

Small-scale Longline Fishery: A MAINSTAY FISHERY as Important as Angling and Gill Net

LONGLINE, as the name implies, is a fishing method which employs a long main line extended in the water, to which branch lines are attached at regular intervals, each being fitted with hooks and bait, thereby fishing a large area at one time. Fishermen throughout Japan's coastal waters use such longline methods either as their main fishery or else as a supplementary fishery. For artisanal fishermen operating boats of up to 3 tons, or of the 3 to 5 ton class, longline is an extremely important fishing method like angling and gill net methods. They operate 2 and 3 of these methods alternately to provide a stable, year-round fishery business.

In deciding which of these three methods, longline, angling and gill net to make their main fishing method, fishermen must take into consideration the type and quantity of fish resources available to them, the life habits of the fish they choose to catch and the conditions of their fishing ground environment, such as tide and current. Then, they must consider the investment resources and labor resources available to

them, and based on these factors choose in which way they can best combine two or more of these fishing methods to provide themselves with a successful and stable fishery business.

In this issue we will review the technical characteristics of the three methods, longline, angling and gill net, and in doing so, we hope to make clearer the catching capability and unique qualities of the longline method, the main theme of this issue. The following is a summary of the unique characteristics of the three different fishing methods:

1) First of all, angling is the fishing method requiring the smallest initial capital investment, and has been a primary fishing method used in all parts of the world. However, since the number of hooks which can be employed in one operation is very small, and since the catching efficiency depends largely on the individual skill of the fishermen, the catch per boat per day is generally small. Therefore in

TABLE 1 Annual fishery sales per fishing unit

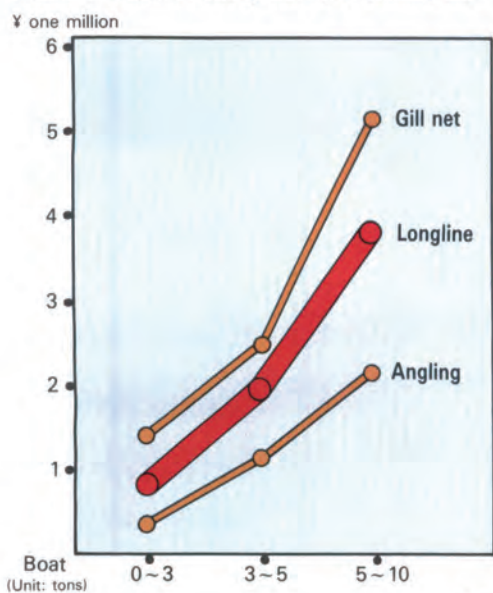
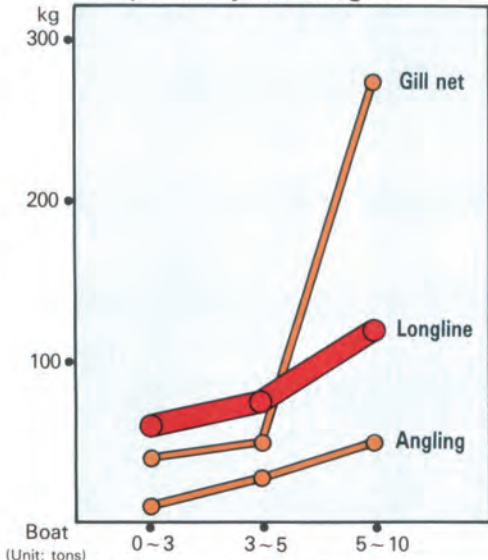


TABLE 2 Amount of catch per fishing operation by one fishing unit



Source: Ministry of Agriculture, Forestry and Fishery figures (1983)



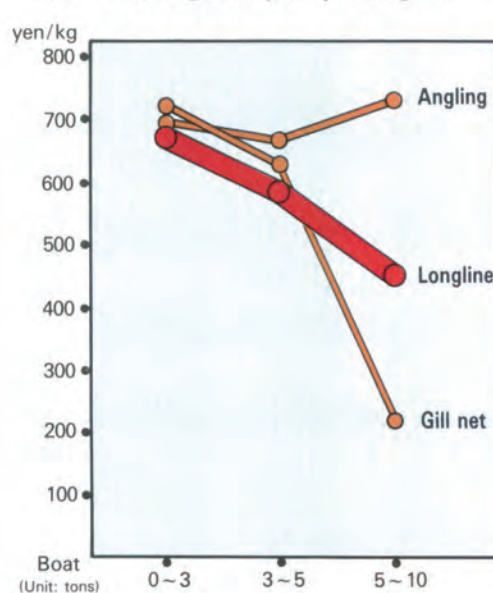
Flounder caught by bottom longline



One set of fishing gear includes: ① main line, branch lines and hooks & snoods ② marker float ③ buoy rope ④ sinkers (natural stones) and ⑤ scoop net

order to continue angling as a successful commercial fishery method, in recent years angling fishery has focused on the catching of high market value fish such as large deep-sea fish or other high-priced fish, and has sought to preserve their market value even further by outfitting the fishing boats with fish-reserve tanks that enable the fish

TABLE 3 Average fish price per kilogram



to be landed alive, or facilities which enable the fish to be preserved in ice on board and landed within a short period with a high degree of freshness.

2) The gill net is an efficient fishing method for catching demersal fishes which move about in the bottom sea waters or for migrating fishes which form schools as they migrate and can be caught in large quantities. However, seeking to increase catch by increasing the number of nets used requires an increase in both capital investment and labor. Also, there are some types of fishing grounds, such as rocky reef areas, which make net operation difficult, and some types of fish which are not suited to a net fishing method.

3) Longline is a fishing method which is basically a more efficient advancement of the angling method. While the increase in initial capital investment is comparatively small, the number of hooks at work in one operation is increased dramatically over the angling method, thus creating the possibility of a much larger catch. Also, because of the lightness of the fishing gear, the fishing operation can usually be performed by one or two fishermen, and it has the added advantage of being easily applicable to fishing grounds in which a gill net cannot be used, such as reef areas, because of the simple structure of the fishing gear. Tables 1 through 3 show the marine production for the three fishing methods, angling, gill net and longline, operated by small-scale coastal fishing boats (up to 10 tons) in 1983. This data excludes offshore and mid-ocean commercial fishery enterprises such as skipjack angling, squid angling, tuna longline, salmon/trout longline, salmon/trout gill net and northern sea gill net and longline.

LONGLINE FISHERY IN JAPAN



Line hauling operation in coastal surface drift longline: One worker hauls in the line by hand while the other lands the fish caught with a scoop net. (Yamaha Fishing Boat Model DX-29B-OB/Yamaha Diesel MD340)

TABLE 4 Longline fishery in Japan (1983)

Type of fishery		Number of fishing units	Amount of catch (in tons)
Pelagic fisheries	① Pelagic tuna longline (over 120 tons)	747	220,335
	② Nearby sea tuna longline (from 20 to 120 tons)	523	83,681
	③ Northern sea longline & gill net (from 200 to 500 tons)	22	44,585
Offshore and coastal fisheries (longline other than ①~③)		17,732	120,661

Note: Offshore & coastal fisheries include tuna longline and salmon/trout longline operations using boats of up to 20 tons.

LONGLINE fishery in Japan can be divided into two main forms. One is the small-scale longline fishery conducted by coastal artisanal fishermen, while the other is high-investment type large-scale longline fishery catching specific types of fish.

1 Large-scale longline fishery operating in pelagic fishing grounds

The representative fishery in this category is that aimed at catching tuna family fishes, especially the bluefin tuna used for sashimi (raw fish fillet), conducted all over the world, with main fishing grounds in the Pacific, Atlantic and Indian Oceans, and using boats ranging from 200 to 500 tons. Next is the Northern Sea longline & gill net fisheries which operate in the fishing grounds of the North Pacific using both longline and gill net to catch bottom fish such as flatfish, cod and others, using fishing boats of 200 to 500 tons.

2 Commercial enterprise-type longline fishery in offshore waters

One type of fishery is aimed at catching high-value bottom fish such as sea bream

family and globefish family species in reef and bank areas of the Pacific and East China Sea offshore waters. On the other hand, there are also tuna longline fishery operations using boats of up to 19 tons in offshore waters basically of southwest Japan, as well as middle-sized operations (20~120 tons) fishing in the offshore waters of the southwest Pacific, ranging as far as the Philippines Islands. (See the separate article for reference.) Finally, there are operations catching salmon and trout with both longline and gill net methods in the Japan Sea offshore.

3 Small-scale longline fishery by artisanal fishermen in Japan's coastal waters

The main type of fishing boat used in this fishery is either less than 3 tons or of the 3~5 ton class, with the occasional inclusion of 5~10 ton class boats. Catching surface fish which migrate in the coastal waters or bottom fish inhabiting the sea bottom in coastal areas, this fishery make use of angling, trolling and gill net methods in combination with longline depending on the season. Fishes which are caught in large quantities by coastal longline fisheries include Alaska pollack,

TABLE 5 Amount of catch by species for coastal longline fishery (1983)

Species	Amount of catch (in tons)	Percentage of total catch
Tuna	140	
Marlin & swordfish	63	
Shark	1,491	1.5 %
Salmon & trout	2,898	3.0 %
Mackerel	124	
Yellowtail	140	
Flounder & flatfish	1,465	1.5 %
Cod	49,963	52.0 %
Atka mackerel	1,107	
Rockfish	435	
Drums & croaker	648	
Lizardfish	91	
Pike conger	350	
Cutlass fish	997	
Ray	324	
Sea bream	4,128	5.0 %
Dorado	1,378	1.5 %
Flying fish	153	
Sea bass	322	
Other species	23,788	25.0 %
Octopus	5,493	6.0 %
Other marine animals	25	
Total	95,536	100 %

Note: In the records of the Ministry of Agriculture, Forestry and Fishery this data is classified under "Other forms of longline".

Source: Annual statistical reports on fishing & fish culture production

cod, flatfish, sea bream, salmon, trout, drums, croaker, octopus and others.

The situation of coastal longline fishery operations

TABLE 6 Number of fishing units

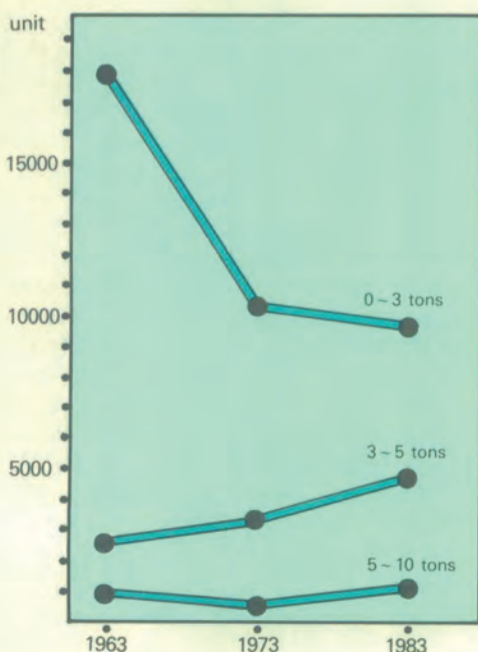


TABLE 7 Average number of fishing days per fishing unit per year

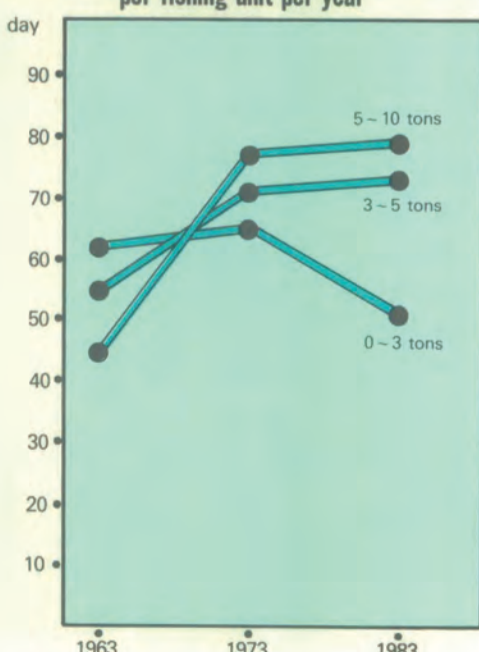
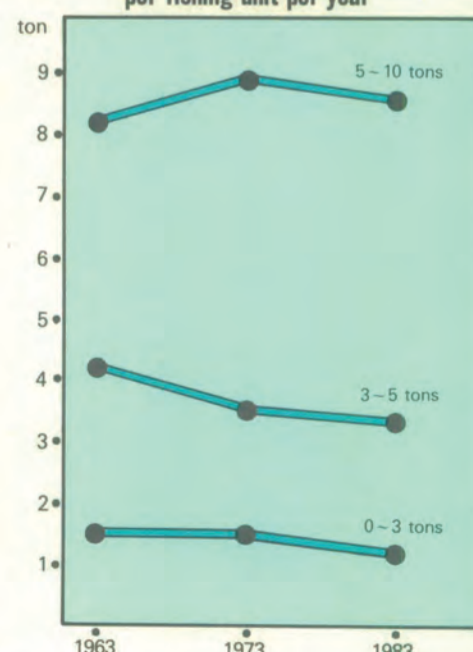


TABLE 8 Average amount of catch per fishing unit per year



Note: In the records of the Ministry of Agriculture, Forestry and Fishery this data is classified under "Other forms of longline". Source: Annual statistical reports on fishing & fish culture production.

Longline

LONGLINE can be divided into two basic types, the drift longline which uses floats to hang the main line (trunk line) at the desired depth in the surface or middle-depth waters, and the bottom longline which is set in such a way that the trunk line and branch lines just come in contact with the sea bottom. In recent years, as a further refinement of the bottom longline we can see a new variation called the vertical-line type bottom longline, in which the trunk line is floated about 10 meters from the sea bottom to allow the branch lines to hang down vertically to the bottom.

Drift longline: This is a longline used for catching fish that migrate in the surface waters or slightly below, with the main catch consisting of tuna, skipjack, marlin, shark, salmon, trout, dorado, sea bass, black rock-fish, halfbeak and others. This category also includes middle-depth type longlines used in catching Alaska pollack, mackerel and yellowtail.

Bottom longline: This is the most popular type of longline and it is used in all the coastal regions of Japan to catch a wide variety of different fish. The main catch includes fish of the cod family, flounder, flatfish family, sea bream, tilefish, Atka mackerel, drum, croaker, hairtail and yellow porgy.

Vertical line type bottom longline: This method is an improvement on the bottom longline having the advantage of being able to be set even in areas with rocky reef bottom topography. It also combines the advantages of being capable of distributing a large number of hooks over a large area of sea bottom and the ability to catch not only bottom feeding fish but also fish that migrate and feed slightly above the sea bottom. The main catch includes big eye, deep sea bass, Japanese parrotfish, centrophid fish, Etelis carbunculus and others.

The structure of a longline

The basic structure of a longline, as shown in Fig. 1, consists of a long main line (trunk line) to which branch lines are attached at regular intervals, each of which ends with a leader or snood to which a hook and bait are attached. After the line has been set in the water, in order to mark the position of the line, marker floats and marker flags (or marker lights) are attached either to the float line at either end of the main line or to marker float lines attached to the middle sections of the main line. And, in the case of bottom longline, in ad-

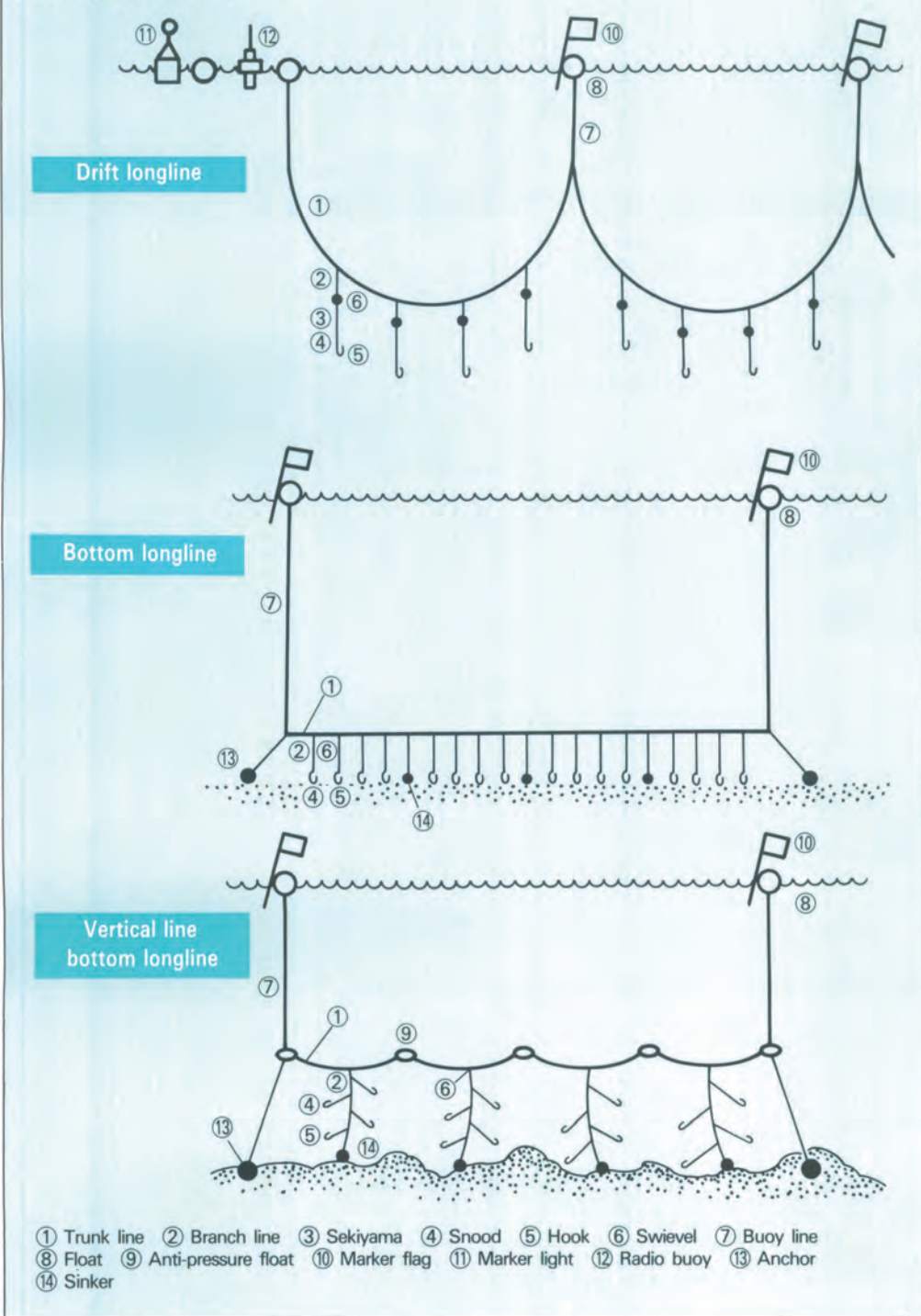


Cutlass fish. Fish caught by the longline method have little damage to the fish body, meaning they bring a high selling price.

Fishing Methods

in Coastal Waters

FIG. 1 Types of longline



dition to the float marker lines, float markers and marker flags (or marker lights), such additional gear as anchors and anchor ropes (attached to either end of the trunk line) and sinkers (attached to the middle sections of the trunk line) are also necessary.

As a fishing method, longline has the particular quality of being able to extend over a large area of water. Pelagic tuna longlines may be of lengths between 50 and 60 kilometers, or even up to 100 kilometers in length, while in coastal waters it is not unusual for fishermen to operate longlines

of up to 10 kilometers in length.

In order to facilitate the fishing operation, the trunk line is usually divided into sections of about 500 meters, called "one basket", which is kept in one basket-shaped container along with its branch lines and snoods & hooks. In coastal longline fishery, the length of the trunk line of "one basket" is usually 630 meters. The containers are called "baskets" and they are made of bamboo, plastics or wood. Each of the "basket" containers with their fishing gear, including the trunk line, branch lines, snoods & hooks and bait, are

prepared in the same way so that they can be easily connected one to another in the line casting operation with no problems. When the line is put back in the basket after use, as well, it is done in a way that will ensure convenient use in the next line casting, with the trunk line stacked in a "flower petal" pattern neatly, and the branch lines piled separately near the rim of the basket so as not to become entangled with each other, and the hooks are stuck lightly into the rim of the basket at regular intervals. And, to make the end of the trunk line easily identifiable, it is pulled out of the basket slightly and left hanging out.

Concerning the materials used for the trunk line and branch lines, vinylon ("Cremona") is most often used for the trunk line while branch lines are usually made of nylon gut. The thickness of the lines is determined by considering the size of the fish to be caught, the depth of water in which the line will be used and the overall length of line to be used in the fishing operation.

The fishing operation

Line casting is done at the time when the fish normally feed, around the hours of sunrise and sunset. The line is cast from the stern of the boat and always in such a way as to have the line lie perpendicular to the tidal current flow. The reason for this being that it increases the probability of migrating fish coming in contact with the hooks, and also prevents the branch lines from becoming entangled with the trunk line, a condition which often occurs when the trunk line is cast parallel to the current flow. Although the trunk line is usually cast in one straight line in the case of both drift longline and bottom longline, when fishing for the fish around a reef area the line will often be cast in a zigzag pattern, as shown in the diagram.

The timing of the line hauling operation may be (1) immediately after casting, (2) one or two hours after casting, or (3) in the morning after leaving the line out all night, depending on the region and the type of fish being caught. Although the use of

mechanized line haulers has spread, small-scale longlines are still hauled by hand.

The fishing hook

A wide variety of distinctive traditional hook shapes have developed for each type of fish in the different regions of the country. Generally, the hook used in longline is one with a curved-in point, with most having a relatively narrow gap. The reason being that this type of hook will set itself in the fish's mouth region and not cause injury to other parts of the fish body, and also because it is capable of holding the catch for long periods of time.

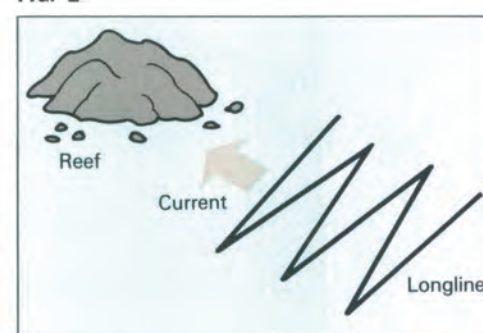
- 1) For sea bream family fishes a round-shaped hook with an extreme curve-in at the point is used.
- 2) For globefish, stingray, hairtail and eel a hook with a long shank is used, to allow for easy dislodging of the hook after the catch is hauled in.
- 3) For flatfish, mackerel and yellowtail family fishes an angular hook is usually used.
- 4) For large-sized fish like tuna, shark and marlin a large hook with an especially large barb is used.

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(Figures of fishing gear)*



Cutlass fish. Longline being cast. Bait is attached to the hooks as the line is cast.

FIG. 2



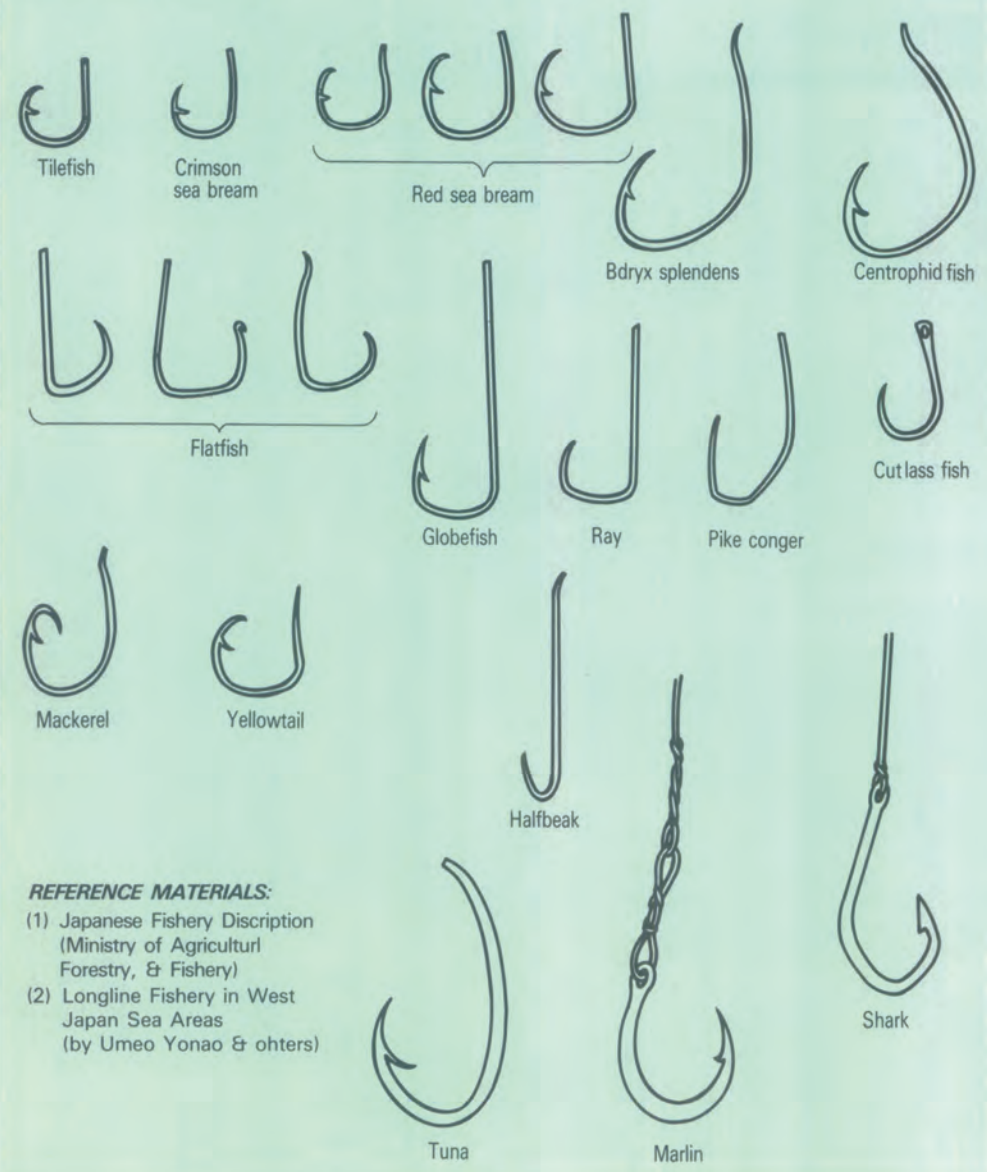
Line hauling operation for flatfish longline. A one man job done by hand.



Line casting of a flounder longline. Casting is done from the portside stern of the boat.

The fishing gear

FIG. 3 Fishing hook shapes



REFERENCE MATERIALS:

- (1) Japanese Fishery Discription (Ministry of Agricultural Forestry, & Fishery)
- (2) Longline Fishery in West Japan Sea Areas (by Umeo Yonao & others)



Salmon longline. A line-casting platform is built on the stern of the boat.



A line hauler and platform for receiving baskets



A rack for the orderly storing of baskets after use.

Flounder bottom longline



Flatfish bottom longline



Tilefish bottom longline
The bait is cut pieces of mackerel & squid attached to the hooks alternately.



Cutlass fish bottom longline



Salmon drift longline

Repair and maintenance of the lines: This work is performed on land by a retired fisherman and his wife.



The rapid growth of the sashimi tuna fishing fleet

Tuna longline fishery is the most representative type of longline fishery in Japan. In 1983 the combined tuna longline catch of the three divisions of pelagic, offshore and coastal, totaled 327 thousand tons, with a total sales of 32 billion yen. After World War II, beginning with the dispatchment of the first 1,913 ton long-term storage type fishing vessel to the Indian Ocean in 1954, the Japanese tuna fishery industry has grown to its present scale of worldwide operation through the employment of a number of technical advances, including ① the development of new fishing grounds based on increased fishing boat size, ② extension of the length of the fishing boats operating period by

means of the dispatchment of supply ships, ③ increased labor economy due to the mechanization of the line operation, and ④ the introduction of super low-temperature freezing facilities capable of achieving temperatures of $-50 \sim -55^{\circ}\text{C}$. Along with this large-scale fishery development, small scale tuna longline operations using boats of up to 20 tons continued to expand their fishing grounds, supported by demand for tuna for export, from their former coastal fishing grounds in southwest Japan's coastal waters and the waters around Tanegashima and the Okinawa Islands to the offshore waters as far south as the 20th parallel north, after the appearance of the 19 ton class fishing boat in 1965. By 1975 a part of this fleet began fishing in waters south of the 20th parallel and, by 1980, south of the 10th parallel. In contrast, the tuna longline operations using boats of in the 5 ton range which could not extend their fishing grounds to the offshore waters began to suffer from

insufficient catch, which forced them to decrease their number of fishing days and eventually to change their fishery activities from purely tuna longline to a combination of activities including angling, trolling and miscellaneous longline fishery.

The composition of fishing grounds for tuna longline fishery in the North Inshore Pacific of Japan

Generally speaking, fish form schools of one type of species having the same body size and migrate at a specific speed and direction with a specific interval between individuals. Also, these schools have a definite relation in the food chain to schools of other species of fish, forming a definite ecological community with regards to time and space in

a given water area. When one looks at the results of the years of fishing operations one sees that the same type of fish migrate to the same places in yearly cycles. Although there may be slight discrepancies in the time and orders that the migrations appear, the pattern of the fishing ground composition never varies. That is why a particular fishing method develops in a given water area for a given species of fish. The fact that such patterns regarding species, degree of maturity, season and sea conditions exist is extremely important to the fishery business. The reason is that it would be impossible to conduct effective, economical fishing activities if it were not possible to plan fishing methods based on knowledge of the numbers of fish, their schooling patterns and distribution of schools for a given species of fish. Professor Tsuyoshi Kawasaki (Tohoku University) has analysed the structure of piscivorous fish communities existing in the North Inshore Pacific areas of Japan, and

1 Coastal Tuna Drift Longline



Figure 5 shows the general construction of existing tuna longline fishing gear. The fishing boats used for tuna longline fishery vary widely from 5 tons to 400 tons, and in the same way, there is great variation in the thickness of trunk lines and branch lines, the number of branch lines, the

dimensions of the hooks used, and the number of 'baskets' used. Here we will introduce the existing types of tuna longline fishing gear suited for small-scale coastal fishery.

Structure: In one common example, 50~60 meter lengths of line are connected together to form one trunk line unit (one 'basket') of 300~450 meters. The number and length of branch lines attached to one "basket" of trunk line varies based on the type of fish to be caught and the fishing ground conditions. For bluefin tuna, yellowfin tuna and bigeye tuna it is standard to have 4 to 5 branch lines of 15~20 meters in length, while Albacore usually calls for 8 to 12 branch lines of 15~20 meters.

Line material: Because a line hauler is used it is necessary to use line material with good flexibility and good strength under tension. In tuna longline "Cremona" (vinyon) is the most common material used. The usual trunk line thickness is from 4 to 6.5 mm, with the branch lines being the same or one grade thinner. Branch lines: These are made up of three

parts, the ① branch line, ② "sekiyama" and ③ snood and hook. Wire is used in the snood for the purpose of reducing visibility, and the "sekiyama" (a steel wire covered with coiled cotton thread) in the middle section serves to facilitate handling during the line hauling process.

Line operation: For effective line operation, it is extremely important that the connecting and disconnecting of the trunk lines, branch lines and float marker lines can be carried out easily and surely. Traditionally this task relied on the skill of the fisherman's ropework, but recently there has been a growth in the use of snaps (Fig. 5 sections A improved and B improved) in tuna longline fishery. The invention of these strong and easy-attaching snaps has made it possible to disconnect the branch lines while the trunk line is being reeled in continuously during the hauling operation.

Here is an example of a case in which fishermen succeeded in establishing a tuna longline fishery industry in fishing grounds which have traditionally been used only for small-scale fishing by trying out new im-

provements on the tuna longline fishing gear.

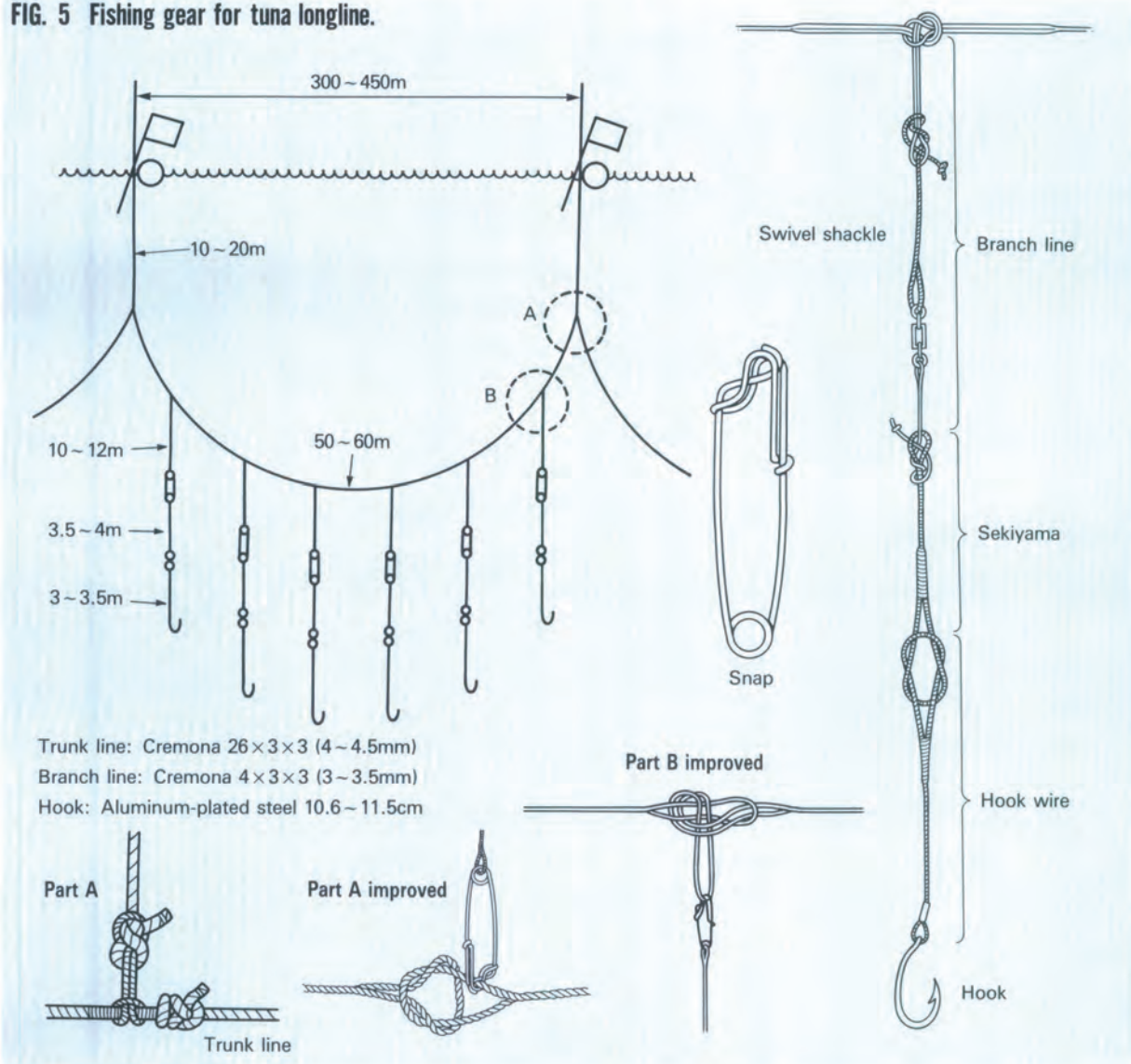
Miyazaki Prefecture is located in the southwest region of the Japanese Islands. The fishermen of the southern part of this prefecture are primarily engaged in pole-and-line angling for skipjack and longline tuna fishery in the offshore and mid-ocean waters.

The fishermen of Tomishima in Hyuga City in the northern part of the prefecture have long been engaged in small-scale fishery from 5 to 10 ton boats, including trolling for skipjack and tuna that migrate into this coastal fishing grounds and dorado longline.

However, following the rise in fuel costs which accompanied the second oil crisis in 1978, it became more and more difficult for fishermen here to conduct profitable trolling fishery due to a condition which was made worse by the inconsistency of the catch, forcing them to search for and develop more efficient and energy saving fishing methods. Observing the fact that often skipjack and small tuna would get caught in the longline fishing for dorado, the fishermen decided to try to revive the coastal tuna longline fishery which had been largely neglected. They tried, first of all, changing the existing tuna longline fishing gear from Cremona to all nylon gut.

(Continued on next page)

FIG. 5 Fishing gear for tuna longline.



Negotiation of tuna price between middleman and retailer. (at the Tokyo Tsukiji Fish Market)

has identified two basic schooling patterns that take shape in the season of June and July. In table 9 the two types of schools are those consisting of large sized fish such as

shark, tuna and marlin, and those consisting of middle-sized fish such as skipjack and Albacore. These two types of schools invariably form in different types of sea areas and never overlap in mingle in the

same area. Because the large-sized fish of the A type schooling pattern tend to spread out over large sea areas with considerable distance between each other, the "extensive"

longline fishing method is the most suitable. On the other hand, middle-sized fish of the B type schools tend to gather in closely concentrated schools, making the "intensive" pole-and-line angling method the most suitable. Because the purse seine method chooses a suitable sea area and encompasses a large water area with a net, it is suitable for catching both A type and B type schools of fish. The longline method which is most effective in catching extensive schools which spread themselves out over a comparatively large sea area, is most often used in catching bottom fish inhabiting a sea area with a flat bottom topography, or for migrating species with relatively weak schooling instincts that migrate in the middle depths and surface water regions.

TABLE 9 Piscivorous fish communities in North Inshore Pacific areas of Japan; their distribution and main species they feed upon (from Professor Kawasaki et.al., 1962)

Fishing method used	Type of school	Main component species	Main areas of distribution	Main species fed upon
A Purse seine & longline	(1) Mackerel shark	Blue shark & mackerel shark	Around offshore Oyashio current front	Squid, anchovy & mackerel
	(2) Mackerel shark & bluefin tuna	Bluefin tuna, blue shark & mackerel shark	Around nearby-sea Oyashio current front Around northern front of nearby-sea Oyashio current	Squid, anchovy, mackerel & Saury
	(3) Bluefin tuna	Bluefin tuna & blue shark	Around nearby-sea Oyashio current front	Squid, anchovy, mackerel & Pacific saury
	(4) Marlin	Blue shark, swordfish & marlin	Southern part of Kuroshio current area	Squid, anchovy & mackerel
B Purse seine & angling	(1) Skipjack	Skipjack	Northern part of Kuroshio current area	Anchovy, Crustacea & squid
	(2) Albacore	Albacore & skipjack	Northern part of Kuroshio current area	Anchovy, Crustacea & squid

REFERENCE MATERIALS:
 (1) "Relation of fish movement to fishing method" by Makoto Inoue
 (2) "Resources of surface fish" by Tsuyoshi Kawasaki

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Fishing gear and methods

The greatest advantages of nylon gut are that it is thin, strong, light and also transparent. For this reason, when used with live anchovy bait the bait appears to be swimming in almost a natural state, thus improving catching effectiveness. However, several problems still remained to be solved. First, because of nylon monofilaments' stretchability it is harder to handle than Cremona twine, and the lines also become entangled more easily. Also, because the #40 weight line which was used at first lacked strength, the lines would sometimes break at their connecting points. Attempts to solve such problems by a series of trial and error have resulted in the present fishing gear construction shown in figure 6.

The followings are the major improvements that have been made.

- 1) Thickness of the nylon gut used in the trunk and branch lines was increased to #90.
- 2) In order to not inhibit the swimming action of the live anchovy bait the wire snood was eliminated and the hook attached directly to the nylon gut. Also, considering the fact that nylon gut is not strong under tension, the number of windings used in attaching it to the hook was increased.
- 3) When hauling the line, a hauling method in which the trunk line and branch lines hauled in together was adopted, and in order to prevent entangling of the lines the swivel used in the attachment was improved (entangling most often occurs because of the twist created by the insufficient action of the swivel).

Fishing grounds and catch

The configuration of the fishing grounds, as shown in Fig. 7, is the area from 70 to 100 miles from the coast (with a depth

of 300 to 1000 meters), and the fishing season is roughly an 8 month period from April to November. The catch is made up of about 70% yellowfin tuna, followed by marlin family, Albacore, dorado and shark.

Fishery management

Presently in Tomishima there are two groups of boats, 5~8 ton class and 9.9 ton class, engaged in tuna longline fishery in the ways shown in table 10 and table 11.

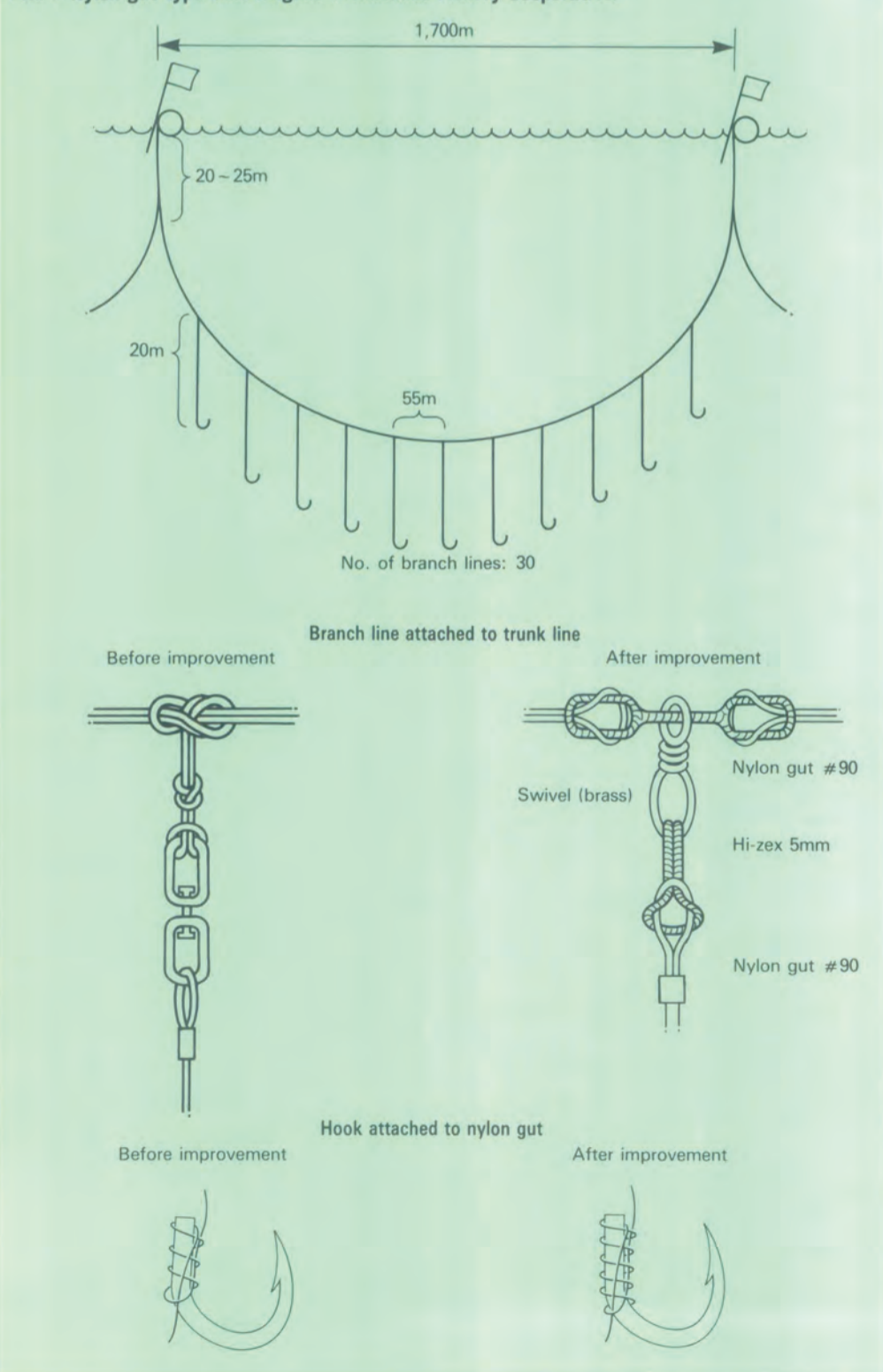
Fishing operation

- At night a group of several boats is formed and leaves on the 7~8 hour trip to the fishing ground.
- After reaching the boats separate at 2~3 mile intervals and turn of their engines and drift.
- Line casting begins at dawn when the fish begin their feeding activities. Fishing

FIG. 7 Fishing grounds and season for tuna longline.



FIG. 6 Nylon gut type tuna longline (Tomishima Fishery Cooperative)



is done for the three-hour period from 6:00 to 9:00 A.M. Fishing is not done at night to avoid having the bait taken by rays or squid.

- The line is cast across the current flow. The casting is begun from the landward side. After completion of the casting the line is left to drift in the water for about six hours before the hauling operation begins.
- The hauling is begun at the offshore side

and works toward land to save unnecessary travel by the fishing boat. The number of "baskets" used in one fishing operation ranges from 15 to 30.

- The line is left in the water drifting for about 6 hours.
- The hauling operation is begun at about 4:00 in the evening and requires about 6 hours.
- The crew sleeps until dawn.
- At dawn the line casting begins again.

TABLE 10 Yearly fishing schedule

Type	Fishery method	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Main fishery	Coastal tuna longline												
Supplementary fishery	(1) 9.9 ton class tuna longline near Okinawa												
	(2) 5~8 ton class												
	• Globefish longline												
	• Tilefish longline												
	• Dorado longline												

TABLE 11 Comparison of fishery methods

	5~8 ton class	9.9 ton class
Crew	2~3 people	3 people
Fishing days per year	• Tuna longline • Other longline	• Tuna longline • Other longline
	120 days 100 days	140~160 days 100 days
Total	220 days	240~260 days
Amount of annual sales	20~35 million yen	30~40 million yen
Number of days per fishing trip	• Round trip to fishing ground • Operation time	• Round trip to fishing ground • Operation time
	2 days 1 days	2 days 3 days
Total	3 days	5 days
Cost of one fishing trip	• Amount of fuel cost • Bait (live fish) • Ice	• Amount of fuel cost • Bait (live fish) • Ice
	100,000 yen or less 350~450 liters 3~4 buckets About 2 tons	120,000~130,000 yen 600~700 liters 9~12 buckets About 2 tons

FIG. 8 Deck layout and crew.

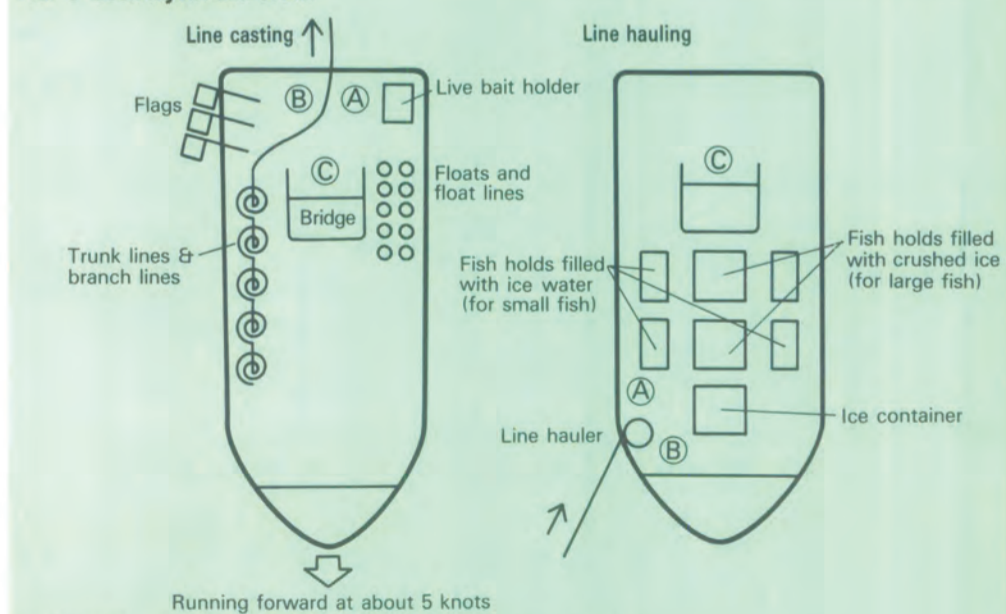


TABLE 12 Division of labor between crew members A~C

Crew member	Crew position	During line casting	During line hauling
(A)	Senior crew member	Attaching live bait to hooks.	Operating line hauler & disengaging catch.
(B)	Junior crew member	Line casting	Helping disengage catch & caring for lines.
(C)	Boat owner/captain	Supervising operation & driving boat.	Same as left

Vertical Line Type Bottom Longline

This fishing gear was first developed in 1972 at the Kagoshima Fishery Experimental Station and the prototype given to fishermen for testing in the waters around the islands of southwest Japan having deep-water reef areas, where it proved successful. Later, between 1974 and 1978 its use spread to neighboring Okinawa, Miyazaki and Tokushima prefectures.

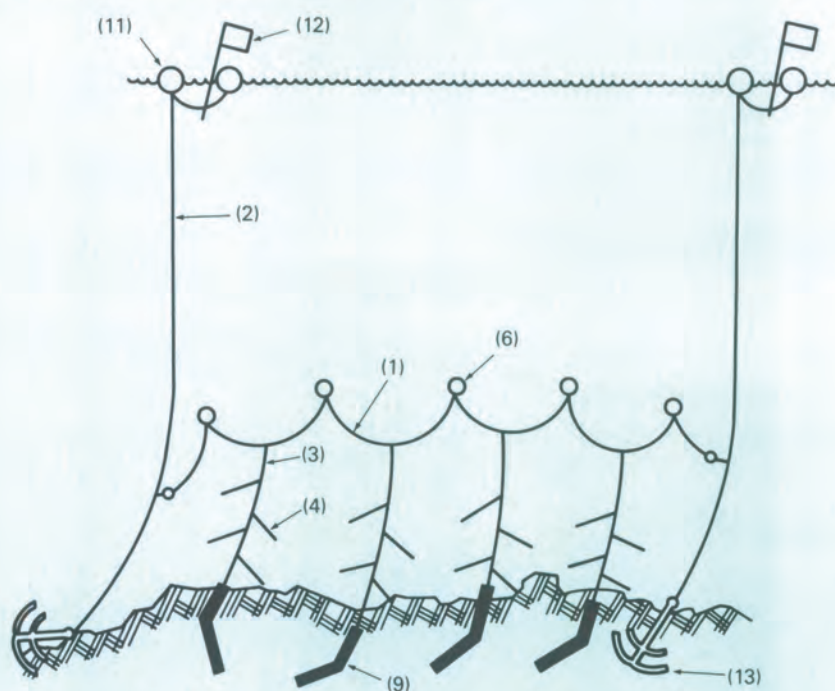
The construction of the fishing gear is illustrated in Fig. 9. With an ordinary bottom longline fishing gear, there will be considerable damage to the trunk line and branch lines when it is used in areas with rocky reef bottoms, and trouble often arises from the hooks becoming caught on the rocks. This improved fishing gear, however, greatly decreases such problems, through the following adaptations.

- 1 Pressure-resistant type floats made of plastics attached to the trunk line cause it to remain suspended in the water above the sea floor and causes the branch lines to hang down vertically. This means that the hooks do not actually come in contact with the rocks on the bottom.
- 2 Because the sinker at the end of the branch lines does come in contact with the bottom rocks, it is necessary to design it in a way that will prevent it becoming caught on the rocks. Normally, stones or concrete or small blocks of iron are used as sinkers, but, in this case, in order to prevent the hooks from becoming caught on the rocks an iron rod proves to be the best form of sinker. Iron rod of about 3/8" thickness are cut into 180~200 cm lengths and the upper 1/6th of the rod is bent at about a 30° angle. This shape of sinker has proved to reduce trouble dramatically.
- 3 At the point where the sinker is attached to the end of the branch line a one-grade thinner line should be used so that if, by chance, the sinker does become caught on a rock pulling strongly on the line will cause it to break off at the point of attachment. This "breaking line" is designated by # 14 in Fig. 9.

Although the basic structure of the fishing gear remains the same in all regions, the specifications, the depth at which the line is operated and the types of fish caught vary considerably. Table 13 shows these differences.

Since the fish to be caught include reef inhabiting fish like *Paracaesio caeruleus*, *Etelis carbunculus*, deep sea bass, big eye and rock cod, the meat of mackerel or saury pike is usually, used as bait, with salted or frozen meat being put on the hooks before leaving port. The boats leave for fishing in the early morning so as to arrive at the fishing grounds by sunrise, the time when the target fish begin their feeding activities. On arrival a fish finder is used to determine the desired fishing depth for the particular fishing ground, and the line is cast along the topographical line of the chosen depth or on the up-current side of a reef. About 1 1/2 hours to 2 hours after the line is cast the hauling operation is begun.

FIG. 9 Structure of vertical line type bottom longline.



- (1) Trunk line (2) Marker float line (3) Branch line (4) Fishing line
- (5) Fishing hook (6) Pressure resistant float (7) Snap (8) Swivel
- (9) Sinker (iron bar) (10) Hook (11) Marker float (12) Marker flag
- (13) Anchor (14) Breaking line

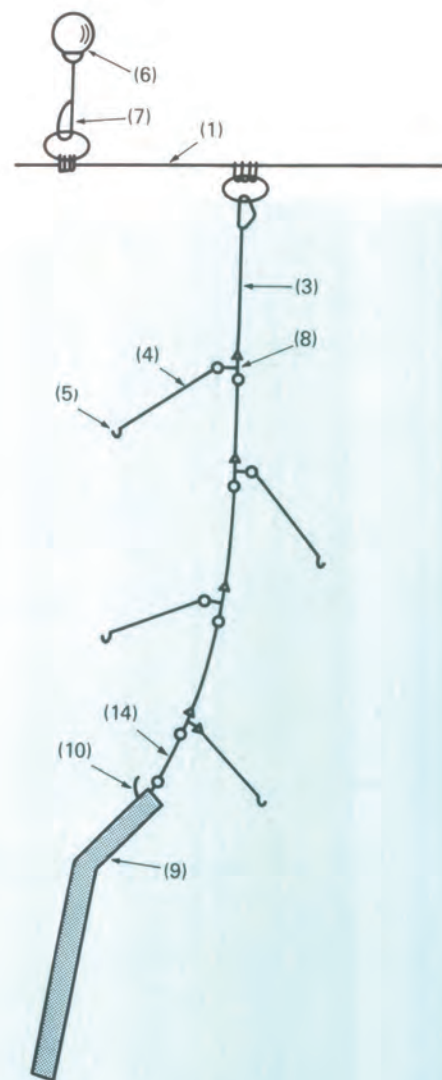


TABLE 13 Vertical line type bottom longline fishing gear specifications.

	Kagoshima	Okinawa	Nagasaki	Nagasaki	Tokunoshima	Miyazaki	Kanagawa
Trunk line	Cremona (polyvinyl) 3.2 mm 450 m	Polypropylene 4 mm 1350~1500 m	Cremona (polyvinyl) 3 mm	Polyethylene 6 mm	Polyethylene 5 mm 800 m	Hi-zex (polyethylene) 5 mm	Polyethylene 3 mm
Branch line	Cremona 70 Y x 9 m & 42 Y x 9 m	Nylon gut #90	Cremona 3 mm 7~8 m	Super-toto #40 12 m	Cremona 42 lines 7~9 m	Nylon gut #40 11 m	Nylon gut 0.52 mm 9 m
Interval between branch lines	16 m	27 m	25 m	NA	37.5 m	55 m	24~30 m
Fishing line	Nylon gut 0.47 mm 1~1.5 m	Nylon gut #50	Nylon gut 0.84~0.87 mm 30~50 cm	Nylon gut #40 40 cm	Nylon gut 0.90 mm 45 cm	Nylon gut 0.90 mm 50 cm	Nylon gut 0.47 mm 50 cm
Depth of fishing grounds	400~500 m	150~180 m	200~400 m	120~180 m	180~250 m	130~300 m	150~250 m
Fish species caught	Deep sea bass, <i>Paracaesio caeruleus</i> , Centrophid fish & shark	<i>Paracaesio caeruleus</i> & <i>Etelis carbunculus</i>	Deep sea bass, big eye & rock cod	Gray rock cod	Deep sea bass & Sea bass	<i>Lutjanus vitta</i> , <i>Epinephelus fasciatus</i> , deep sea bass & big eye	Big eye, rock cod & <i>Beryx splendens</i>

Because this type of fishery aims a specific points on the sea bottom as fishing grounds, it is desirable that the fishing gear have an appropriate sinking speed in relation to the current speed, and in order to insure the trunk line has sufficient floatage to keep it the proper distance above the sea bottom, it is necessary to adjust the strength of the floatability of the gear by means of the thickness of the trunk line material and the size and number of pressure-resistant floats, and the sinking capacity by means of the weight and number of sinkers used. The fishing operation is performed during the natural feeding hours for the fish to be

caught. One is likely to reason that the longer the fishing gear is left in the water the greater the catch will be, but Professor Arimoto of the Tokyo Marine Industry University conducted experiments with this type of fishing gear in Sagami Bay and demonstrated the following facts. While not all the fish are caught immediately after the line is put into the water, after a certain amount of time there reaches a point where no additional fish of the desired species will be caught. And, leaving the line in the water for extremely long periods results in the increase in catch of undesired species as well as increasing the chance that the catch will free itself from the hook

and escape or else be eaten by a larger predator.

We can say in summary that this is a very effective fishing gear which has been adopted successfully in many regions of Japan shortly after its development some years ago. However, since it is a method which catches the bottom fish inhabiting a certain reef or shoal area there is a danger of depleting the fish resources of the given area. Therefore, it has been recognized that this fishing method must be closely controlled with regard to fishing ground use.



Bottom Longline for Tilefish



Here we will introduce a small-scale longline fishery for tilefish conducted around a group of islands lying off the coast of Southwest Japan in the East China Sea. Traditionally, fishermen of these islands used 3 ton class boats to conduct various forms of angling fishery in the neighboring waters, but with the increase in boat size to the 5 ton class they were able to expand their fishing grounds to in offshore waters and through the inclusion of bottom longline fishery for tilefish to provide themselves with a more stable year-round fishery productions. As a result, these fishermen now engage in bottom longline fishery from September to May and conduct their traditional angling fishery during the months of June to August.

Management

1 The cost of one 5-ton class fishing boat with its engine and necessary fishing equipment is between 15 and 16 million yen. The FRP fishing boat in the photo has an overall length of 11.8 meters, a

width of 2.8 meters, has a depth of 1.45 meters and weighs 4.68 gross tons.

2 Yearly fishery gross sales range from 8 to 10 million yen, with yearly fishery expenses totalling between 4 and 5.5 million yen. (including 1 to 1.5 million yen repayment of low interest fishery loan)

Labor

- 1 The fishing operation at sea usually requires two laborers.
- 2 In order to save labor the boat is often equipped with an automatic pilot device and a line hauler for the hauling operation.

(Note) Japan's high level economic development in the 1960's and '70s caused a migration

of labor to the cities, resulting in a labor shortage problem in the fishing villages. The introduction of such line haulers and automatic pilots have enabled one fisherman to do the work usually performed by two.

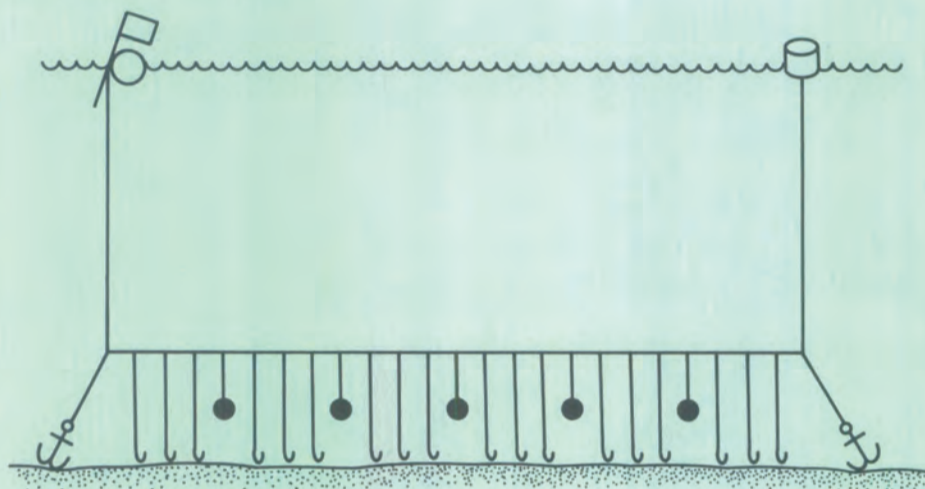
- 3 Before leaving port for fishing, the lines which will be used that day (60~70 baskets) must be prepared and the hooks baited. This work is done by the fisherman and his wife, and often with the help of local women working on a part-time job basis.

Fishing operation

- 1 The fishing season for tilefish is the 9 month period from September to May, with the fishing grounds lying three nautical miles offshore from the islands

- and sand-and-mud bottom areas farther offshore.
- 2 Usually this is a one-day fishing operation, but at times one night will be spent at sea. For this reason the bridge is made large enough to enable 2 men to sleep inside.
- 3 The number of "baskets" used on one fishing trip is between 60 and 70.
- 4 During the line casting operation one person will drive the boat, running forward at 4 to 5 knots, while the second person casts the line from the rear of the boat. In the hauling operation, one person will haul in the line from the front of the boat while the second person takes the caught fish from the hooks and then sorts and stores the catch.
- 5 The catch is lined up and sorted in crates and then packed in crushed ice from the ice locker before being stored in the fish hold.
- 6 The bait is a combination of salted squid and mackerel pieces.

FIG.11 Tilefish bottom longline



Trunk line: Cremona 60~70 Y/2 strands
 Fishing line: Nylon gut #8, 40~50cm
 Interval between branch lines: 3.6m
 Number of "baskets" for one length of longline: 15~20 "baskets"

Branch line: Cremona 18~20 Y/2 strands, 1.5~2m
 Fishing hook: #11
 Number of branch lines per "basket": 60 lines



Line casting: The boat is driven forward at 4~5 knots as the line is cast. An automatic pilot is used to control the boat.



Yamaha FRP fishing boat model DY-39F-OA Gross tonnage: 4.68 tons



The catch is lined neatly in wooden crates and covered with ice for storage. The main catch is tilefish (in front).



Line hauling: The line is reeled in automatically by a line hauler.