forestry, and Fisheries Finance Corporation for the construction of fishing boats and for the installation of ice-making, cold-storage, and fish culture equipment.

Besides these, in order to ease the supply of loans from commercial banks there exist prefectural fisheries credit fund associations that guarantee

the repayment of loans provided from the banks to fishermen and such guaranteed loans are insured by the government under the Medium and Smaller Fisheries Loan Guarantee Law.

6) Fisheries Education

The highest type of fisheries education is given at the State Fisheries University under the direct control of the Ministry of Education.

Besides the above there exist about 40 prefectural fisheries high schools and many other high schools that have fisheries courses or include curricula on fisheries.

7) Fisheries Research

Research and experiments on the various sectors of fisheries resources, propagation, fishing gear, fishing techniques, and processing, and utilization of fish and shellfish are conducted at the national fisheries research laboratories. Research and experiments of sea water fisheries are conducted with the cooperation of the Tokai Regional Fisheries Research Laboratory in Tokyo and six other prefectures. Research and experiments of inland water fisheries are conducted at the Fresh-water Fisheries Research Laboratory in Tokyo.

Besides these, basic research and experiments are conducted at laboratories or experiment centers of universities.

In addition, there are prefectural fisheries experiment stations and fisheries information offices. These stations are engaged in research connected with the respective local fisheries and in cooperation with the government agencies. The results of experiments are disseminated among fishermen. The government has made efforts for improvement and extension of fisheries techniques through fisheries specialists, though they are few in number as yet, and through study groups under the leadership of pioneer fishing boats.

FISHERIES STATISTICS

Outline of History of Fisheries Statistics in Japan

The bulk of the fisheries statistics in Japan naturally consist of what have been prepared by governmental agencies. In the library attached to the Ministry of Agriculture and Forestry there are found the series of statistics of the Ministry of Agricultural and Commercial Affairs, from Volume 1 (originated in 1886) to 40, and another series, the statistics of the Ministry of Agriculture and Forestry, from Vol. 1 (originated in 1926) to 35.

The following is the outline of the history of the fisheries statistics in Japan based upon the above data. The first of the national statistics on both agriculture and fisheries is the "Produce Survey" which the Meiji government had each prefecture prepared in 1870 with the purpose of grasping the financial basis of the new administration, compiling the reports on the annual production of rice, other grains, salt, oil, and fishes. After 1884 "Regulations on agriculture and commerce reports forms" determined the forms of reports submitted from prefectures. In these early days, the kinds of fisheries products reported in the statistics were limited and have little statistical use today. Until the Sino-Japanese War of 1894 and 1895, Japan had entered the period of modern capitalism, developing various industries and the need for grasping the actual national strength was keenly felt. In 1894, therefore, the contents of the various reports were revised and the form of fisheries statistics was improved.

The "Annual Statistics of Ministry of Agriculture and Forestry," published in 1955 by Statistics and Survey Division, M.A.F., is the most handy book to look back upon the past statistics on agriculture, forestry and fishery. As the book reveals, from the end of the 19th century the catch and processed amount of the major kinds are annually given enabling us to make the yearly comparison, although some reservation is held as to the dependability of these figures. Besides the amount of production the number of fishing boats and nets is given.

In 1892, "Special Survey on Fisheries" was conducted in the name of the Minister of Agricultural and Commercial Affairs, all over Japan going into details, but this survey was carried out only for that year. The survey covered such items as those engaged in fisheries (breakdown of shipowners and crew), the number of households and people engaged in fisheries, broken down by full-time and part-time, number of fishing boats, nets and tackles,

the amount of catch by kinds of fishes (quantities and values), amount of processed products by kinds (quantities and values), fishing season, fishing areas, fish markets, etc. This is the only exhaustive statistics on fisheries before World War II. Also this is the only statistics giving the number of fisheries managements by households and people until 1915 when the statistics of the Ministry of Agricultural and Commercial Affairs added a new item on "the number of fishermen and their households, broken down by full-time and part-time, and by sexes," enabling us to get the basic ideas on the movement of labor force in fisheries.

After W. W. I, the progress of the Japanese capitalism was remarkable, and mechanization of fishing boats was speeded up and the pelagic fisheries went on in an extensive scale. The need for the statistics on the managements and the employed workers was beginning to be felt, so that after the 1921 revision in the statistics forms, such breakdown is given. Also the catch is broken down by coastal fisheries, off-shore fisheries and pelagic fisheries.

In 1925 the Ministry of Commerce and Industry was established so that the statistics on commerce and industry came to be separately prepared, and from 1926 on the fisheries statistics were prepared in accordance with the "Regulations on Statistics and Reports of Ministry of Agriculture and Forestry," but their content did not change much until 1940 when the statistics on agriculture and forestry was again revised.

The revision of 1940 aimed at preparing the statistics which would be useful for the controlled economy under the war regime. In other words, while the former statistics laid stress on the amount of production, the revised form of survey tried to grasp the national production capacity and to clarify how the fisheries were related with other economic activities. In accordance with the "Natural Resources Survey Law," based on the National Mobilization Law, the "Regulations on Survey of Agriculture, Forestry and Fisheries" were set up and the survey covered such items as kinds of fisheries, number of managements, boats, workers, amount of catch," etc. and the survey was carried out twice a year, instead of once a year as before. Although the manner of survey was an improvement in some respects, under the circumstances there was no drastic progress in the structure of survey itself, so that the survey was still based on the reports from cities, towns, villages and prefectures, no different from 1920s, or 1930s. Then came the end of the war.

What brought about the remarkable progress in the statistics of agriculture, forestry and fisheries after the end of the war was the establishment of the crop reporting system which was for the purpose of preparing

the accurate basic data on the rice delivery quota which was necessitated by the food situation at the time. In 1947 the Statistics Section, which had been only a section within the Ministry of Agriculture and Forestry, became Statistics and Survey Bureau (after 1949, called Statistics and Survey Division), established exclusively for the purpose of statistics and surveys independent from the administrative organ. At the prefectural level, the Crop Reporting Offices were established directly under it (changed their name to Prefectural Statistics and Survey Offices in 1950), having more than 1,000 branch offices all over Japan, at the rate of 1 for 10 town and village communities, having more than 10,000 staffs in all engaged in the work of statistics on agriculture, forestry, and fisheries.

Fisheries Statistics Section was established in 1950 within the Statistics and Survey Division (which has 7 sections and one special room) in 1950 and at the local levels special staffs on fisheries statistics were placed. Through this organization the basic statistics on fisheries which are systematic and dependable came to be compiled independently from the agricultural statistics to which the fisheries statistics had only been an appendage before.

Present Situation

The most basic statistics on the Japanese fisheries is prepared by the Statistics and Survey Division, M.A.F., as described before and there are others which are prepared by the Fisheries Agency, M.A.F. or its outside organizations from time to time according to the operational necessities, and still others which are prepared by the prefectural offices and private concerns. The major ones of them are carried in the "Statistical Yearbooks of the Ministry of Agriculture and Forestry" continuously since the Meiji era and the contents are improving gradually. The following are the items on fisheries carried in Vol. 35 (1958), of the Yearbook.

1. Fisheries management (a part of the result of the "Census of Fisheries" carried out by the Statistics and Survey Division in 1958 and "Survey of Fisheries Management for Inter-Census Year," carried out from 1955).
   (1) No. of management unit.
   (2) No. of fisheries labourers by important types of fisheries.
   (3) No. of individual managements broken down by full-time or part-time.
2. Means and facilities of fisheries production.
   (1) No. of boats (the survey made in accordance with the regulation concerning fishing boat registration of the Fisheries Agency).

(2) Fishing ports (survey of Fisheries Agency).
(3) Ice-making and refrigeration plants (survey of Fisheries Agency).
(4) Consumption of petroleum products for fishing use (survey of Statistics and Survey Division)

3. Fisheries catches.
(1) Whaling (survey of Fisheries Agency).
(2) Pelagic fisheries on high seas (survey of Fisheries Agency).
A) North Pacific Ocean fisheries (ditto).
B) Tuna long line.
C) South China Sea fishing (ditto).
(3) Domestic marine fisheries (Statistics & Survey Division).
(4) Inland water fisheries (ditto).

4. Aquiculture.
(1) Culture in shallow sea (Statistics & Survey Division).
(2) Culture in inland water (ditto).
(3) Fish culture in paddy field (ditto).

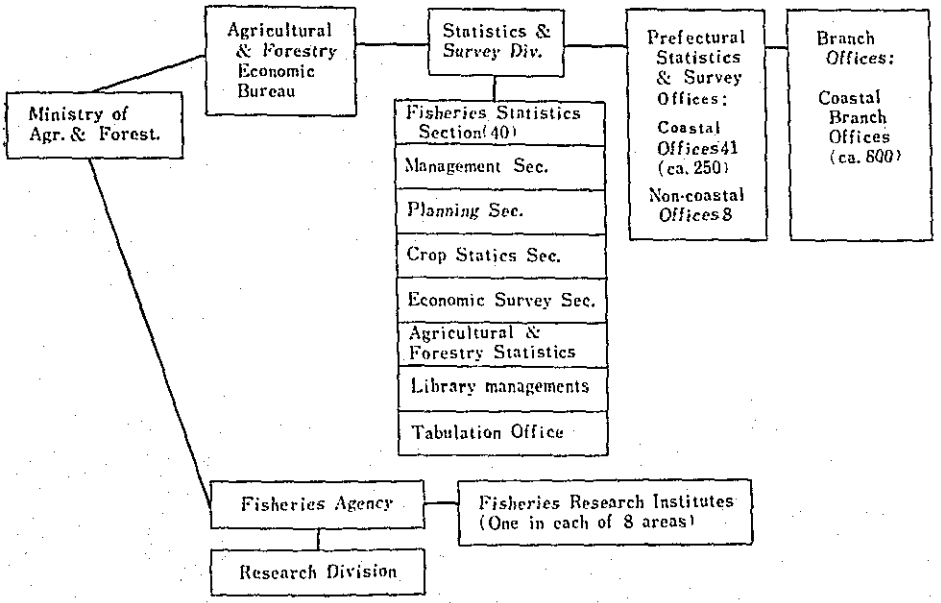
5. Fisheries economy, fisheries household and fisheries management (ditto).
6. Production of processed marine products for marketing (ditto).
7. Market price of fisheries products (ditto).
8. Fishing boat insurance (survey of Fisheries Agency).
(1) Subscription.
(2) Payment of insurance money.
9. Fisheries Cooperative Association (ditto).
(1) Unit Association.
(2) Federation.
10. Foreign trade relating to agriculture, forestry and fisheries (Custom Division, Ministry of Finance).
11. Index number of production of agriculture, forestry and fisheries (prepared by Statistics and Survey Division).

The above are the annual reports on the fisheries statistics in Japan. Beside these the Statistics and Survey Division publishes "Monthly Report on Agricultural, Forestry and Fisheries Statistics" every month giving the amount of products of marine fisheries and shallow sea culture, market prices of fisheries products, quarterly survey of fisheries economy, etc.

In short, the Statistical Yearbooks of M. A. F. compile in a comprehensive manner various statistics on agriculture, forestry and fisheries. The Fisheries Statistics Section of the Statistics and Survey Division publishes more detailed "Fisheries Census," "Survey of Fisheries Management for Inter-census Year," "Annual Report of Catch Statistics of Fishery and Agriculture (including processing)," "Statistics on Fishery Economies,"

"Result of Survey on Fisheries Products Market Prices," etc. Fisheries Agency publishes "Statistics on Fishing Boats," "Statistics on Fishing Boats Insurance," and "Monthly Bulletin of Fisheries Survey" is published by Research Data Section, Fisheries Agency, carrying the major statistical indices on fisheries all over Japan to enable us to observe the monthly changes in the indices.

Now an explanation will be given of the research methods and activities carried on by various agencies. The basic statistics is handled by the Statistics and Survey Division. The fisheries research organization of the M.A.F. is as follows:



(*Note*: Figures in brackets represent staffs on fisheries statistics.)

1. Fisheries Census

This is carried out with the objective of grasping the actual conditions of the Japanese fisheries (fishery and agriculture) by means of systematic statistics, and is an indispensable data for determining how the future fisheries administration should be. We can also trace the structural changes in the Japanese fisheries. However, it was only after the end of the war when the basic research covering all the fisheries managements was carried out, as follows:

August, 1947: Basic research on fisheries

March, 1949: First fisheries census
January, 1954: Second fisheries census

It was decided that a fisheries census would be conducted every five years after 1949, and the second census was carried out in 1954. For budgetary reasons, the third one was conducted in November 1958. The second and third census will be compared in the following:

Objects of Census—In 1954, all fisheries managements in Japan, numbering 251,747 (including individual managements, managements by fisheries co-operative associations, managements by fisheries production associations, joint managements, and companies), and also fisheries laborers' households were made the objects of the census, but in the 1958 census, only fisheries managements (which decreased to 229,334) were taken up as objects. Separately, surveys were conducted of all fisheries cooperative associations in 1958.

Method of Investigation—At the time of the census, the research body of the Ministry of Agriculture and Forestry was not capable enough to carry out such extensive survey single-handedly, and therefore the survey planning itself was worked out by the Fisheries Statistics Section of the Statistics and Survey Division, while actual survey was carried out by way of the following steps:

(1) MAF—prefectures—villages, towns, cities—enumerators
(about fisheries managements)

(2) MAF—Statistics and Survey Offices—Branch Offices
(about fisheries cooperative associations and fisheries rights)

In making surveys, a list of census objects was drawn up first, and enumerators met all these, and filled in questionnaires. In regard to surveys of fisheries managements, survey items include the type of operation, type of fisheries, boats used, fishing operating unit, number of workers engaged in fishing, fishing days, total catch, wages byworks, number of household members, their employment, etc. As to surveys of fisheries cooperative associations, the membership of the association, subscriptions, credit business, marketing, purchasing business, ice-manufacturing and refrigeration business, fisheries self-management, propagation projects, financial affairs, etc. In respect to fisheries rights, the number of fisheries rights and their exercise were surveyed.

Outcome of Survey—The results of the 1954 census were summed up into six chapters and made public. In the case of the 1958 census, statistics on fisheries managements, fisheries cooperative associations, and fisheries rights were published in 1959. In 1960, statistics on fishing operating unit and fisheries by cities, towns and villages are scheduled to come out, and statistics on the number of fishing households, in 1961.

2. Survey of Fisheries Management for Inter-census Years

Based on the result of the second fisheries census, the cards were filled for each fishing management unit, giving the name, address, type of operation, items concerning the boat used, etc. As of January 1 of each of the inter-census years the investigation is made of these items so that the changes in the management units, sizes of fishing boats, number of management units by kinds of fishing will be known during these years. There are considerable changes seen in these matters, and the tendency is that the size of boats gets bigger and the number of shallow sea culturers increase.

3. Production Survey

Unlike rice and barley, the fish catch must be disposed of quickly because it will otherwise taint readily. It is necessary, therefore, to visit landing ports, if possible, and make direct investigation to get correct figures on products. In prewar days, statistics on fish catch or processed products were prepared on the basis of surveys carried out once a year. The figures thus obtained were not dependable and "up to date." After the war, in accordance with the directive from G.H.Q., S.C.A.P., the Fisheries Agency came to make monthly investigations on fisheries catches since 1949 by requesting the prefectural governments to tabulate reports from the fisheries cooperative associations in the respective prefectures. This was a notable improvement, but admittedly cooperative associations' reports were not so satisfactory. The first work the Fisheries Statistics Section of the Statistics and Survey Division (established in 1950) took up was to work out ideal methods of conducting surveys and compiling statistics on the catches of marine products, and new methods were established and adopted in April 1951.

(a) *Statistics and Survey of Marine Fisheries Catch*

Since 1951 several improvements have taken place. The following is the present method taken.

The correct data on the whaling and mother boat type of fishing is available by the statistics of Fisheries Agency, to these two types are excluded. The other types are called domestic marine fisheries, which are classified into 38 kinds. The scale of fishing also ranges widely, from the one which does not use fishing boats to the one using over 500-ton powered boats. So they are broken down into 12 strata by tonnage of fishing boats, and the monthly number of fishing units, number of trips, the number of fishing days and catch are investigated. The amount

of catch is classified into 94 kinds of fish.

The reason why the statistics of the fishing units and the number of trips, not just the catch, came to be taken up (since 1957, the number of fishing days as well) was because the catch per fishing effort, by types of fishery, and by sizes of management, can be grasped, and because if this is continued, it will contribute to the analysis of the fisheries resources.

Method of Survey—It is not practical to adopt the same method of investigation for the very small type of fishing to that of the biggest size, so that various methods are applied depending upon the type of fishing or the actual local conditions. Over 80 per cent of the total catch is investigated by the sampling method with considerable accuracy. The local offices would go over to the landing place (port) of bigger fishing boats, pick up a sample boat at random, and correctly compute the catch, or distribute the diaries to the sampled fishermen's houses and let them enter the daily catch, later to be collected.

Formerly when the off-shore and pelagic types of fishing boats left their home ports and landed their catch at the ports in the prefectures other than their home prefectures, their catch was listed at the landing ports, but since 1957, it was made so that the statistics give the catch by the prefectures the fishing boats belong to.

(b) *Survey of Aquiculture*

This survey is conducted on pearls, laver and oyster. Approximately the same method is taken as the sea fisheries investigation previously described, also on monthly basis. Besides the production the number of culture facilities are also investigated.

(c) *Survey of Inland Water and Culture Fisheries (including fish farming in paddy fields) and Processed Fisheries Products*

This kind of survey is assuming great importance in fisheries, but the survey of processed fisheries products is conducted only once a year. Better survey methods are now under study.

In respect to inland water fisheries, survey methods have been improved considerably since 1957, the number of fishermen, and liberation, and as to culture in inland waters, the number of management units, water area used for culture, number of workers, number of seed fish sold, amount of food given, etc. have come to be surveyed. In regard to the major rivers, lakes and swamps, surveys are conducted several times a year.

4. Survey of Fisheries Economy

The fishing entrepreneurs are requested to keep the records of cash

and catch transaction and also the labor employed. The branch offices tabulate the results every month. At the beginning and end of each year, the investigation is made on the assets (debts) held by the fishermen, including fixed and floating assets, etc., so that the operation for the year can be grasped. Of course the survey depends upon the full cooperation on the part of the fishermen and the investigators' wholehearted guidance, so that the number covered by the investigation is limited. The survey was begun in 1951, and 736 out of 250,000 units of operation all over Japan send in their reports. On the basis of this data, the basic ideas upon the changes in the fisheries management in Japan can be grasped since the reports would cover whether the management was in the red or not, amount of the assets, house-keeping expenses, fund, production per unit of management, consumption of material and equipment, their prices, etc.

5. Survey of Market Prices of Fisheries Products

The annual Statistical Yearbooks of the Ministry of Agriculture and Forestry listed, until 1940, the amount of the total catch in money, as well as its quantity, but after 1941 the fisheries products came to be controlled and rationed, so that the survey on their values was discontinued. In 1950, the control was lifted, but it was difficult to get the more correct figure on the prices, than that on the total quantity, so that this was left for future study. After 1955, the Statistics and Survey Division limited the survey on the prices to the major 83 fishing ports and the wholesale markets of 6 big cities, and tabulated the amount and the prices handled there, and published the monthly figures of quantities and prices by items. So far, the investigation is carried on only with the fresh fisheries products, and not the processed ones. The fisheries census of 1954 grasped the total catch in the amount of money, but this was not too reliable in view of the methods of survey taken.

The annual catch in terms of money is only an estimate based on the survey of the market prices of the fisheries products.

6. Survey of Disposition and Distribution of Fisheries Products

This kind of survey has been carried out since January 1960 at the nation's 46 major landing ports. In surveys, primary stress is being placed on how fish catches are being used (fresh fish, frozen products, canned or bottled products, fish paste, fish oil, manure and feed), and how fish catches (fresh fish at present) are being transported (by railway, automobile or ship)

—to where.

Local officers visit fish markets, association members engaged in processing or transportation bodies every month, or collect reports from them, to make the survey. Survey methods depend on the circumstances in which census objects are placed.

The above surveys are conducted by Statistics and Survey Division and the following are the statistics compiled by Fisheries Agency, tabulating the reports of the prefectural offices, etc.

(1) Whaling and Factory Ship Type Fisheries Production Statistics

The statistics is tabulated based on the reports of the catch from the entrepreneurs who are obliged to make such reports in compliance with the Fisheries Regulations. The result is included in the Statistics of Fisheries Production (Annual Report on Catch Statistics of Fisheries and Agriculture) compiled by the Statistics and Survey Division.

(2) Fishing Vessels Statistics

The Annual Statistics of the Ministry of Agriculture and Forestry gave fishing vessels statistics after 1905 every year, compiled in accordance with the "Regulations on the Statistical Reports of the Ministry of Agricultural and Commercial Affairs" and "Regulations on the Survey of Agriculture, Forestry and Fisheries." Independent research on the fishing vessels was conducted by Fisheries Bureau and the result appeared in the "Fishing Vessels Statistics," in 1924, 1929, 1934 and 1939. In 1949, "Reports on the Movement of Fishing Vessels and Crews" was published. After the war, since the end of 1947, in accordance with the Regulations on Fishing Vessel Registration, Fishing Vessels Law, each fishing vessel carries the registration card, and the cards are collected by the prefectural offices and the result is tabulated by the Fishing Vessels Section, Fisheries Agency, and published as "Statistics Table of Fishing Vessels" every year. The contents and accuracy of the statistics have much improved compared with the pre-war days.

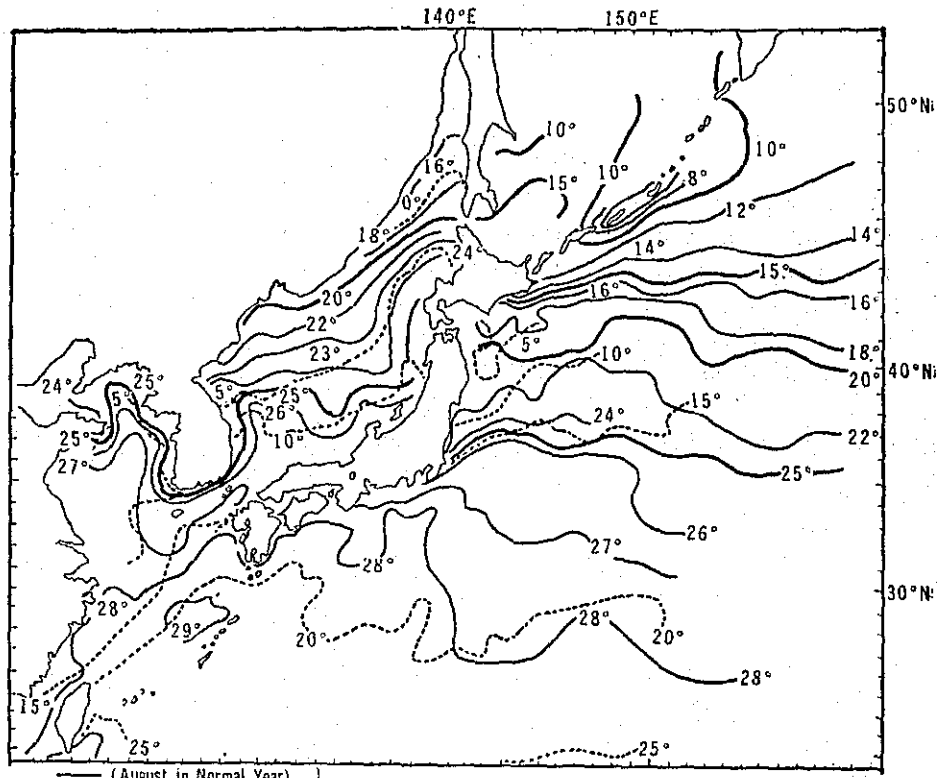
(3) Fishing Vessels Insurance Statistics

This gives the subscription and the number of accidents and is published both monthly and annually, by Fishing Vessels Insurance Section, Fisheries Agency, which collects the notices sent from the Fishing Vessels Insurance Associations.

(4) Survey of Cold Storage Holdings

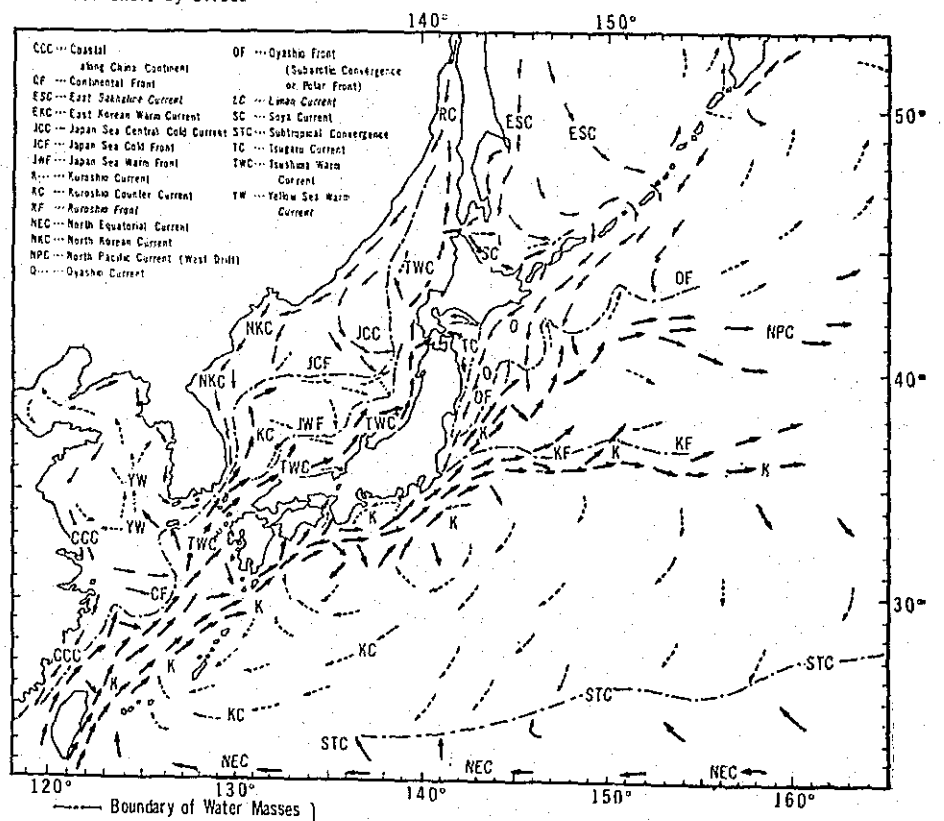
The statistics is broken down by the kinds of fish, their conditions (frozen, fresh, salted, dried, etc.), giving the monthly total and the number of stock at the end of the month, based upon the data from the sample factories picked up at random, reported to the Research Data Section, Fisheries Agency.

There are some other statistics prepared by the Fisheries Agency every year including those on production, circulation, consumption, trade, prices, finance, raw material, etc. or biological and oceanographic statistics sent in from the governmental offices other than Fisheries Agency, prefectural offices, research institutes, various organizations and companies, etc. Although the explanation on each one of these statistics is omitted here, the major ones are carried at the end of this book giving the sources. The readers' attention is also called to the pertinent items on fisheries carried in the 35th Statistical Yearbook of the Ministry of Agriculture and Forestry.



——— (August in Normal Year)
----- (February in Normal Year)
} Isotherms of Water Temperature at Sea Surface

Note: Chart by Dr. Uda



——— Boundary of Water Masses
——→ Warm Current
——→ Cold Current
——→ Current of Mixed Water
} in Warmer Season in the Waters Adjacent to Japan

Note: Chart by Dr. Uda