

Published by Yamaha

# Fishery Journal

No.27

# Simpler and more effective modernized methods

## Pot Fishing

**P**ot fishing is a relatively simple fishing method which has been used traditionally by fishermen all over the world to lure and catch marine animals. The gear used in this type of fishery include a wide variety of baskets, cylinders, boxes and jars, all of which, for the sake of simplicity, we will refer to here under the one name, "pots".

The materials traditionally used in making pots have included such natural materials as bamboo, reeds, palm leaves, willow branches and the aerial roots of mangrove trees, and the traditional shapes which have developed around the world include cylinder shapes, barrel shapes and heart shapes among others.

The common elements shared by all these pot fishing methods are; (1) they are conducted in confined water areas such as the inside of bays and deltas, lakes and ponds, (2) they are passive fishing methods in which the pot is set in one spot for a given period of time and (3) in order to increase the amount of catch, methods requiring a large amount of cooperative labor, such as setting of fence nets and the draining of ponds are used.

When primitive trap-type fishing gear are used by themselves, fishing efficiency is too low to enable them to constitute a commercial fishery operation. In the pursuit of technical advancements that will enable the higher catching capability required in a commercial operation, alternatives such as larger scale fish wires, keddle nets and set nets come first to mind.

However, with the introduction of modern technology and adaptive measures suited to the local marine and labor resources, pot fishing can still be made to function as a significant part of a modern fishery industry.

Here is a list of the basic innovations which have taken place over the years in Japanese pot fishing.

- Improvement of materials used in fishing gear construction (use of synthetic nets, steel frames and plastics), resulting in lighter, longer lasting gear.
- Expansion of fishing grounds due to the introduction of motorized fishing boats, and the increased mechanization of fishery equipment.
- Introduction of long-line type fishing methods due to the introduction of motorized line haulers.

As a result of these innovations, Japanese coastal fishermen have been able to easily include pot fishing as a part of their fishery operations, and also it has enabled them to exploit particular marine resources in deep offshore sea areas. In this issue we will introduce several examples of pot fishery utilizing simple fishing gear and efficient fishing methods that are presently in use in Japan's coastal fisheries.

Horsehair crab pot fishery in Hokkaido





# POT FISHING IN JAPAN



Since the Japanese government does not keep separate records of the pot fishery catch within its marine industries production statistics, it is hard to know exactly what the overall production by pot fishing constitutes in Japanese fishery, but, according to recent research materials, we can estimate that pot fishing accounts for approximately the following types and amount of catch:

Shrimp	.....approx. 6,000 tons
Crab	.....approx. 70,000 tons
Shellfish	.....approx. 20,000 tons
Octopus	.....approx. 20,000 tons

Also, in addition to the above-mentioned catches, in certain areas conger eel, cuttlefish, filefish, black porgy, and puffer are caught by pot fishing methods, although the amount of catch is unknown.

The fishing grounds of Japanese pot fishery include coastal areas within its territorial waters as well as areas of the North Pacific and the Japan Sea. Particularly in the North Pacific waters, large-scale pot fishing operations for crab and ivory shell have been conducted in the Bering Sea and the Sea of Okhotsk since the 1960's, but in both cases the fishing grounds fell within the 200-mile zones of either the U.S.A. or the Soviet Union resulting in the setting of limits on catch and other restrictions beginning in 1977 which have led to a decline in total catch.

Here, let us investigate the general situation of small-scale pot fishing operations being conducted presently in the coastal waters of Japan.

In 1976, a group of marine researchers conducted a survey by questionnaires sent to the Statistics Department of the Ministry of Agriculture, Forestry and Fishery, large-scale private fishery enterprises, fishery cooperative associations and fishery research and experimental stations around the country concerning pot fishing. Also, in another case, the National Federation of Fishery Cooperatives gathered available information and records concerning pot fishing operations throughout the country between the years 1977 - 79. According to these two studies, it became clear that pot fishing is conducted with relatively high concentration in the coastal waters of Hok-

kaido and the Japan Sea, while it is not nearly as popular along the Pacific coast of the country. The marine resources for pot fishing were shown to be distributed by species, in the following way:

## 1) Crab Pot Fishing (FIG. 1-A)

The main types of crab caught include horsehair crab (*Erimacrus isenbekii*), tanner crab (*Chionocetes opilio*), Pacific tanner crab (*Chionocetes japonicus*), gazami crab (*Neptunus trituberculatus*), hiratsume crab (*Ovalipes punctatus*), red frog crab (*Ranina ranina*) and others, each of which is an important fishing resource in its region.

### •Horsehair crab

Coastal waters of Hokkaido

### •Tanner crab

Northern Japan Sea Coast along Hokkaido and Akita and Niigata Prefectures.

(NOTE) In the western Japan Sea coast areas it is caught by small-scale trawl net fishery.

### •Pacific tanner crab

Since it lives in deeper waters than the tanner crab on the continental shelf, it is impossible to catch by trawl and can only be caught by pot fishing. It is caught mainly in the central and western part of the Japan Sea coast from Toyama Prefecture to Yamaguchi Pref.

### •Gazami crab

In inland sea and bay waters as in Aichi, Mie, Kumamoto and Kagoshima Prefectures.

### •Hiratsume crab

In certain parts of the Pacific coast such as Iwate and Ibaragi Prefectures.

### •Red frog crab

In the coastal waters of Kyushu, such as Oita and Miyazaki Prefectures.

Also, although the size of the catch remains small, in recent years coastal fishing boats have begun to exploit resources of Ibara crab (*Lithodes aequispina*) and Ezoibara crab (*Paralomis multispina*) in the deep waters of Sagami Bay and the offshore waters of Boso Peninsula, and Japanese giant crab (*Macrocheira kaempferi*) in the deep waters of Suruga Bay.

## 2) Prawn pot fishing (FIG. 1-B)

Although in America and Europe spiny lobster and crayfish are the main objects of

commercial pot fishing operations, in Japan members of the prawn family such as coonstripe shrimp (*Pandulus hypsinotus*) and northern shrimp (*Pandulus borealis*) constitute the major part of the catch. The fishing grounds are located in the northern Japan Sea coastal waters stretching from Hokkaido and Akita to Niigata, Toyama and as far as Ishikawa Prefectures. The highest prized member of the prawn family, Kuruma prawn (*Penaeus japonicus*), is rarely caught by pot fishing, being mainly caught by either trawl net or gillnet fishing methods.

Also, beginning in Suruga Bay (Shizuoka Pref.) in 1973 and in Sagami Bay (Kanagawa Pref.) in 1978, pot fishing operations for Akaza prawn (*Nephrops japonicus*) at a depth of 200-300 meters are being successfully conducted.

## 3) Shellfish pot fishing (FIG. 1-C)

Pot fishing operations aimed at ivory shell (*Babylonia japonicus*) are conducted in the cold sea areas of the Japan Sea coast in Hokkaido.

## 4) Octopus pot fishing

The main objects of this type of fishery are the warm sea inhabiting octopus (*Octopus vulgaris*) and the large-sized octopus (*Paroctopus dofleini dofleini*) inhabiting the cold sea areas. The former has been caught in Central and Western Japan since older times by means of a ceramic (stoneware) pot. The latter has long been caught in Hokkaido's coastal waters by means of a wooden box.

In Japan, these octopuses are eaten either boiled or processed into flavored products for consumption by the general public.

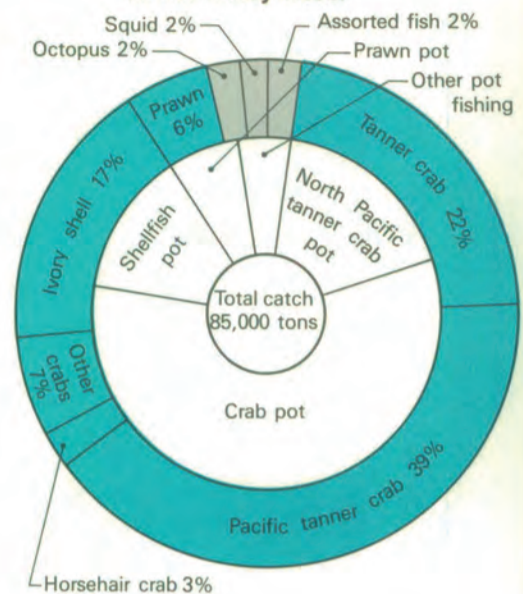
## 5) Other types of pot fishing

In addition to the above-mentioned types of fishery, Japanese coastal fishermen in different regions make a wide variety of pot fishing gear to catch sea urchin, rock trout, conger eel, cuttlefish, lamprey, eel, filefish, black porgy, puffer and other marine resources.

All of these are fishing methods with a long tradition of techniques unique to each different fishing ground spread around the country's coastal regions, and are therefore difficult to classify in generalized groups.

# General

TABLE 1 Amount of Catch by Species for Pot Fishery (1979)



## ■ Important types of catch

In 1979 Japanese pot fishing landed a total catch of 85,000 tons of marine products. The distribution of this catch by species is shown in Table 1. As can be seen at a glance, almost the entire catch was made up of either crustaceans including crabs and shrimp (prawn) or shellfish (ivory shell). Even if the 14,000 tons of tanner crab and 850 tons of kitaibara crab (*Lithodes couesi*) caught in the north Pacific that year were subtracted from the catch shown in Table 1, over 3/4 of the catch by coastal and offshore pot fishery would be made up of crustaceans (shrimp, crab, etc.) and shellfish.

This fact is evidence of the effect of changes in pot fishing in recent years to a modernized commercial-type fishery with improved fishing gear and methods which have allowed the fishermen to specialize their catch to certain species of marine animals that respond to benthos. This modernization of gear and methods have enabled fishermen to take advantage of the following unique qualities of pot fishery as a fishing method.

- 1) Construction of the fishing gear is simple and the operation is easy to perform, so the introduction of motorized line haulers has enabled pot fishing to be conducted on a larger scale and with greater catching efficiency.
- 2) Pot fishing can be conducted in sea areas where trawl net and bottom gillnet fisheries are not possible.
- 3) New fishing grounds in the deep sea can be exploited.

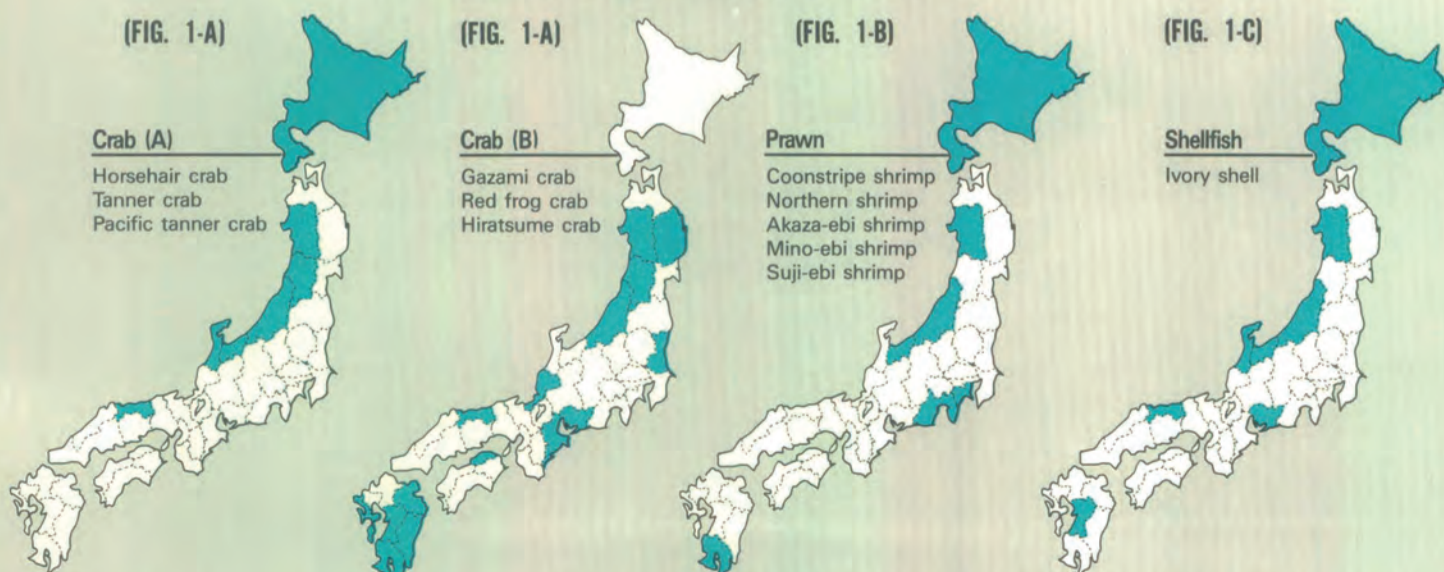
## ■ The catching function

There are three basic means of luring a marine animal into a pot; luring it with bait, stimulating its thigmotactic instinct, or providing it with a shelter-functioning pot. Among these three, the most effective means is considered to be, of course, the use of a bait.

In shallow sea areas with a depth of less than 50 meters, the sea is inhabited by a large number of marine animals, and food (bait) is plentiful. At depths below 50 meters, however, the variety and number of marine animals decreases rapidly and the overall biota becomes sparse. Therefore, the presence of bait in a pot is thought to have an especially strong effect on the predatory demersal animals, such as shrimp, crab and shellfish that inhabit these deep sea areas. The pot fishing method can be thought of primarily as a fishing method aimed at catching the scavenger-type predators which inhabit such sea bottom areas.

For example, the ivory shell is a shellfish which burrows itself into the sand on the sea bottom and extends its long snout up into the water, and, it has been observed, when a piece of fish meat is placed a short distance away, the ivory shell senses the

FIG. 1 Geographical distribution of pot fishing





# Features of Modernized Pot Fishing Gear

meat and crawls out of the sand to eat it. It must be mentioned, however, that the reaction to bait varies considerably with the species and with various biological conditions. Shrimp pot fishermen in Hokkaido state that the coonstripe shrimp are best caught with bait in the order; tanner crab, cucumber fish (*Osmerus deutex*), Atka mackerel, and lastly, saury pike. Probably because of its shiny appearance, fish often enter a pot baited with saury pike, while with Atka mackerel the amount of bait left uneaten in the pot is noted to be high.

Also, when observing the actions of the marine animal that approaches the pot, it is evident that in addition to the animal's feeding instinct there are also thigmotaxis and hiding instincts at work.

Especially, some types of eels and octopuses show a definite preference for dark holes or crevices and the pot clearly functions as a shelter for these species.

The catching effectiveness of the pot, in other words, its ability to hold an animal that has entered it in a trapped state, the size and location of the entrance (funnel), the effect of the shape of the entrance on the difficulty for a trapped animal to escape, the size of the mesh and the holding capacity of the interior compartment of the trap are all important factors, but ones which are difficult to make quantitative analysis of. Therefore, fishermen depend mainly on their own experience through trial and error in designing their own pots.

## Points in designing a pot

The following is the points taken into consideration when designing a pot:

**1) Portability...**It is important that the pots be such that a large number of them can be transported to the fishing ground at one time. Therefore, they should be designed either as collapsible pots or ones which can be stacked easily on top of one another on the deck of the fishing boat.

**2) Lightness/compactness...**The pots should be light and compact enough to enable rapid sinking and hauling during the fishing operation.

**3) Stability...**It is essential that the pots have sufficient stability to assure that they land on the sea floor in upright position and that they are not easily knocked over on

their sides. To achieve such stability, a stable cone-shaped design is often used, as is a metal frame on the bottom of the pot to serve as ballast.

**4) Durability...**The durability of pots has improved considerably with the use of synthetic fiber netting, but with square-shaped pots the tendency for the netting at the edges to be torn or worn through is rather high. That is why, today, round pot shapes are preferred over square ones.

**5) Simple construction...**Pot should be made of inexpensive, easy-to-find materials and designed in an easy-to-construct way. Also, damaged pots must be easy to repair.

**6) Use of a large number of pots...**In order to ensure an increased catching capacity it is necessary to set a large number of pots over a large area, and for this purpose the longline method is used. Also, with the addition of a line hauling device it is possible to fish in area from 200 to 300 meters in depth for deep sea shrimp (prawn) and crab.

## Classification of pot fishing gear

When classifying the various shaped pots used in different regions according to the type of marine animal being caught, some clear standards can be recognized with regard to their structure and shape. These can be seen in Fig. 2-4.

It is important to note, here that in the early 1960's there was an active exchange of technical expertise within the various regions. With regard to general pot fishing technology, Hokkaido has long been the leader within Japan, and certain types of pots developed there have spread to the fishermen of the Japan Sea and Pacific coast areas. With regard to crab pots, however, two basic prototypes are recognized, the "Hokkaido type" used for catching cold sea crabs, and the "Western Japan type" used for catching warm sea "gazami crab". There is a basic difference in the position of the pot entrance depending on whether the crab to be caught is a "crawling" crab, such as tanner crab or horsehair crab, or a "swimming" crab such as gazami crab. For a crawling crab the entrance is located on top of the pot and for a swimming crab it is located on the side.

FIG.2 Crab pot

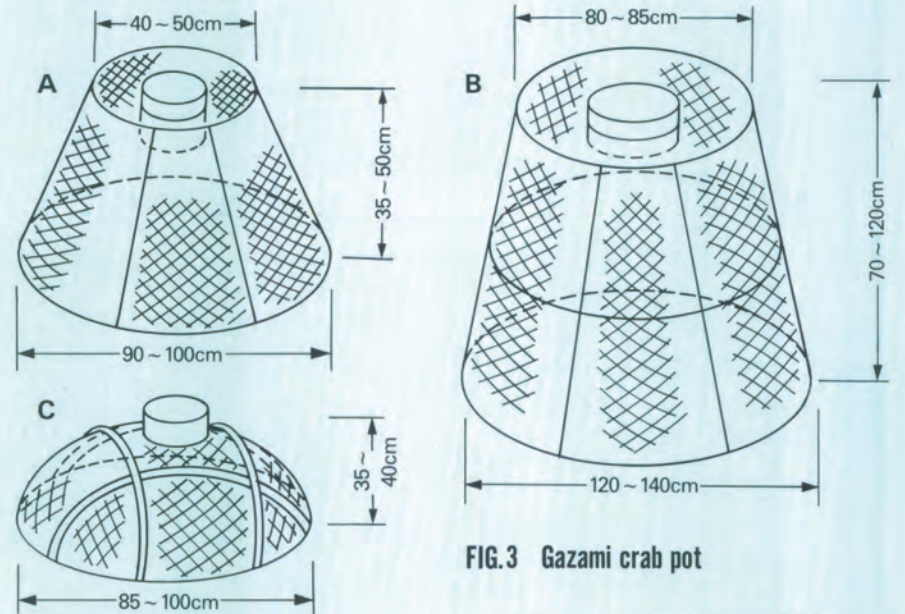


FIG.3 Gazami crab pot

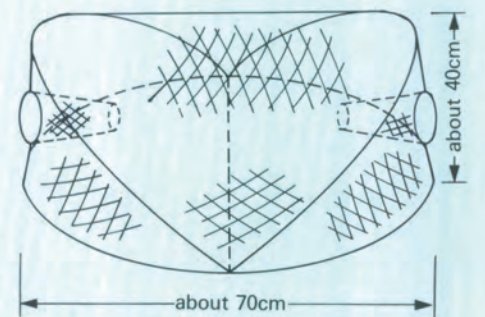
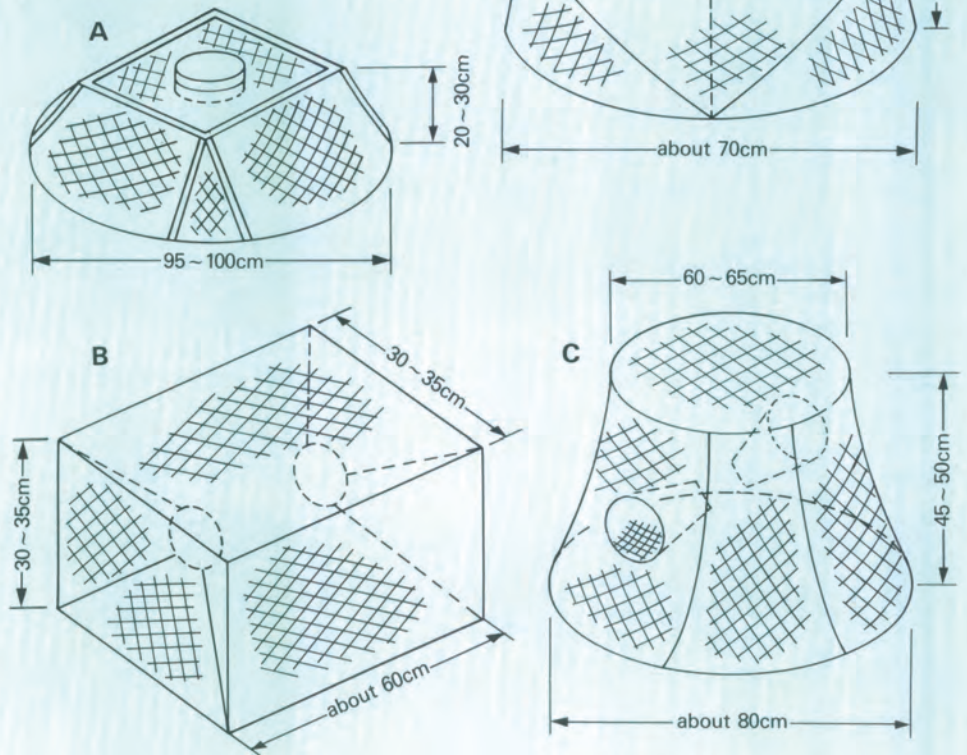


FIG.4 Shrimp pot

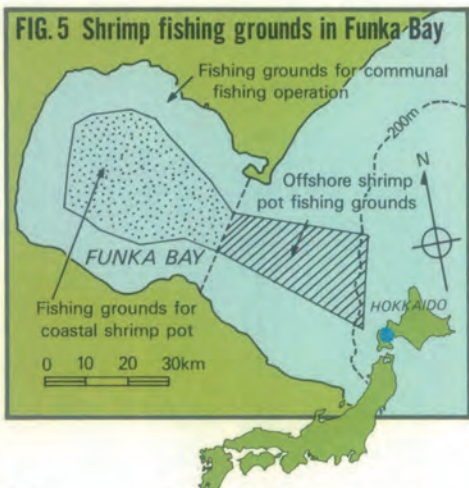




# EXAMPLE

Funka Bay, Hokkaido

# 1 Shrimp Pot Fishing



### Environment of the fishing grounds

Here we will introduce a pot fishing industry catching cold current shrimp for human consumption in the northernmost Japanese island, Hokkaido.

The three main types of edible shrimp caught in the coastal waters of Hokkaido include Hokkai shrimp (*Pandalus kessleri*), coonstripe shrimp (*Pandalus hypsinotus*) and northern shrimp (*Pandalus borealis*).

**TABLE 2 Shrimp produced by coastal fisheries in Hokkaido**

Popular name	Scientific name	Habitat
Hokkai shrimp	<i>Pandalus kessleri</i>	Shallow bay waters, especially in seaweeded areas
Coonstripe shrimp	<i>Pandalus hypsinotus</i>	Sand & mud bottom areas 100-200m in depth
Northern shrimp	<i>Pandalus borealis</i>	Summer: 300-600m depth Winter: 150-250m depth

Among these, Hokkai shrimp is found in Northern and Eastern Hokkaido and the coastal waters of the Okhotsk Sea, and is caught in certain bay areas by use of a sail-driven seine. The largest catches are in coonstripe and northern shrimp, both of which are deep sea shrimp caught in 200-250 meter depth areas either in coastal waters or offshore waters.

Although in the past coonstripe shrimp which live near shore were caught by a sail-driven seine, today they are caught by pot fishing, the same as offshore northern shrimp.

In Funka Bay in Southern Hokkaido the slope of the sea floor is rather steep from the shore to a depth of 40 meters, after which the slope becomes more gentle, giving the central part of the bay a large area of comparatively flat sea bottom. The bay opens to the sea on the southeast, outside of which the fan-shaped continental shelf is rather narrow, extending only 20 nautical miles before its outer slope begins to drop toward the deep sea.

According to Hokkaido prefectural regulations, the bay area is divided from the open sea by a line from Chikyu Cape to Sunazaki Point, and licensed shrimp pot fishing (for coonstripe shrimp) using fishing boats up to 10 tons is permitted inside the bay, and pot fishing (for northern shrimp) using 3 - 20 ton boats is licensed in waters outside the bay. Observations show that 5-ton class boats are most commonly used by the former group, while 9.9-ton class is

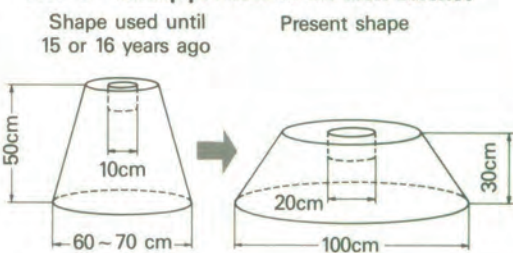
most commonly used by the latter. Regarding fishing grounds, it is strictly forbidden for one group to operate in the waters of the other.

### Fishing gear and fishing methods

Let us take a look at the type of coastal pot fishing operated in the fishing villages of the Mori District on the shores of Funka



**FIG. 6 Shrimp pot used in the Mori District**



Bay. The type of pot used here is seen in the photographs and in Fig.6, and has the following characteristics:

- The round frame at the bottom of the pot is made of steel rod, while the upper frame is made of vinyl tubing.
- Netting: Cremona #3 (mesh size 23mm)
- The entrance for the shrimp at the top of the pot is made by hanging a plastic cylinder. Its color is pink, which shrimp are said to prefer.
- Hooks are fitted on the lower edge of the plastic cylinder for attaching the bait.
- Until 15 or 16 years ago the dimensions of the pots were 60-70 centimeters in diameter at the bottom and about 50cm in height, but it was changed since to shallower fan shape with a wider bottom ring diameter. These improvements were aimed at giving the pot greater stability on the sea bottom, while also making it easier for the shrimp to enter the pot.
- The netting on the bottom of the pot is fitted with an opening for removing the shrimp, which is closed by means of a draw-string.
- The netting on the top and slope section of the pot is stretched tightly over the frame. However, the netting on the bottom of the pot is left slack to allow the pots to be stacked easily on top of one another.
- The cost of an order-made pots is about 2000 yen.

The pots are set in the fishing ground by means of a longline method, and regulations established by the local fishermen's association limits the number of pots on one long line to 70 pots (line length less than 915 meters), with each fishing family permitted to operate no more than 7 long lines. The fishing operation is usually performed by a crew of three (see Fig.7) but it can sometimes be operated by a crew of only two. The operation involves, (1) hauling the pots, (2) removing the shrimp, (3) baiting the pots, (4) closing the draw-string on the bottom net opening, (5) stacking the pots on deck, and (6) re-setting the pots. This process of hauling and resetting one long line of seventy pots requires about one hour. The pots are left in the fishing ground for a period of three to four days. For bait, cut pieces of Atka mackerel, *Osmerus dentex* and saury pike are used. The fishing boats leave port before dawn and return by afternoon, but this timing has nothing to do with the life habits of the shrimp. It is aimed, rather, at coordinating with selling and shipping times in the market.

**FIG. 7 Operating layout for shrimp pot fishing**



- ①..A line hauler is used to haul in the pots.
- ②.. Shrimp are removed and placed in the live tank and new bait is put on the hooks.
- ③.. The pots are stacked on the aft deck area.



**The Mori District Fisheries Cooperative Association Office**



**Mori fishing port**



**A Yamaha fishing boat used for shrimp pot fishing and scallop culture fishery. On the rear deck is a derrick used in scallop culture operation.**

### Management of a family fishing business

Since 1970 there has been a rapid development in scallop culture fisheries in Funka Bay, and today culture cages line the whole coastline of the bay.

The first three kilometers from shore are the waters licensed as common fishing right ground where various operations are conducted, including kelp gathering and gillnet fishery for flatfish and Alaska pollack, so the shrimp pot fishing is operated farther from shore in the central area of the bay.

At present, 65 fishing boats are licensed to conduct shrimp pot fishery within the bay. Coonstripe shrimp form small school which move about the bay with the seasons, and although shrimp pot fishing can be conducted year-round, for the following reasons it is only conducted in the four months of March and April, and September and October.

- (1) Most of the shrimp pot fishermen are also involved in scallop culture fishery. The months of January-April are the time of year when the fishermen are busy with the shipping of scallop and raising the new crop of infant scallop, and most of the labor force is involved in these operations.
- (2) The summer months (June - August) are the time when fishermen conduct kelp gathering and horsehair crab pot fishing operations.
- (3) The winter months (November - February) are the prime catch time for Alaska pollack gillnet fishery.

In short, the coastal fishermen of Funka Bay are involved in scallop culture and gillnet fishery as their primary fisheries, and kelp gathering and shrimp pot fishing are secondary fisheries used to fill out the yearly fishing schedule. In the Mori District, 25 boats involved in shrimp pot fishing landed a total of 20 tons of shrimp in 1984 for a total value of 25 million yen. The average fishery income from shrimp pot fishery per family was one million yen which constitutes about 14 - 20% of the total fishery income for families in this district.

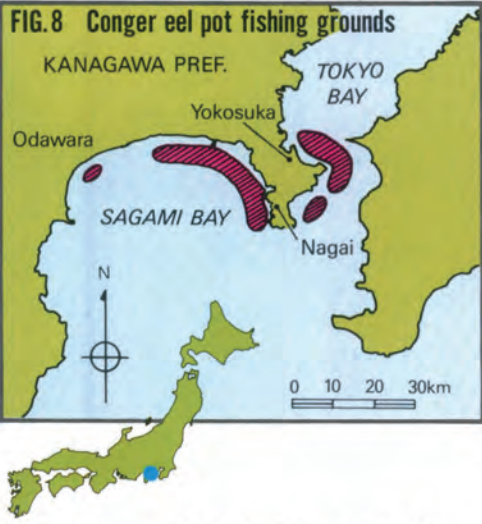
Regarding shipment of the catch, the shrimp are kept in a live tank on board the fishing boat and, directly after landing, they are packed in styro-foam cartons by size, covered with ice and shipped immediately by refrigerator truck to markets within Hokkaido like Sapporo and Hakodate.





# Conger Eel Pot Fishing

(Cylindrical pot)



### Environment of the fishing grounds

This is a type of pot fishing using a cylinder-shaped pot to catch conger eel in the Pacific coastal waters of central Japan. Since older times the Japanese have enjoyed eel, purple pike, conger eel and other eel family fish as marine delicacies. There are 4 or 5 species of edible conger eel, but by far the largest catch is the species with the scientific name, *Astroconger myriaster*. The fry, *Leptocephalus*, appears in large numbers in coastal waters throughout Japan in early spring and grow to maturity in sand and mud sea bottom areas where seaweeds grow in abundance in bay waters.

For a two year period from 1961-62, as a measure to exploit new deep sea marine resources and, also, to find new types of fishery for small-scale coastal fishing boats to engage in during the off-season months for their main fishery, the Fisheries Experimental Station of Kanagawa Prefecture engaged in an experiment to develop conger eel pot fishing and deep sea shrimp pot fishing methods. In this experiment, the Experimental Station developed a number of experimental fishing gear and, through local fishery cooperative associations, distributed them to a number of fishermen interested in searching for new fishing methods. Employees of the Fishery Experimental Station then joined the fishermen on their initial fishing trials to observe

the effectiveness of the gear and methods. Here we will look at the results of the experiment in conger eel pot fishing.

The Fisheries Experimental Station designed 5 or 6 different types of pots including (1) a half-cylinder-shaped pot made with cremona minnow net, (2) a sheet-metal pot and (3) a "Hi-Zex" pipe cylinder pot. Among these the Hi-Zex cylinder was judged to be superior based on the following conditions, in addition to its catching capabilities;

- Ease of water drain during the hauling operation
- Weight and ease of handling
- Volume and transporting (stacking) ease
- Damage resistance and durability
- Cost

Since then, with the addition of 2 or 3 improvements, this fishing gear has become the standard for conger eel pot fishing and its use has spread throughout Japan. Mature conger eel live in waters with mud or sand and mud bottoms at a depth of greater than 10 meters, and are found primarily in areas with a depth of 50-100 meters, although they can be caught at depths of up to 250 meters in some areas. In Sagami Bay and near the entrance to Tokyo Bay the conger eel fishing grounds are distributed as shown in Fig.8.

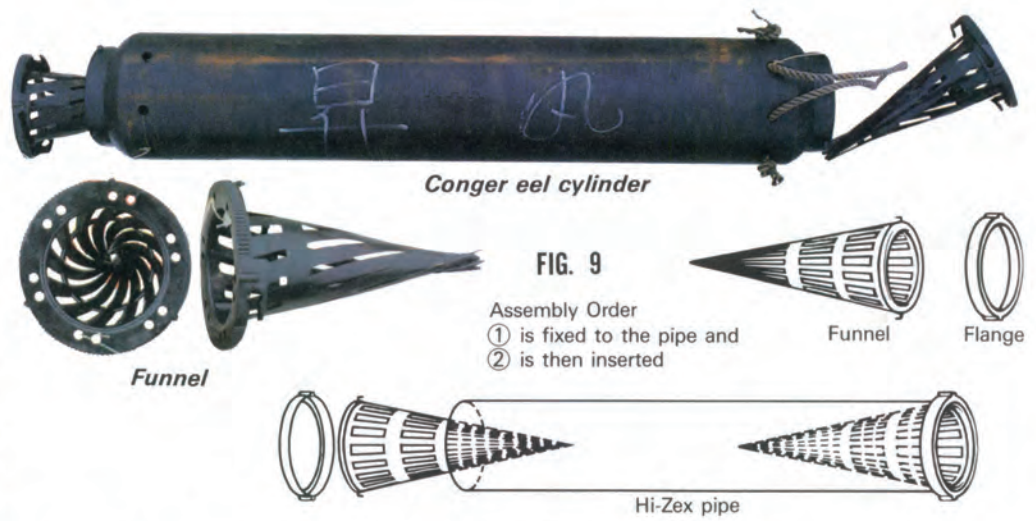
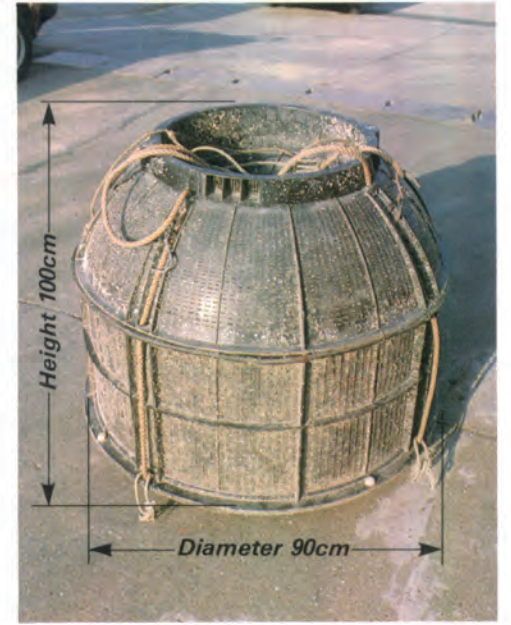


FIG. 9

Assembly Order  
① is fixed to the pipe and  
② is then inserted



A preserve tank for keeping live conger eels

TABLE 3 A yearly fishery schedule

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Conger eel pot					■	■	■	■	■	■	■	■
Octopus pot						■	■					
Halfbeak	■	■	■	■							■	■
Filefish scoop net	■	■	■	■								
Flounder gillnet	■	■	■	■							■	■

### The fishing gear and fishing method

The Hi-Zex pipe cylinder-type conger eel pot is made up of the following parts:

- 1) The cylinder...**In order to attract the conger eel, which dislikes light, with a dark hole, black Hi-Zex pipe is used for the cylinder. The pipe diameter is 15cm, length 80cm, and thickness 8mm. A number of small holes, 4mm in diameter, are drilled in both ends of the cylinder to serve as water drainage holes and also to let out the smell of the bait.
- 2) Funnel...**A funnel-shaped entrance, which allows the conger eel to enter the cylinder but prevents it from escape, is fitted to each end of the pipe. At first the funnels were made of bamboo, later, however, an improved polyethylene one was developed.
- 3) Sinkers...**In order to provide the cylinder with stability on the sea bottom, two old iron rods, diameter 9mm, are attached to the cylinder by wires with a slight interval in between.
- 4) Branch line...**A two meter length of 4.5-6mm diameter branch line attached to one end of the cylinder is used to secure the pot to the main-line.
- 5) Main line...**An old tuna long line is used and the cylinders are attached to it at 25-45 meter intervals (depending on the water depth), with 30-60 cylinders being used on one length of long line. A 3 to 5 ton fishing boat is used to operate three lines (a total of 100-180 pots) in one day.

In conger eel pot fishing, two or three frozen sardines or the entrails of other fish are put in the cylinder as bait before it is lowered to the sea bottom. After one day the cylinder is hauled again and the catch is removed. The fishing grounds for conger eel are usually found at a depth of 50 - 100 meters.

In the cold season they are also found in deeper waters at a depth of 200 - 250 meters in areas of mud or mud and sand

bottom consistency. The fishing operation involves raising the cylinders from the sea bottom by means of a line hauler, removing the lid holding the funnel in place, taking out the catch, placing in new bait, replacing the funnel and lid and stacking the cylinders on deck. When a full long line has been hauled, instead of laying it again in the same fishing ground, the line should be taken to a new ground for re-laying. The catch is then taken to port and transferred to a plastic preserve tank facility at the port, where they are kept for one or two days to allow for the complete digestion of food in the intestines and the elimination of wastes before the conger eels are shipped in the live state to the market.

### Management of a family fishing business

The fishermen we spoke to while researching this study, as can be seen in Table.3, are engaged in 5 or 6 different types of fishery during the course of the year. Because conger eel pot fishing uses the same coastal fishing grounds as other fisheries such as octopus pot fishing, long line and gillnet, in order to avoid conflict with such operations, the conger eel fishery is only conducted during the months of May to November.

Also, from the viewpoint of proper conservation of marine resources, it is desirable to designate a certain part of the year as an off-season. Because conger eel pot fishing requires no particular skills, ever since the development of efficient fishing gear in 1967-68 the number of fishermen engaged in this fishery increased rapidly, resulting in a decrease in the catch after 2 or 3 years and bringing on the need to establish off-seasons in some districts. Since this is a highly efficient fishing method, a rapid increase in the fishing intensity can easily lead to the destruction of the resources of conger eel in a given area. Therefore it is necessary to set limits on the number of fishing boats involved and the length of the fishing season.

Reference: "National Anthology of Pot Fishing Gear and Methods" by The National Federation of Fishery Cooperative Associations and the National Association for the Advancement of Fisheries



3

# Pot Fishing for Assorted Fishes



FIG.10 The Koshiki Islands

Environment of the fishing grounds  
Here we will introduce a pot fishery directed at various species of fish, being conducted on the Koshiki Islands in the East China Sea off the coast of Kyushu in southern Japan. Koshiki Islands is a group of islands lying from 30-50km west of the coast of the main island of Kyushu. Concerning the sea topography between the islands and the mainland of Kyushu, the Kyushu coast has a long, shallow sand beach topography, while around the islands the sea drops off steeply in a rocky reef topography. Therefore the Kyushu coast tends to be inhabited by non-migrating bottom fishes and the feeding ground for the fry and young of various migrating species. On the other hand, the coasts of the islands are fishing grounds for mature migrating fishes. Since olden times the coastal waters of the Koshiki Islands have been the site of set net fishery, catching migrating fishes that come to the island waters. The only other types of fishing traditionally conducted on the islands were a small amount of angling and net fishery aimed at assorted fish species living near shore, thus showing the typical underdeveloped fishing industry common to most isolated island groups. During the period from 1967 to 1981, the prefectural government of Kagoshima undertook a program to encourage the spread of various pot fishing methods, including those for puffer, cuttlefish, spiny lobster, gazami crab and assorted fish. Here, we will deal with the pot fishing method aimed at catching assorted fish, which is actually a method developed originally in the Ama-

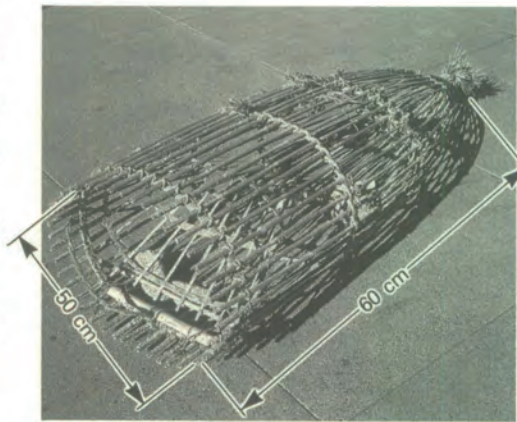
kusa region of Kumamoto Prefecture and introduced afterward to Kagoshima. This fishing method was successfully adopted by the fishermen of the Taira Fisheries Cooperative in the Koshiki Islands for catching assorted tidal fishes. There are two advantages of this fish pot which make it effective as a commercial fishing method:

- 1) Unlike gillnet, this fish pot does not damage the fish, so the fish are kept alive even if the pot must be left in the water for several days, making this a flexible fishing method suitable for operation during even the busiest fishing season.
- 2) Because the fish caught by this method are landed live, they bring a higher market price as fresh fish.

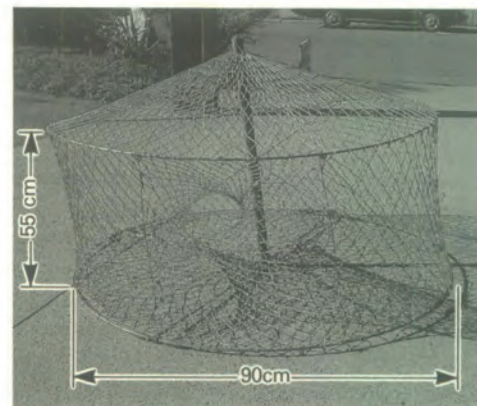
### The fishing gear and fishing method

The pot is made of an anti-deteriorant treated polypropylene netting stretched over a stainless steel rod frame (φ3/8). The front of the pot is fitted with a funnel function entrance, while the back is equipped with a bag opening for removing the catch. On the sides and top of the pot the leaves of cryptomeria, "sharimbae" (*Raphiolepis umbellata*) or moss are stuck into the netting to darken the interior of the pot. It is believed that the contrast of light and shadow created by these leaves is effective in attracting fish to the pot. Also, it is recognized that small shrimp will often attach themselves to the leaves, which is believed to increase the bait effect of the pot. The fishermen here do not put any type of bait into the pots.

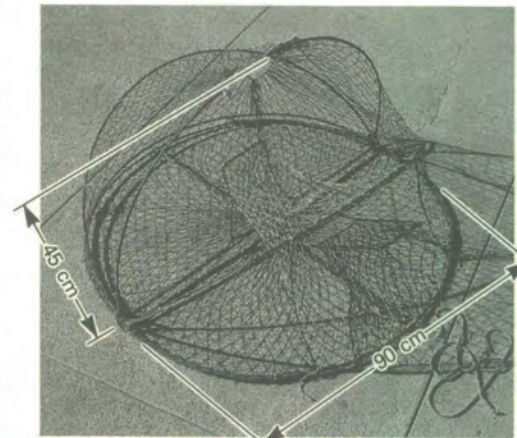
Picture 1 shows the standard shape of pot that has been adopted here, but the fishermen are also experimenting with a larger type of pot, as shown in picture 2. The pots are set in rocky reef areas with a depth of 30 to 60 meters, or in the narrow crevices between the reefs. The pots are left in the water for about 3 days. Although it is difficult to generalize about the average catching efficiency of the different pots, the local fishermen say that in the standard-sized pot as much as 11 kilograms of fish, or as many as 40 fish, have been caught in one pot. And, in the larger type of pot, large fish such as grouper are often caught, resulting in catches of up to 23kg at one time. The main species of fish caught by this method include black porgy, "umihigo" (*Pseudupeneus chrysopleuron*), "koshio bream" (*Plectorhynchus cinctus*) and filefish. The number of pots that can be laid in one operation depends on the deck area and stacking capacity of the boat. The 5-ton class boats in use here carry 10 of the standard-sized pots or 5 of the large-sized pots.



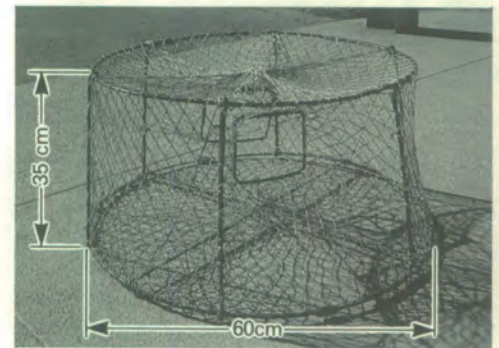
Cuttlefish (Bamboo)



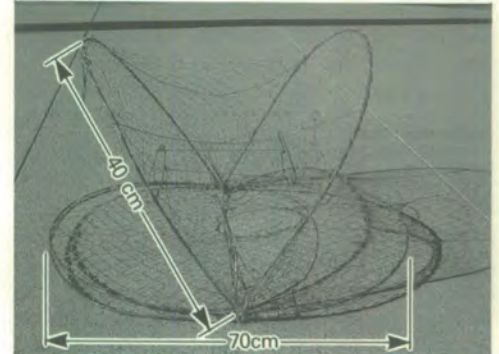
Cuttlefish pot



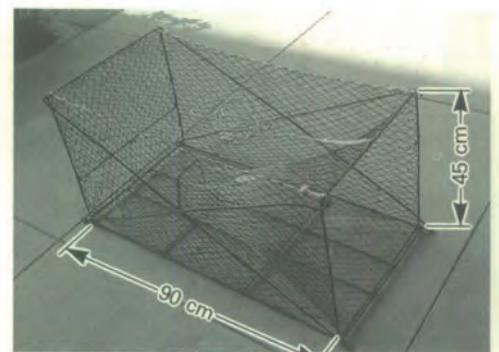
Newest collapsible cuttlefish pot



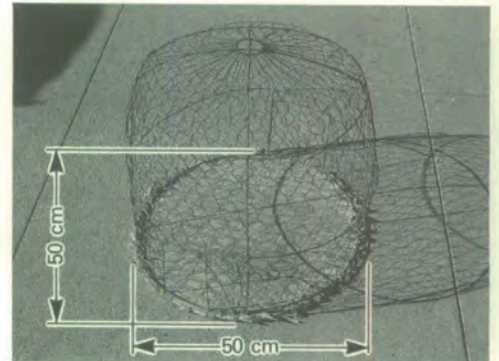
Shrimp pot



Gazami crab pot



Tidal fish pot



Gray mullet pot

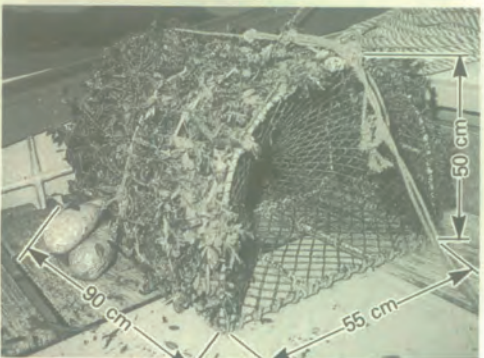
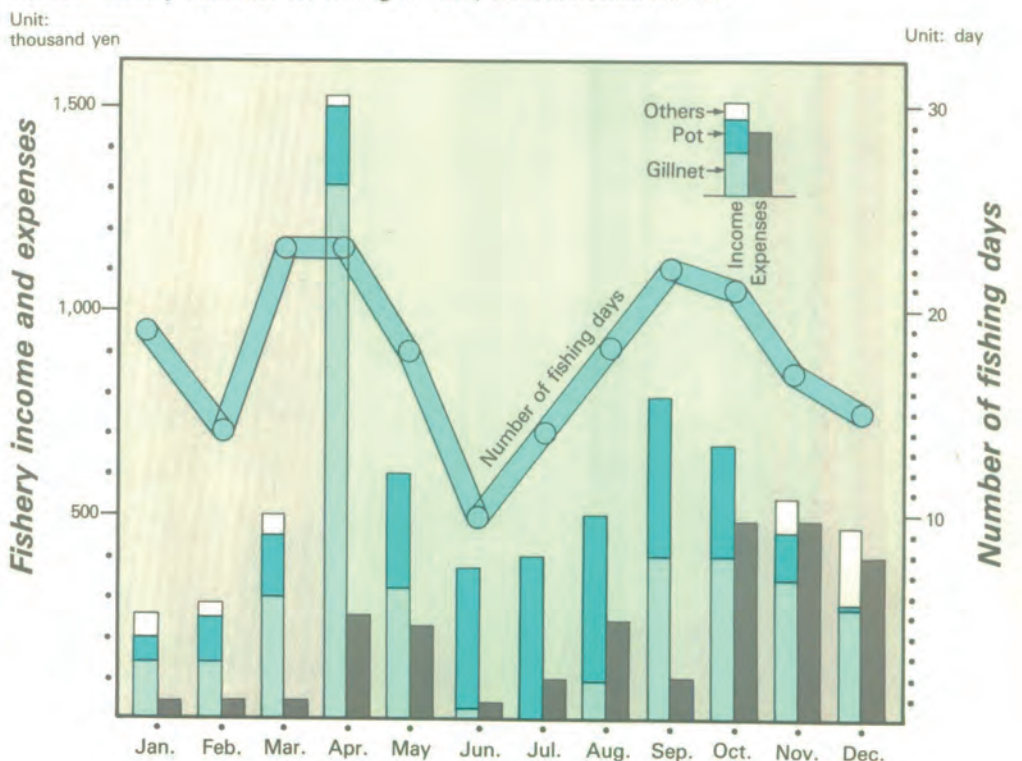
Provided by Kagoshima Fisheries Experimental Station

### Management of a family fishing business

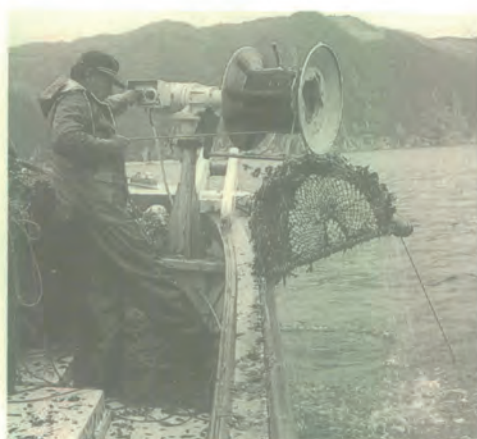
Traditionally, the fishermen of the Koshiki Islands were divided into 2 groups, those engaged primarily in angling and those engaged primarily in shore gillnet fishery. The fishermen, here, who adopted the new pot fishing method were only those of the gillnet fishing group, who were already used to the work of constantly repairing or modifying nets. Table 4 shows one example of a pot fishing business in 1984. Because of the fact that emmeshed fish in a gillnet decay rapidly during the summer season, it is necessary to stop fishing at this time of year. The pot fishing method, however, keeps the fish unharmed for 2 or

3 days, so it has become an important fishing method for maintaining a stable fishery income for those fishermen during the summer months. Although this assorted-fish pot method has succeeded in providing a stabilized fishery income for the fishermen here, because of the fact that it is a method which catches only the sedentary fishes of the rocky reef coast waters, it cannot be developed into a larger fishery. For this reason, in order to make pot fishing the main fishing method for fishermen here to engage in year-round, they are investigating, presently, the possibility of introducing pot fishing methods for catching puffer and cuttlefish in the offshore fishing grounds.

TABLE 4 Fishery statistics for fishing in 1984, Taira in Koshiki Islands



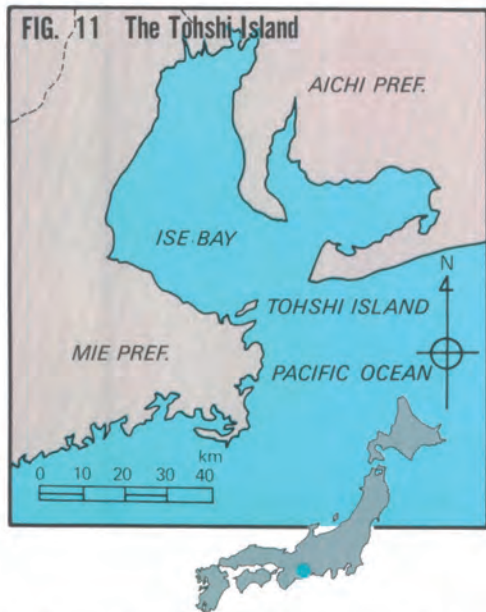
Picture 1 Standard-sized pot



Picture 2 Large-sized pot  
W100cm x L150cm x H90cm



# 4 Octopus Pot Fishing



## Environment of the fishing grounds

Various species of octopus are found in all areas of Japan's coastal waters. In terms of fishery catch, however, the "mizu" octopus (*Paroctopus defleini*) is the main species caught in cold current waters, and "madako" (*Octopus vulgaris*) is the main catch in warm current waters. In this article we will discuss "madako" pot fishing conducted in the Pacific coast waters of central Japan.

With the exception of a short period just after hatching which is spent in a drifting migration state, the octopus spends its whole life on the sea bottom. Being a bottom-dweller, the octopus' active habitat is quite small and, as a marine resource, therefore, it is comparatively limited. Also, since the octopus lives separately, showing no schooling habit, as an object of commercial fishery, it will always be a small-scale type.

Within 40 days of hatching, the young octopus reaches a body size of about 12mm, at which time it begins life on the sea bottom. Within 5 months it reaches a marketable size of 1 to 1.5 kilograms in body weight. In the coastal waters of Japan, the octopus usually inhabits shallow sea areas at a depth of 30 to 40 meters in the summer season, and moves to a depth of around 100 meters or even deeper during the cold season. The octopus prefers to live in holes in rocky areas of the sea bottom, coming out only at night to feed on shrimp, crab, shellfish and other fishes. It is this preference shown by the octopus to hide its body in dark holes upon which the octopus pot fishing method was developed. The fishing season for octopus extends throughout the year, and ideal fishing grounds are found in sand and pebble bottom areas with a fast current, as in a sea strait, during the season of migration between the deep and shallow water habitats.

## The fishing gear and fishing method

Although a considerable amount of octopus is caught by trawl net fishery, the main fishing methods aimed directly at octopus include pot fishing, baitless long line angling and drifting buoy angling. Among these methods, however, pot fishing is the most important method used in commercial octopus fishery. Especially with regard to "madako" octopus, fishery using a stoneware pot has long been practiced in central and southwest Japan.

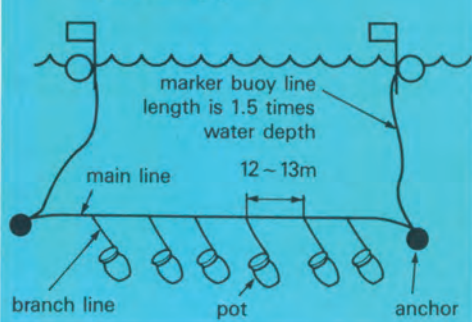
Pictures 1~3 show a number of variations of octopus pots. All of these pots take ad-

vantage of the octopus' habit of hiding itself in dark holes, and therefore, bait is not usually used with them. However, picture 2 shows a pot widely used in eastern Japan which has a hook inside on which a small crab or some other fish is put as bait, and when the octopus tries to eat the bait it trips a mechanism which closes a trap door, thus catching the octopus within. Also, picture 3 shows a unique wooden box pot used in Hokkaido to catch "mizu" octopus. Picture 4 represents the octopus pot fishery of Tohshi Island in Mie Prefecture. Tohshi Island lies in the sea lane which joins Ise Bay with the Pacific Ocean, and the prime octopus fishing season here is during the period when octopuses migrate from the shallow bay waters to the deeper waters outside of the bay, and again when they return to the bay waters.

The pots are attached by means of branch lines to a long main line of between 1 and 1.5 kilometers in length, and an anchor is fitted to both ends of the long line to set its position on the sea bottom. Also, buoy lines are attached and flag marker buoys are used to mark the position of the line in the water. After setting the fishing gear in the fishing ground, it is left in the water for between 1 and 3 days, and then it is raised by reeling in the main line. After the catch has been removed from the pots, they are once again lowered to the sea bottom. This process is repeated over and over throughout the fishing season.

The number of pots attached to one long line depends on the season. In the summer season between 60 and 70 pots are attached to one long line, while in the prime fishing season in winter this number will increase to between 100 and 130 pots. In shallow waters the distance between pots is 12 or 13 meters. In deep water fishing grounds the weight of the pots on the line hauler is taken into consideration and the distance between pots is increased.

FIG.12 Setting of the octopus pot fishing gear

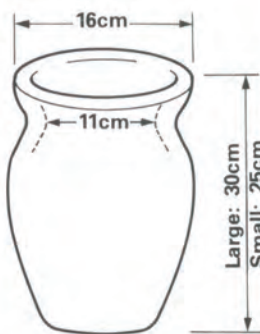


## Management of a family fishing business

Tohshi Island is blessed with an abundance of marine resources of the sedentary shore-inhabiting types, including abalone, wreath shell, spiny lobster, shrimp, sea cucumber, laver and undaria, as well as seasonal migrating fish resources such as silver whiting, Spanish mackerel, squid and Japanese sand lance. For this reason the island has been a home for coastal fishermen since olden times, and today there are about 300 fishing boats in operation here, in spite of the fact that the total population of the island does not exceed 3,000 people. The three main fisheries that the fishermen of the island engage in are small beam trawl for shrimp, silver whiting gillnet and shore net for spiny lobster.

TABLE 5 Fishing season for octopus pot fishery

Season	Fishing season	Migration	Fishing ground depth	Body size of octopus caught	Size of pot
Summer	Apr.~Aug.	Deep waters → shallow waters	30~40m	About 1kg	Small
Winter	Oct.~Feb.	Shallow waters → deep waters	70~80m	About 2kg	Large



Note: The pot is made of stoneware, the coarse texture of which the octopus is said to prefer. They are made in 2 or 3 different sizes to be used in the different seasons.



Picture ①

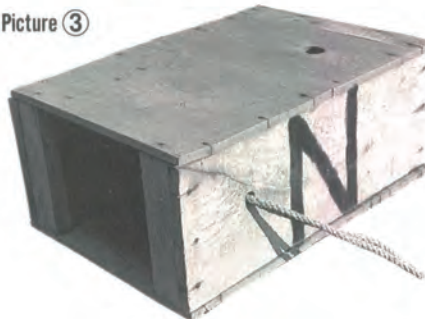


Picture ②



An octopus pot for catching "madako"

Picture ③



An octopus box used for catching "mizu" octopus



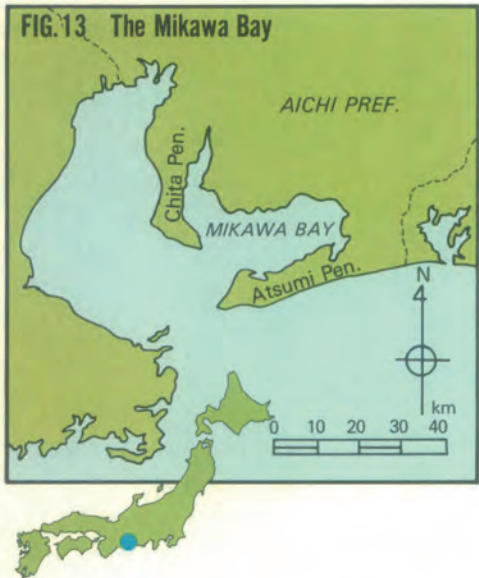
The main types of fishing boats used here are 4 to 5 ton or 7 to 8 ton diesel powered boats with the cruising capabilities and operational facilities to handle all three of the above mentioned fishing methods. Since octopus pot fishing is a method which can only be operated in a specific fishing ground, the number of fishermen involved in this fishery has been limited to 20. The fishermen who, years ago, first staked claim to the octopus pot fishing grounds are recognized by the local fishing community as having priority rights to these grounds, and even though there is no

formal "licensing", their rights are observed as hereditary ones by all. The earliest of the claim stakers took the shallower fishing grounds, and those who came later staked claims in the deeper waters. Octopus pot fishing is a very profitable fishing method in Japan because it catches a high-priced product with a very economical fishing gear and method, and therefore, the creation of an effective system for regulating the use of the limited fishing grounds in which octopus can be caught by this method has been an important problem.



# Gazami Crab Pot Fishing

FIG. 13 The Mikawa Bay



### Environment of the fishing grounds

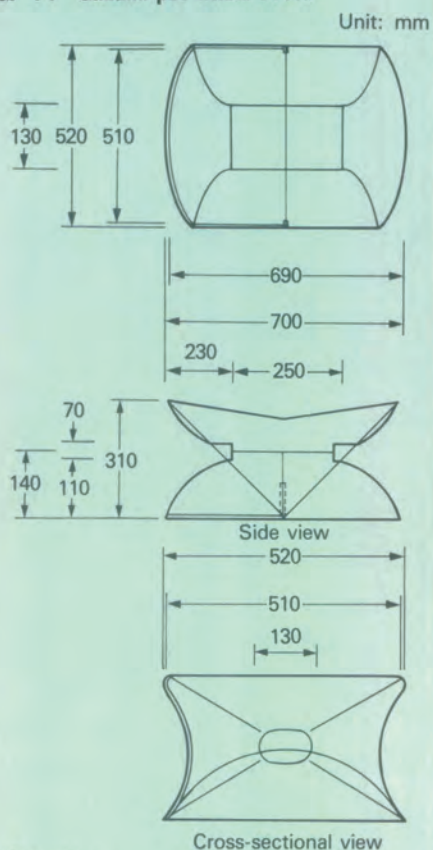
As a representative example of a small crab fishery in Japanese coastal waters, we will introduce here the "gazami" crab (*Portunus trituberculatus*) pot fishery of the Pacific coast waters of central Japan. Gazami is a warm current crab which inhabits inland sea or bay waters, found usually at depths of 5 to 30 meters, and migrating between shallow and deep waters with the seasons. Gazami comes to shore waters of 5 to 10 meters to lay its eggs, and at other times, is believed to retreat to a depth of greater than 10 meters. To catch gazami crab of the marketable size of about 15 cm, gazami pot fishing is conducted in the months of June to November, and the fishing grounds that are chosen are sand and mud bottom areas at a depth of 15 to 30 meters. August and September are the peak fishing season. Good fishing grounds are found near river mouths with inflowing fresh water or on the sea floor encircling a reef.

### The fishing gear and fishing method

Compared to the crab gillnet fishing method, crab pot fishing has the two advantages of requiring less hand labor

than freeing each emmeshed crab from a net, and it catches the undamaged so that the catch can be sold as live crab. Although in the past there were a wide variety of pot shapes in different regions, in recent years the collapsible type shown here has become the standard pot used in commercial fishery. Fig.14 shows the dimensions of the pot used in Aichi Prefecture for gazami pot fishery.

FIG. 14 Gazami pot (Aichi Pref.)



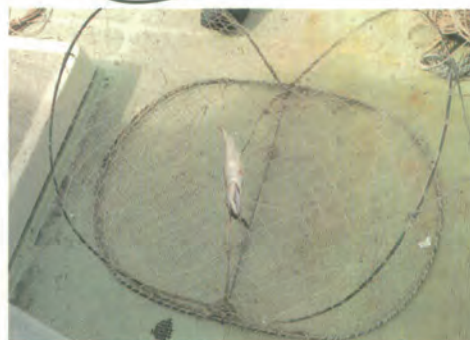
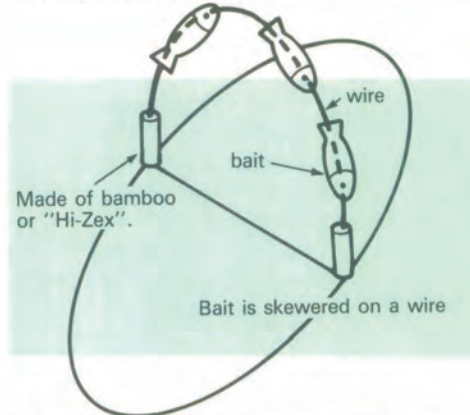
**Reference:**

National Federation of Fishery Cooperative Associations and National Council of the Members for the Improvement and Promotion of Fishery Industries.

At first a brown netting stained with coal tar was used for these pots, and later experiments were tried with red, yellow and white netting, but now the standard net-



FIG. 15 Baiting method



Between 60 and 100 pots are attached to one long line, and about 4 lines are set in one fishing operation. Two important points in this fishing method are to be sure that the pots rest in a stable position on the sea bottom, and to always use fresh bait. The crabs are caught in the live state. By the way, in Japan, crabs with soft shells right after their ecdysis sell for only one fourth the price of those with hard shells.

### Management of a family fishing business

The marine resources of Mikawa Bay include such inland sea type resources as shrimp, conger eel, gazami crab, surf shell, pen shell, sea cucumber, abalone and black porgy, and with only 5-ton class fishing boats allowed to operate in the bay waters, the following types of fisheries are being conducted:

#### Fisheries of Mikawa Bay

1. **Pot fishing**  
gazami crab, conger eel, etc.
2. **Bottom drift gillnet**  
shrimp, silver whiting, and conger eel
3. **Dredge net**  
sea cucumber (only permitted in winter season)
4. **Dive fishing**  
surf clam, pen shell, etc.
5. **Angling**  
assorted shore fishes
6. **Culture fisheries**  
laver

In order to protect the marine resources within the bay, small-scale trawl net (5 to 10 tons) fishery is only permitted in waters outside of the bay area.



Gazami pot fishery



Gazami crabs