

LIFT NET
COOPERATION
among FISHERMEN:

One answer amid diverse fishery possibilities



LIFT NET is a type of fishery in which a net that has been set out horizontally under water is raised suddenly to catch fish that have either wandered naturally into the water above the net, or else have been lured there by fish-attracting lights or by scattering bait in the water.

Lift net is an extremely diversified fishing method that is used all over the world in rivers, lakes, marshes, coastal sea waters and even the open sea, and ranges widely in both scale and operation from small-scale scoop nets, four-armed scoop nets or scarf nets operated by one man without a boat, to stick-held dip nets operated from a motorized boat, two-boat operated lift nets, and even four-boat and eight-boat large-scale lift net operations.

Looking at the characteristics of the lift net, we can divide them into a number of

variations which function differently in accordance with the life habits of the fish to be caught and the sea conditions of the fishing grounds. First of all, concerning the type of sea area the net is used in, we can divide lift nets into two main groups; bottom lift nets, which are set on the sea bottom; and floating lift nets, which are set in the surface or middle depth waters. Next, concerning the fish-gathering method, we can divide the lift nets into the following three basic types;

- 1) Active fish gathering by scattering bait on the water above the net, or at night, shining lights on the water to attract fish.
- 2) Waiting type methods in which the net is set with a bag net in a strategic position for catching fish which migrate naturally into the net with the tidal currents.

- 3) Methods in which supplementary fishing gear such as surrounding gill nets are used to drive schools of fish into the area above the lift net.

Presently in Japan, the most common lift net operations are ones in which a single, powered boat using a stick-held dip net catches fish effectively by attracting schools of fish with fish-lights. Multi-boat lift net operations are on the steady decrease in Japan today. However, for this report we have chosen to introduce one such multi-boat operation relying on a large number of laborers, which is presently being operated in one of the island groups in the central part of Japan's Pacific coast, as a representative type of lift net fishery.

This type of fishery is a group fishery which relies on the collaboration of a large number of fishermen in a given area. It is a type of fishery that requires a consider-

able investment in boats and deck equipment as well as a firm commitment to cooperative labor on an established basis by the local fishermen involved.

In order to find out why these fishermen maintain this cooperative fishing method to this day, we decided to investigate the following questions:

- How do these fishermen adapt their fishing methods and the scale of their fish-catching capabilities to fit the life ecology and environment of their fish resources?
- How do they use their available local capital resources and labor resources, and how are these two factors balanced?
- How do they run their fishery business in order to attain a sufficient productivity and maintain favorable sales conditions for their products?

When we look at the highly diversified lift net fisheries of Japan from the standpoint of the types of boats used, we see the divisions shown in Table 1 and Fig. 1-11.

(1) Small-scale hand-operated nets not using boats (Fig. 1-4)

Traditionally, these fishing methods, including scoop nets, push nets and four-armed scoop nets, were popular throughout Japan's rivers, lakes and marsh areas, but presently their use is limited to commercial-type fishing for sweet fish in Lake Biwa, catching of eel fry for seeding culture operations in estuary waters, or other specialized, regional fisheries such as icefish catching in estuary waters.

Note 1: Large-scale four-armed lift net (Fig. 4):
This is a fishery method used in rivers and shallow sea areas in which fish are caught in a net fixed to a framework made of wood or bamboo. Although this method is seldom seen in Japan, it is used widely throughout Southeast Asia. A fishing boat is used for transportation between land and the net site.

Table 2 Lift net catch by fish species (1983)

Main fish species	Gross catch (tons)
Saury	233,115
Mackerel	43,087
Sardine	10,343
Anchovy	6,274
Round herring	7,498
Launce	30,658
Horse mackerel	3,825
Mackerel	43,087
Flying fish	1,805
Frigate mackerel	1,389
Squid & cuttlefish	1,502
Other marine animals	23,431
Grand total	369,259



Photo by Mr. Koji Hori (The 16th Maruho-maru/Akkeshi Port, Hokkaido)

(2) Lift net fishery using one fishing boat (Fig. 5-6)

The most common fishing method in this group uses a stick-held dip net. In Japan this is by far the main type of lift net fishery operation. In this method two sticks are pointed out over the water from one side of the boat and the net is attached to these by means of net-raising ropes. At night, fish-attracting lights are shown on the water on the non-net side of the boat. When enough fish have gathered, the lights are turned off and a different set of lights, on the net side of the boat, are turned on to attract the fish into the net. Then, in a well-timed action, the net-raising ropes are pulled in suddenly, closing the net into a bag shape and catching the fish.

The types of fishes caught by the stick-held dip net method include surface fishes which are easily attracted to fish lights, such as saury, mackerel, horse mackerel, and sardine. Because this is an active-type fishing method that is repeated at chosen spots around the fishing grounds, making full use of the fishattracting qualities of lights, it is a very effective fishing method.

The boats used in this fishing method range from small-scale coastal water fishing boats of the 3 to 5 ton class, to large-scale off-shore fishing boats of the 100 ton class. Because of restrictions on the length of boat used, the size of net used is rather small. This means that skillful use of mobility in the fishing process becomes the strong point of this method.

There is another type of fishing method using one boat that falls in the lift net category. In this method a large-scale scoop net is attached to the bow of a motorized boat to scoop up fish and mysis. One example of this fishing gear pictured in Fig. 5 is a local fishing gear of Northeast

The diversity of lift net fisheries in Japan

Japan used for catching launce and mysis. It is a method that achieves a rather high catching rate with a very simple fishing gear.

(3) Multiple-boat fishing methods using 2 or more boats (Fig. 7-9)

This is a fishing method in which a square or fan-shaped net is set out in a fixed position in the water by two or more boats, after which bait is scattered on the water or fish lights are used to attract fish

to the area above the net. Then the net is pulled up suddenly from the sinker edges into a bag shape and the trapped fish are caught with a scoop net.

a) Two-boat lift net (Fig. 7)

Two boats lay out the net in a fixed position. The net is designed so that the tidal current will cause it to billow out into a bag shape. At night, fish lights are used to attract surface fishes such as mackerel, horse mackerel and sardine for catching.

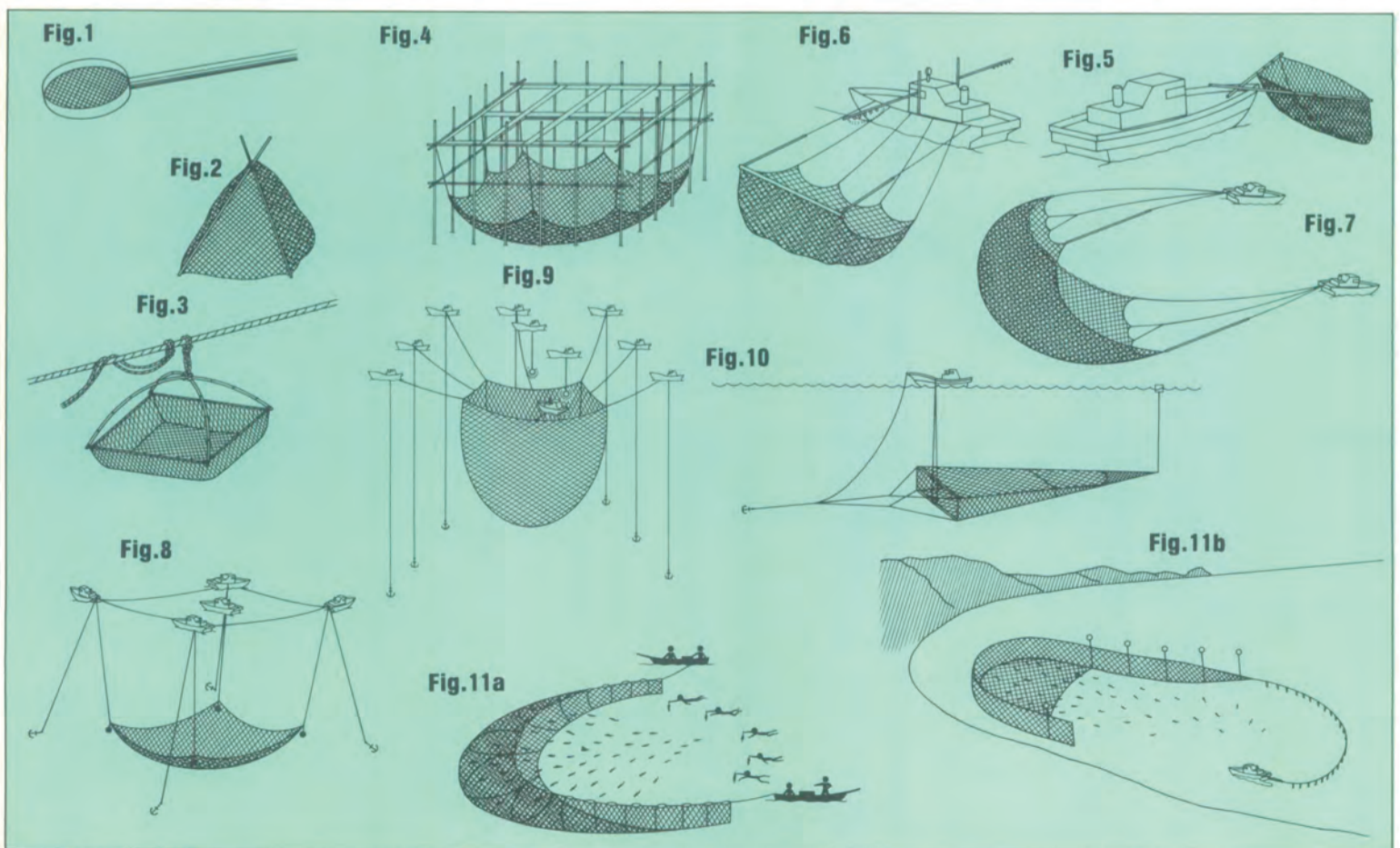
Although the net used is larger than that in stick-held dip net operations, this method locks the mobility of the stick-held method. And, if, in order to increase mobility the two boats are used to tow the net around, it must then be classified as two-boat seine fishery.

b) Four-boat and eight-boat lift net (Fig. 8-9)

As with 2-boat lift net, fish are caught after being lured to the net by the scattering of bait or the use of fish lights. There are two basic types of net settings: a bottom lift net which is set on the sea bottom, and a floating lift net which is set off the bottom and held in place by the boats. The latter is used primarily in areas with a reefy sea bottom or in areas with a particularly strong tidal flow. In spite of the fact that this method uses a large net, it is not a very effective catching method when considering the number of boats and the large amount of labor required in its operation. For this reason, it is on the decline as a fishing method in Japan today.

Table 1 Various lift net operations

Fishing boat used	Type of fishing operation	Examples of fish caught	Remarks
Not used	Scoop net	Eel fry	Fig. 1
	Push net	Sweetfish, crucian carp, striped mullet, young perch & eel	Fig. 2
	Four armed scoop net manual/portable	Same as above	Fig. 3
	Stationary	*Note 1	Fig. 4
One-boat operation	Powered push net	Launce & mysis	Fig. 5
	Stick-held dip net	Saury, sardine, horse mackerel & mackerel	Fig. 6
Multi-boat operation	2-boat lift net	Blue sprat, striped mullet & perch	Fig. 7
	4-boat lift net	Horse mackerel & sardine	Fig. 8
	8-boat lift net	Horse mackerel & mackerel	Fig. 9
Special method	1 or 2 boats used	Fukuro-machi-ami & Komase-ami	Prawn, squid & launce Fig. 10
	2 or more boats used	Drive-in net	Barracuda, seabream, flying fish, takabe & striped jack Fig. 11 a & b



(4) Specialized lift nets (Fig. 10-11)

a) "Fukuro-machi-ami" (net with bag net) (Fig. 10)

This is a waiting-type fishing method that catches fish which ride the tidal currents into a net shaped like a bag. Usually, the net is set with its mouth facing the tidal flow at the mouths of rivers or in shallow tidelands, catching the fish which ride the current into the net. Sometimes, however, the net is also set vertically in the water with the mouth of the net facing upward, and fish which have been lured into the waters above the net are caught by raising the net suddenly. The fish caught by this method include sardine fry, launce, seabream, croaker, porkey and small shrimp.

b) Oikomi-ami (drive-in net) (Fig. 11a & b.)

This is a fishing method in which a bag-shaped net which is fitted with wing nets or fence nets is set in the water and several methods are used to drive fish into the net, including divers, surrounding gill nets or making threatening noises on the water from the fishing boats. The "takabe" drive-in type bottom lift net of Kozushima which we will introduce in this issue is one of the nets that falls into this category. It makes use of a four-boat lift net and surrounding gill nets. We find that in different regions, different combinations of fishing nets of varying shapes are used in great variety, with some of them being very similar in appearance to small-scale set nets.

ISLANDS

in the middle of the Kuroshio Current.

Fig. 12



THE LIFT NET FISHERY which we have chosen to introduce here is one used for catching "takabe" (*Labracoglossa argentiventris*) in the Izu Islands, located in the central part of Japan's Pacific coast. The island we researched for this report is one of the Izu Islands called Kozushima. This is an island which

rises abruptly out of the sea with most of its coastline being dominated by cliffs ranging in height from 20 to 120 meters. The island itself has a quite rugged topography as well. The island lies directly in the path of the Kuroshio Current, which runs northward along Japan's Pacific coast. At the same time, this is an area in which scattered reefs and shallow sea areas create a complicated ocean topography and sea conditions.

The following three factors contribute to the unique nature of Kozushima's fishery industry:

- 1) In addition to the pelagic fish species that visit these fishing grounds, there are also an abundance of fish, shellfish and seaweeds that make their home in the reef areas around the islands, thus increasing the wealth of these waters.
- 2) These are isolated islands without easily available means of transportation.
- 3) The islands are relatively close (about 120-130 km by sea) to the markets of the huge Tokyo metropolitan area. (They lie about eight hours away by cargo-passenger vessel)

Structure of the Islands' Industries

The main industries of the Izu Islands include agriculture, livestock raising, fishery and a tourist industry. Among the islands of this group there are some which have relied traditionally on agriculture as their primary industry, while others have relied almost solely on fishery, and there are also some which have long relied on a combination of the two. Toshima, Mikurajima and Aogashima are examples of islands in the Izu group which traditionally have had almost no fishery industry, and in each case the reason seems to lie in the fact that they have no good stretches of sand beach and no good inlets on their coasts. The lack of good fishing harbors undoubtedly inhibited the development of fishery on these islands.

The total land area of Kozushima is 18.58 square kilometers, of which 7% is used as farmland, 12% as forestry land, 1% as residential land and 8% for other uses, leaving the remaining 72% of the land unused. From these figures it is plain to see that for many generations the people of this island have made their livelihood almost solely from fishery.

On the west coast of the island there is just one stretch of sand beach. It is here that Kozushima harbor stands, and here that all the facilities necessary for a fishing industry have been built. All of the catch from Kozushima's fisheries is shipped fresh (packed in ice) to Tokyo's Tsukiji Central

Fish Market. There has been no development of a processing industry for Kozushima's marine products on the island. The only processing done here is a small production of salted and dried fish by the local middlemen for sale to tourists to the island.

Traditionally, agricultural production was limited to crops for household use, such as field rice, rye, sweet potatoes, and vegetables, but since the latter half of the 60's some islanders have engaged in the production of field peas for sale in the metropolitan markets.

One more sustaining industry in the island's economy is the tourist industry. Beginning in the latter part of the 60's there have been an increasing number of tourists coming to the island to enjoy ocean swimming and sport fishing, making it profitable for the island residents to run private lodging houses.

Fishery resources

- 1) The rate of flow of the main stream of the Kuroshio Current is between 3 to 5 knots, and the width of the strongly flowing waters with a speed of no less than 2 knots is from 60 to 70 kilometers, and, having a depth of 600 to 700 meters, it constitutes an extremely large ocean current. Kozushima and the other islands of the Izu group lie virtually in the middle of this Kuroshio Current.

As well as being the route of pelagic fish species such as marlin, tuna, skip-

jack, various species of mackerel, flying fish and yellowtail, that migrate in the Pacific, the Kuroshio Current also serves as the vehicle by which the eggs and fry of these fishes are distributed to the coastal water feeding grounds. The "current rip" waters where the warm Kuroshio current meets the surrounding cold currents are excellent fishing grounds in which these fishes tend to gather. The warm water species such as skipjack and tuna tend to gather along the southern outskirts of the Kuroshio, while cold water species such as yellowtail and mackerel tend to gather on the northern outskirts.

- 2) In the shallow sea areas, reefs and underwater mountain ridges that intersperse these islands we find a number of coastal species living in abundance, including grunt, "takabe" and yellowjack. And, in the rather deep reef areas there is an abundance of seaweeds such as red alga (*Gelidium amansii*, and *Gelidium subcostatum*).
- 3) Recently there are also increasingly large catches of deep sea demersal fishes such as big eye, *Etelis carbunculus*, *Paracaesio caeruleus* and *Pristipomoides sieboldi* being caught in the waters where the underwater volcanic range has risen to a depth of between 600 and 1200 meters.

General conditions of the fishery industry

According to documents of the Village of Kozushima, the total sales by Kozushima fisheries in 1912 was ¥43,478, of which ¥26,162 was for fish and ¥17,316 was for seaweed (60% and 40% respectively). Before World War II, the island's fisheries consisted mainly of drive-in type bottom lift net, drift gillnet and seaweed gathering operations. The principal fishes caught were round scad and flying fish, which were made into a salt-dried fish product with a unique fragrance. The principal seaweeds harvested were *Gelidium amansii*, *Gloiopeltis tenax* and *Meristotheca populosa*, which were used to make agars and pastes. These same patterns continued for a while after World War II, as well. Since the 1960's, however, in addition to the existing lift net and drift gillnet fisheries, we see the development of fishery for other types of fishes which could now be sent fresh to the urban markets (for example; spear fishing, hook-and-line fishing for bottom fishes, and squid jiggling).

Table4 Fisher production

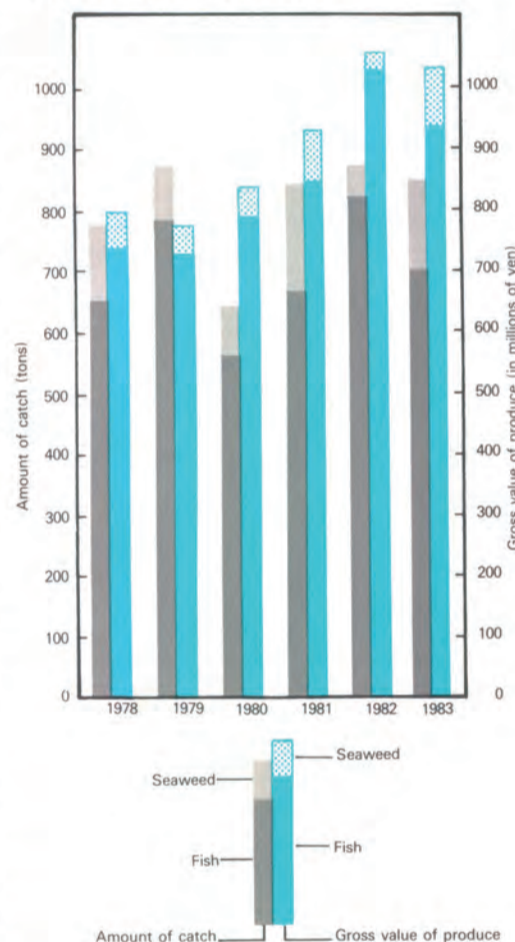


Table3 Number of people employed and gross earnings for the different industries of Kozushima.

	Number employed	Gross earnings (¥ 1 mil.)
Primary industry total	240	928
Farming & forestry	23	81
Livestocking		11
Fishing	217	836
Secondary industry total	256	323
Construction	219	218
Mining & manufacturing	37	105
Third level industry total	547	959
Wholesaling & retailing	151	270
Services	229	273
Public services	80	281
Others	87	135
Grand total	1,043	2,210

Source: Isolated Islands Register by the National Land Bureau (1980)



The drive-in type bottom lift net Kozushima Island

A compound fishing method using surrounding gill net, drive-in lift net and divers

Life cycle, resources, fishing grounds and fishing season

Life cycle: "Takabe" (*Labracoglossa argentiventris* Peters) is one species of the Percida family of fishes. In Japan, they are found in the central and southern Pacific coast waters of Honshu and in the coastal waters of Shikoku and Kyushu Islands. The spawning season for takabe is from September to November (water temp. 18°~21°C), and the eggs are of the floating type, with the eggs and fry being distributed over a large area by the Kuroshio Current. Although the exact

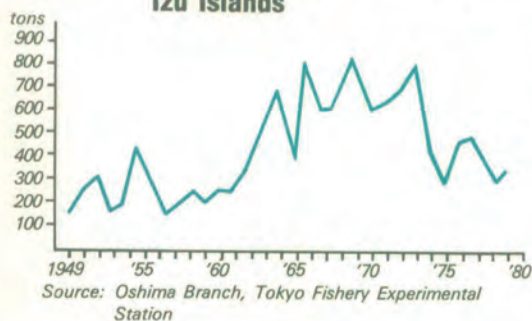
Takabe (*Labracoglossa argentiventris*)



course of the infant takabe from the time of hatching to the time they reach the coastal feeding grounds is not known, in the Izu Island group fingerlings with a body length of 3~4cm appear around the islands in March and April (suitable water temp. 15°C~24°C), after which they inhabit the current rip waters along the outskirts of the Kuroshio Current. Throughout their lives takabe are plankton feeders. As they grow they repeat a daily migration pattern of swimming around the off-shore reef waters in the daytime, and then, moving to the coastal waters at night in schools. Within one year they reach a maximum body length of 22~23 cm (from nose to tail cleft), at which point they reach sexual maturity. The catching age is from 1 to 2 years of age, with 3 and 4 year olds seldom being caught. The maximum age that takabe reach is believed to be 5~6 years.

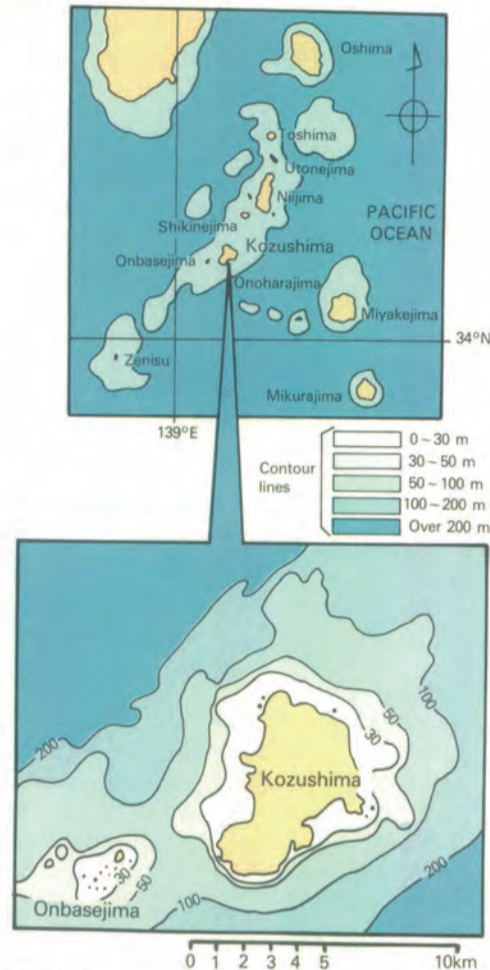
Resources: The total catch of fisheries in the Izu Islands between the years 1949 and 1980 are shown in Table 5. This table reflects the ups and downs caused by the varying prosperity of fishery as a business, as well as transitions in the fishing methods used, with both of these factors effecting the amount of effort (CPUE) spent on fishery. Disregarding these variables, however, it is believed that the reproductive capacity of the resources in these waters is between 500 and 600 tons a year.

Table 5 Total catch of takabe in the Izu Islands



Fishing grounds: The fishing grounds are waters with a depth of less than 50 meters, with depths of 20~30 meters being the most common. Of the fishery operations catching mostly takabe, there are both drive-in type bottom lift net and gillnet operations. The type of fishing method used by the fishermen of each

Fig. 13 Izu Islands



NOTE: Contour lines are shown in meters.

island and the distribution of fishing grounds used are shown by Table 6.

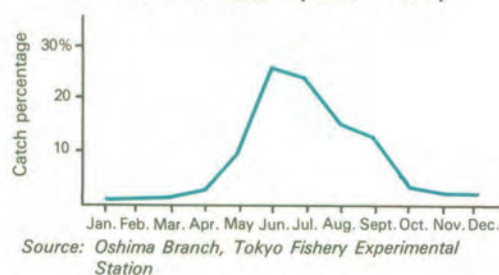
Table 6 Takabe fishery in the Izu Islands

Name of island	Fishing method	Fishing ground
Kozushima	• Drive-in type bottom lift net • Gillnet	① Onbasejima water area ② Kozushima water area ③ Zenisu water area
Niijima (Wakago)	• Drive-in type bottom lift net • Set net	① Utonejima water area ② Niijima water area ③ Shikinejima water area ④ Toshima water area
Oshima	• Gillnet • Drive-in type bottom lift net	Oshima water area
Shikinejima	Gillnet	Shikinejima water area

NOTE: The number of the fishing ground shows its ranking of importance.

Fishing season: The fishing season begins in April and May when there is an increase in the number of schools migrating into the fishing grounds. The catches reach the peak in size in June and July, and begin to decrease again in August, after which the spawning season begins. Fishing operations cease completely by October.

Table 7 Month-to-month change in takabe catch (1970~1979)



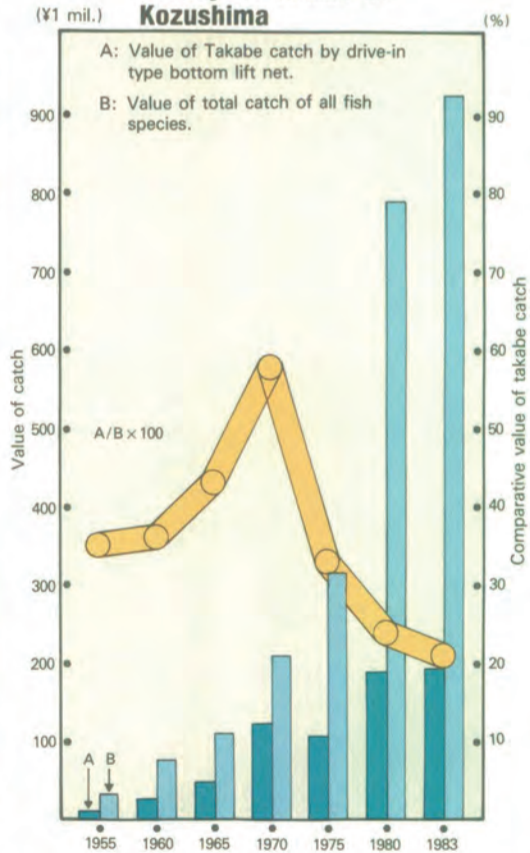
The importance of "takabe" fishery

The total catch by Kozushima fisheries in 1983 was 850 tons (gross value ¥1,030 million). As shown in Table 8, the takabe catch by drive-in type bottom lift net was 116 tons (13.6% of the total), making it one of the major fisheries of the island. However, as can be seen in Table 9, in relation to the island's other types of fisheries, takabe fishery reached its peak in 1970, and since then has been on the decline.

Table 8 Catch amount (Jan. to Dec., 1983) Kozushima Fishery Cooperative

Fishing method	Main fish species caught	Amount (tons)	Value (¥1000)
Hook-and-line for bottom fish	Snapper & <i>Paracaesio caeruleus</i>	233	318,760
Drive-in type bottom lift net	Takabe & grunt	116	192,500
Squid jigging	Flying squid	138	169,505
Dart fishing	Swordfish	127	126,575
Flying fish drift gillnet	Flying fish	59	23,162
Takabe bottom gillnet	Takabe & grunt	5	4,819
Lobster gillnet	Lobster	10	72,120
Set net & others	<i>Scombrops boops</i> & <i>Seriola aureovittata</i>	12	19,474
Seaweed gathering	<i>Gelidium amansii</i> , <i>Gelidium sub-costatum</i> , <i>Gloiopeltis tenax</i> & <i>Meristotheca papulosa</i>	150	103,540
Total		850	1,030,455

Table 9 Drive-in type bottom lift net fishery for takabe of Kozushima



Drive-in type bottom lift net fishery for takabe was first introduced to Kozushima in 1896. Following is a detailed picture of the changes that have taken place in the fishery industries of Kozushima during the nearly 100 years since.

1) The decline of pole-and-line fishery for skipjack and the transition to small-scale fishery operations in the fishing grounds close to the island.

Since the beginning of the 19th century, pole-and-line fishery for skipjack was the main fishery pursued by the fishermen of Kozushima. However, with the beginning of motorization of fishing boats at the end

of the century, large fishing boats began to come to the good fishing grounds of the islands from the mainland in increasing numbers and dominated these fishing grounds with their mechanized fishing techniques. Because of a lack of domestic capital for investment in the motorization of their boats, the island's fishermen could no longer compete with the outsiders for the skipjack catch, and they gradually began to abandon this fishery.

After this, stick-held dip net, drive-in lift net and angling became the island's principal fishing methods. Soon, however, their failure to keep up with the trends of moto-

rization and increase in size of fishing boats, and a decrease in the resources of round scad from the coastal fishing grounds, caused the decline of the stick-held dip net operations. Eventually the types of fisheries that survived in the island were small-scale fisheries relying on coastal water marine resources, such as, drive-in type bottom lift net, angling, drift gillnet, lobster gillnet, and seaweed gathering.

2) Selective fishery for high value fish

In terms of monetary value, only 1% of Kozushima's total catch is consumed on the island, with virtually all of it being sent to Tokyo and other mass-consumption markets. Because all of their products have to bear the burden of shipping costs to the large markets, the fishermen of the island have concentrated their production around high priced fish and "speciality" products. In the past, products like lobster, abalone, *Gelidium amansii* (seaweed for agar processing) and round scad (for salt-dried fish processing) served the role of high value or speciality products, but after World War II regular sea transportation between the island and the central wholesale markets of Tokyo became available, making it possible to ship fresh fish to these markets. This important factor served to stimulate a period of rapid growth in Kozushima's fisheries.

Although takabe was traditionally treated as a low-value fish in the Tokyo markets, when large quantities of takabe began to reach the market on a regular basis the value of takabe as a product went up considerably. Even though takabe is a small fish with a body length of no more than 20cm or so, it has a high fat content and a distinctive flavor which gradually won it a reputation as a high-class fish.

3) A cooperative operation system by independent fishermen

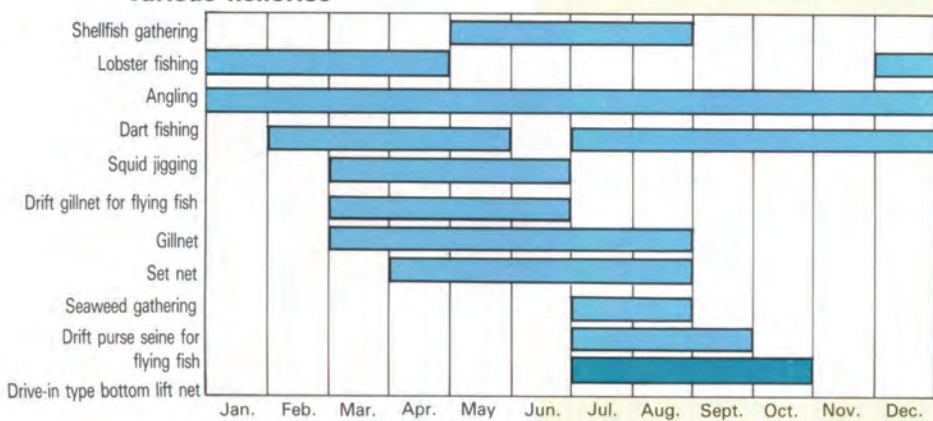
Drive-in type bottom lift net fishery for takabe is a type of fishery managed by an

fishery for "Takabe" on

autonomous cooperative group called a "net group". Here are the distinctive characteristics of this management group:

- i) Independent fishermen become a part of the cooperative by supplying either labor or their privately owned fishing boats for the fishing operation.
- ii) The fishing season for drive-in type bottom lift net is limited to summer and autumn, and when the season ends the individual fishermen use their privately-owned boats to engage in other types of fisheries, thus supporting themselves as year-round fishermen.
- iii) The gross income from the cooperative fishery activities is divided among the members in proportion to the size of their contribution in labor and equip-

Table 10 Operation periods for the various fisheries



ment (fishing boats), according to a prearranged system of distribution.

It should be noted that, in recent years, the following phenomena are associated with Kozushima's drive-in type bottom lift net fishery for takabe, which must be dealt with in the future.

- 1) The introduction of such things as simple diving equipment and net haulers brought about a sharp increase in catching activities, but as the true extent of the takabe resources in these waters is not yet established, there is a concern that there might be over-fishing of these waters.
- 2) The steady increase in fish prices which continued throughout the 1970's came to an end in the '80's, and thus, no further growth in fishery production based on increases in fish prices can be anticipated.
- 3) There has been an increase in boat size by some of the participating fishermen from 3~5 ton class to 5~10 ton class boats, which has led to an increase in the scale of fishing activity possible and the size of the usable fishing grounds. This, in turn, has caused a recent trend for individual fishermen to leave the cooperative fishery in favor of their own private fishery management.

In this way, there are a growing number of new social tensions surrounding the drive-in type bottom lift net fishery for takabe on Kozushima. Up until recently, however, the socio-economic conditions which supported this type of cooperative fishery can be summarized in the following way:

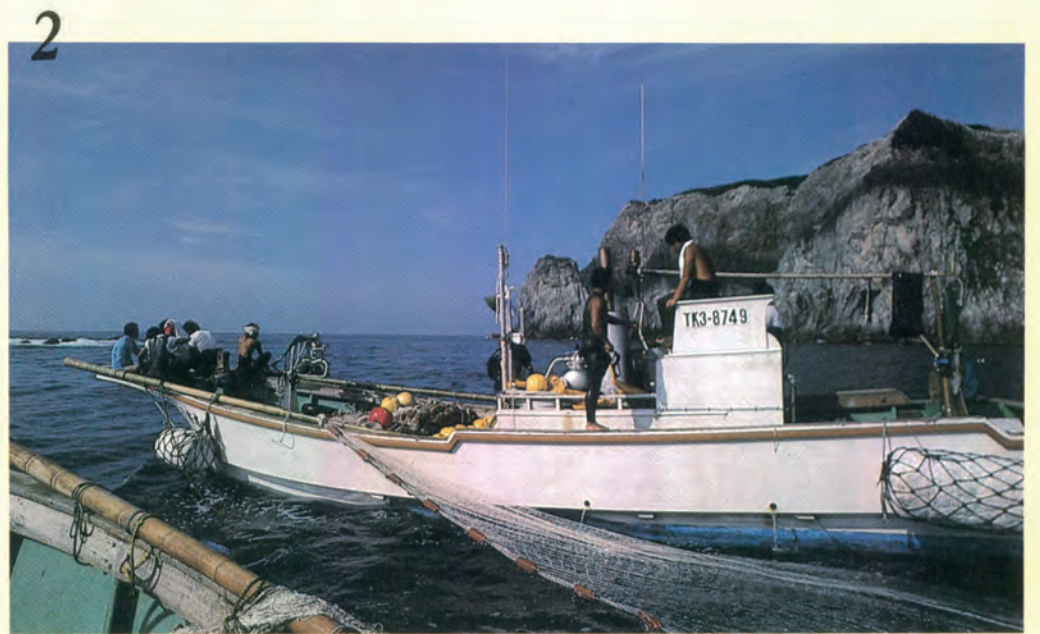
- 1) Kozushima's fishermen were able to maintain a successful fishing industry by making use of a few specialized fishing techniques even if the scale is reduced, as is common among all isolated island communities.
- 2) They were able to concentrate their catch in high-priced marine products, and thus overcome the handicap of being an island isolated from the large markets.
- 3) They were able to establish a successful system of cooperative fishery operation by independent fishermen.



Divers search for schools of fish



Setting out the gill net to surround the school



Casting the surrounding gill net



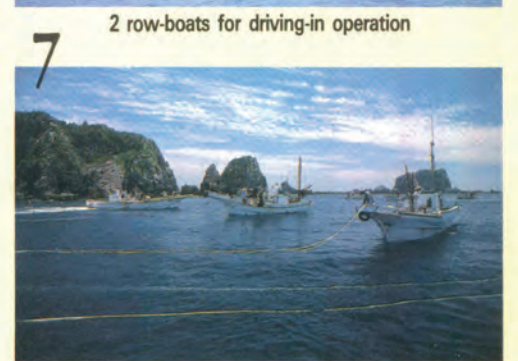
Laying out the divider net



2 row-boats for driving-in operation



Divers driving the fish ahead of them



Hauling in the lift net



Divers boat



Setting out the bottom lift net



The surrounding gill net (float side)



The surrounding gill net (sinker side with selvedge)



A work boat with surrounding gill net stacked ready for use

Fishing gear and fishing method

1) The structure of the fishing gear

The net is constructed of four parts; the four-boat bottom lift net, a surrounding gill net (tatekiri-ami), a divider net (yahiro-ami), and the drive-in net (kari-ami). As for the materials from which the nets are made; the bottom lift net is made of nylon, which cuts through the water easily; the gill net, divider net and drive-in net (with the exception of one segment) are all made of cremona.

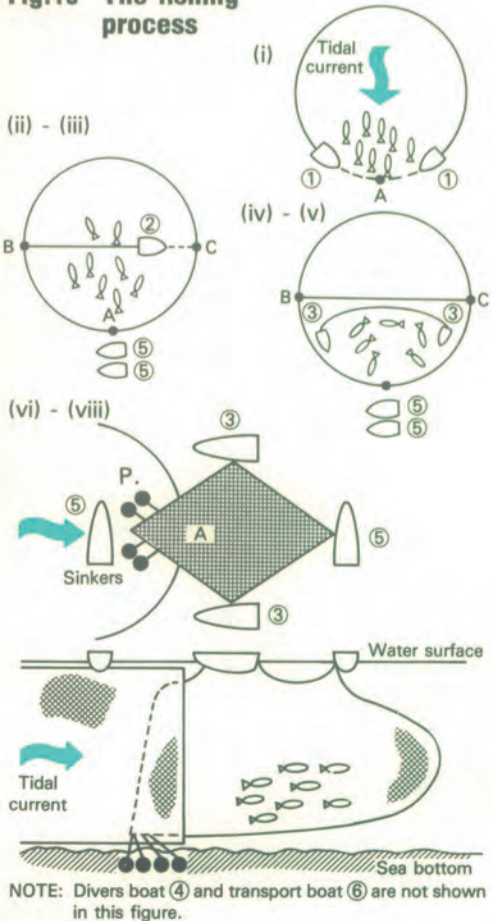
NOTE: Cremona is a short-fiber thread similar in nature to cotton thread. It has a degree of stiffness that makes it easy to work with the hands, which makes it a suitable material for use in nets which must be repaired often, like the gill net, divider net and drive-in net. Cremona also has the advantage that sea weeds do not attach to it as easily as to nylon.

2) Fishing method

Upon arriving at the fishing ground, first of all, several young divers get into the water and begin to search around areas of natural reef for schools large enough to catch. A school that looks large enough to fill 20 fish crates (700kg) is considered proper to call for the beginning of a netting operation. When such a school is located, the divers signal to the net boats.

- i) Two work boats ① lay out the surrounding gill nets in a circle closing off at point A. In a case like this it is the takabe's nature to try to escape by swimming into the tidal current, so the net is always set from the up-tide direction.
- ii) Next, the divider net boat ② cuts across the circle made by the surrounding gill net and as it does it lays out the divider net, as quickly as possible. In this way the divider net divides the circle from point B to point C closing off the main part of the school in one hemisphere, and thus reducing the area over which the following catch operation must take place.
- iii) Two large net boats ⑤ are made to wait at point A.
- iv) Two drive-in net boats ③ use the drive-in net to steadily move the fish in a down-current direction.
- v) At this point twelve or more divers from the divers boat ④, the work boat equipped with compressor ① and the divider net boat ② get into the water and drive the fish before them. In this case the bubbles from the divers' heads serve to intimidate the fish.
- vi) When the drive-in net reaches the proximity of point A, the two drive-in net

Fig.16 The fishing process



NOTE: Divers boat ④ and transport boat ⑥ are not shown in this figure.

Fig.14 Lay-out of the fishing gear

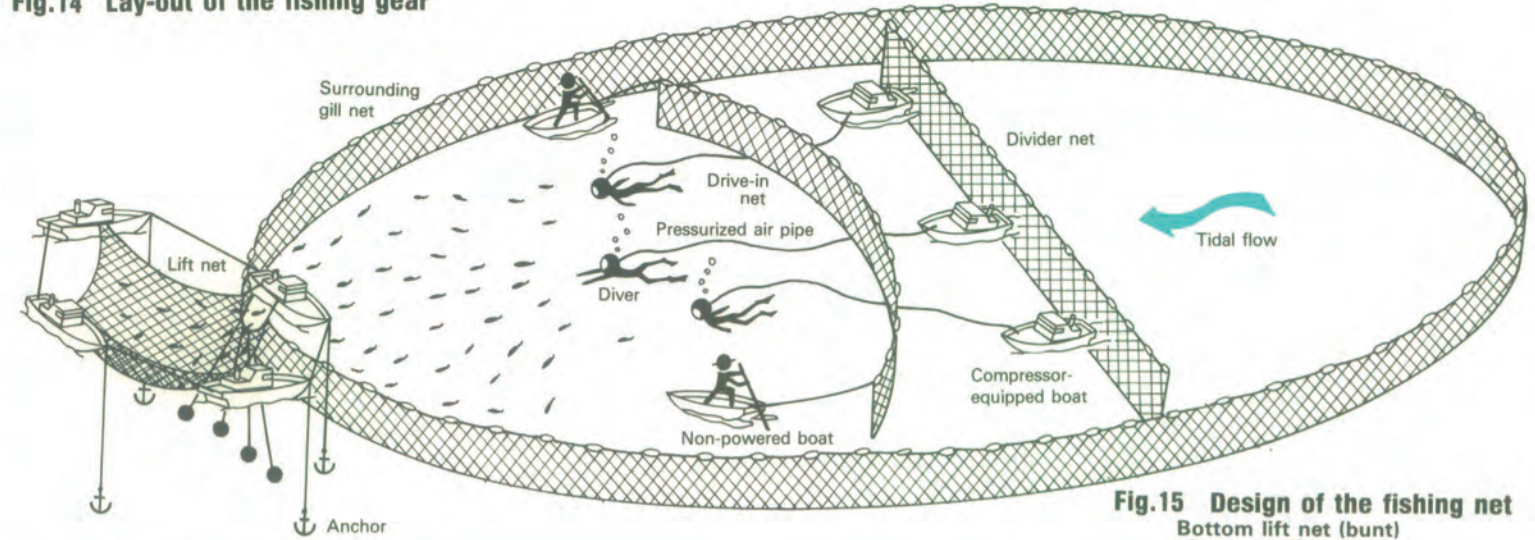


Table11 Net specifications

Part	Material	Thickness	Mesh size	Width (No. of mesh eyes)	No. of sheets used
(a) Bunt	Nylon	210D/15y.	34 mm	100	400 (60,600 m)
(b) Serikomi	Nylon	210D/15y.	43 mm	100	400 (60,600 m)
(c) Arame	Nylon	210D/12y.	50.5 mm	100	400 (60,600 m)

NOTE: Each sheet is 151.5 meters long.

Table12 Surrounding gill net/divider net/drive-in net

(c)	Selvedge (upper)
(a)	Body net (upper)
(b)	Body net (lower)
(c)	Selvedge (lower)

Table13 Net specifications

	Part	Material	Thickness	Mesh size	Net depth	Length per sheet	Finished length per sheet	No. of sheets used
Surrounding gill net	(a) Body net (Upper)	Cremona	20s/30y	24 cm	10 fathoms	80 mesh eyes (19.2 m)	10.5 m	100 sheets
	(b) Body net (Lower)	Cremona	20s/24y	12 cm	6 fathoms	160 mesh eyes (19.2 m)	10.5 m	100 sheets
	(c) Selvedge	Cremona	20s/30y	6 cm	4-5 mesh eyes up & down each	320 mesh eyes (19.2 m)	10.5 m	100 sheets
Drive-in net	(a) Body net (Upper)	Nylon	210D/18y	12 cm	8 fathoms	160 mesh eyes	10.5 m	40-50 sheets
	(b) Body net (Lower)	Cremona	20s/15y	6 cm	7 fathoms	320 mesh eyes (19.2 m)	10.5 m	40-50 sheets
	(c) Selvedge	Cremona	20s/15y	6 cm	4-5 mesh eyes up & down each	250-280 mesh eyes	10.5 m	40-50 sheets
Divider net	Same as surrounding gill net specifications, except for the number of sheets used (30-33 sheets)							

Table14 Float/sinker specifications

	Material	Size/weight	Surrounding gill net/divider net	Drive-in net
Float	Plastic	21 cm x 8 cm	At intervals of 30 cm	At intervals of 70 cm
Sinker	Lead	400 g	At intervals of 45 cm (7.5 kg per sheet)	At intervals of 30 cm (15 kg per sheet)

Table15 Fishing boat and crew

Type of fishing boat	Tons	Horsepower	Number of boats used	Number of crew/ age bracket of crew	Use of boat in individual fishery activities
① Work boat	5 ton class	190HP *Note 1	2	10-12 for each boat/ twenties & thirties	• Small-scale set net • Lobster gill net
② Divider net boat	5 ton class	190HP *Note 1	1	10-12 for each boat/ twenties & thirties	Same as above
③ Drive-in net boat	3 ton class	Non-Powered	2	6-7 for each boat/ fifties & sixties	None
④ Divers boat	5 ton class	24-160HP	8	2 for each boat/ twenties & forties	• Boat seine • Pole & line fishing for bottom fish
⑤ Large net boat	3 ton class	80HP & 160HP	2	4 for each boat/ sixties	Same as above
⑥ Transport boat	9.9 ton class	350HP & 500HP	2	3 for each boat/ sixties	Dart fishing
Total			17	70-80 persons	

NOTE 1: The work boat and divider-net boat move above the float line of the surrounding gill net so often that they are driven by a hydraulic jet propeller.

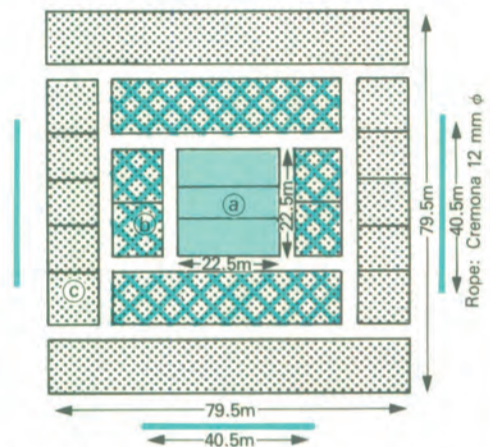
- boats ③ leave the rest of the driving process to the divers and proceed to point A to join with the two large net boats ⑤ in setting out the lift net.
- vii) The surrounding gill net is opened slightly at point A and one corner of the lift net is set into the gap. To this corner of the lift net (point P) four 15kg iron sinkers are attached and it is sent to the bottom. Because the lift net is

- made with an extremely high hang-in ratio, when it receives the tidal current it billows out into a bag shape in the down-current direction.
- viii) When the school of fish has entered the net, the sinkers at point P are pulled up and, then, the four boats at the four corners of the net begin to pull it up in unison and complete the catch operation.

Table16 Catch statistics

Date	Operations	Size of catch (tons)				Value of catch (in thousands of yen)
		Takabe	Grunt	Seriola Aurovittata	Total	
July 13	1st	1.2	0.1	-	1.3	
	2nd	1.8	0.7	0.8	3.3	
	Total	3.0	0.8	0.8	4.6	3,420
July 14	1st	2.2	0.4	...	2.6	3,180
	2nd	0.4	-	-	0.4	
July 15	1st	2.3	0.6	0.1	3.0	
	Total	2.7	0.6	0.1	3.4	4,800

Fig.15 Design of the fishing net Bottom lift net (bunt) Cremona 12mmφ



3) Evaluating the fishing method

For the following reasons, this fishing method can be evaluated as a method for catching takabe in large quantities in reefy areas around islands, being specially designed and gradually improved for this purpose.

- a) Because the takabe's habitat is reef areas with a strong tidal current, it is difficult to use either trawl net or surrounding net techniques. In the case of surrounding net, the quickness of the current causes the net to take a poor set in the water as well as causing it to get stuck on the reefs, both of which reduce the net's catchability greatly.
- b) Because takabe are middle to bottom water fish, fishing methods designed for surface fishes, such as stick-held dip net are not suitable.
- c) A normal bottom lift net is not suitable because the net can become caught on the reefs, and also because takabe are not easily attracted by fish lights.
- d) This is why the process of first surrounding the takabe schools with a surrounding gill net, then using a drive-in net and divers to drive the fish to a sandy bottom area where a 4-boat type bottom lift net could be set and the fish caught, was developed.

Operation

The fishing boats leave port at 6 o'clock in the morning and continue to fish until evening. The fishing grounds are usually at a distance that can be reached in 20 to 30 minutes, and are never more than an hour away. The amount of time needed for each part of the fishing operation is described below in detail. Because the entire process takes from two to three hours, only one or two operations can be completed in one day.

- Search for fish schools50-60 min.
Casting the surrounding gill net10-20 min.
Driving in the fish with drive-in net and divers60-90 min.
Raising the lift net and landing the catch in the boats30 min.
Total2-3 hours

The catch

There is a great fluctuation in the size of catch brought in by one net hauling, and the mean is hard to determine. For example, here are the statistics on the catches from a three-day period from July 13th to the 15th in 1984. This period falls in the high catch season.

Local fishery capabilities

(1) Port facilities

In the seven years between 1925 and 1931, the citizens of Kozushima completed the breakwater which is the base of the present Kozushima Harbor, working with volunteer labor at a rate of up to 100 work days per citizen per year. Since then, Kozushima has several times been the recipient of grants from both the national and prefectural governments which have enabled them to continue construction of harbor facilities, such as the present fishing boat mooring area (6750 m²), a fishing boat beaching slope (7342 m²) and a pier for passenger and cargo vessels (200 m²). Also, in the future there are plans to construct an additional pier capable of handling a 5000 ton class ship, with expansion of an emergency fishing boat shelter area against typhoons, and a mooring area for pleasure boats.

(2) Fishing boats

As of the last day of 1982, Kozushima had 139 registered fishing boats. Of these, about half are powered fishing boats of under 5 tons.

Non-powered boats	3
Powered boats less than 5 tons	69
" from 5 to 10 tons	37
" over 10 tons	26
Total	135

In recent years, national loans for the construction of fishing boats have made it easier for fishermen to invest in new boats, leading to a steady increase in the number of boats, the size of boats and their horsepower. Also, after the introduction of FRP boats in 1970, it took only five years for half of the entire fishing fleet to be replaced by these boats, and by 1980 virtually all of the boats on the island were FRP. The modernization of fishing equipment, such as the introduction of fish finders, radar and net haulers is also proceeding at a rapid rate.

Table 17 shows the size of boats that are now engaged in the different fisheries and the size of the catch for each type of fishery.

(3) The Fisheries Cooperative Union

There is only one village on the island of Kozushima, and this is where the Kozushima Fisheries Cooperative Union is established. The Fisheries Cooperative consists of several affiliated groups, including a net group, small boat fishing group, pleasure anglers transporting group and other voluntary group, each of which conducts its own independent activities. However, it is the net group that has the long tradition in fishery here and that holds the authorized rights to engage in drive-in type bottom lift net fishery.

Statistics concerning the Kozushima Fisheries Cooperative Union (1983, January-December)

(1) Union members	
Regular members	302
Associate members	326
total	628

(2) Executives and officials					
Chairman	1	Directors	8	Auditors	3

Fig.17 Kozushima Harbor

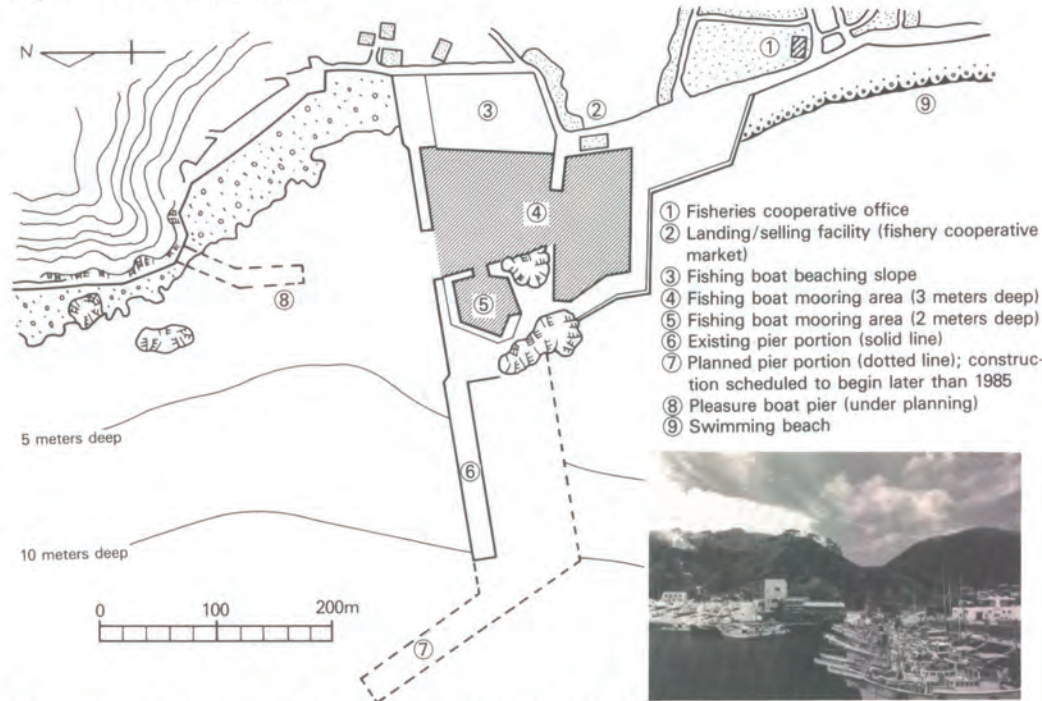


Table 17 Production of fishing boat size (March '83)

Division	Amount of production (tons/year)	Principal fisheries applicable									
		Shellfish gathering	Seaweed gathering	Lift net	Dive-in type bottom	Gillnet	Trotting	Squid jigging	Hook-and-line for bottom fish	Flying fish drift gill-net	Marlin dart fishing
Non-powered boats		5	●	●	●						
Boat fisheries	0-3 tons	163		●	●	●	●				
	3-5 tons	103			●	●	●				
	5-10 tons	292			●	●	●				
	10-20 tons	284						●	●	●	
	Total	847							●	●	●
Small-scale set net		25									
Ground total		872									

Source: Kozushima Fishery Cooperative

Table 18 Comparison of fish prices

	A price when bought at Kozushima Fisheries Cooperative auction		B Wholesale price at Tokyo Central Wholesale Market	
	Takabe	Other fresh fish average	Takabe	Other fresh fish average
1979	1,658	932	1,304	785
1980	1,536	1,372	1,316	829
1981	1,190	1,257	1,262	901
1982	1,683	1,266	1,626	964
1983	1,657	1,323	1,630	892

Source: Kozushima Fishery Coop.

Source: Annual Report by Tokyo Central Wholesale Market

Management

Councilor...1 Supervisors...4 Accountant...1

Business Staff

Sales officers...3
Purchasing officers...4
Credit officers...2
Ice, Refrigeration and other facility attendants...3

Technical instructors

Instructor, wireless telephone operator...1
Total...19

(3) Union business statistics

* Sales

	Quantity (tons)	Value (¥ 1 mil.)	Average price
Fish	700	926.9	1,323 ¥/kg
Seaweeds	150	103.5	690 ¥/kg
Total	850	1,030.4	

* Credit

(1) Savings balance...¥545 million
(2) Balance on loan...¥807 million
(3) Balance borrowed by Coop...¥534 million

* Purchasing

(1) Fishery equipment...¥227 million (of this oil costs ¥141 mil.)

(2) Basic necessities...¥16 million
total...¥243 million

* Ice making/refrigeration

(1) Ice: daily production 4 tons/storage capacity 100 tons, total sales for 1983...1,192 tons at ¥16 mil.

(2) Refrigeration: fresh fish, salt dried fish in storage...¥1.4 mil.

(3) Frozen commodities (baits)...¥5.3 mil.

* Facility rental...¥1.5 mil.
* Fish preserve...¥2.6 mil.

(4) Facilities

* Landing/selling facilities: 148 m²
* Storehouse for fishing gear: 119 m²
* Storehouse for fishery supplies: 57 m²
* Ice-making machine: 4 tons/day
* Refrigerator and ice storage: 109 m²
* Fuel tank: 150 kl (1 tank of 100kl & 1 tank of 50kl)
* Storehouse for marine products (agar-agar): 298 m²
* Hoisting block area: 50 m² (two locations)
* Vehicles: 2

(4) Cooperative selling and shipment to metropolitan markets

All Kozushima's fishery catches are landed at the Fisheries Cooperative's market facility, and all are sold by a cooperative sales system. There are six local middlemen who take part in the Coop's daily auction, and ship their buying to the wholesale companies in the metropolitan markets. All of the products that are shipped for Kozushima are fresh products. There are no frozen or processed products shipped from this market. Shipment to the mainland is done by either regularly scheduled passenger/cargo vessels of a commercial steamship company or by privately operated cargo vessels (80-ton class). Although most of the products are sent to the central wholesale markets of Tokyo, the middlemen are constantly gathering information on conditions in the various urban markets to decide which will be the most profitable to send their shipments to at any given time.

The shipments of fish reach the consumer markets about 30 hours after they have been caught, which means that their freshness is sufficiently guaranteed. At the Tokyo (Tsukiji) market they are classified as highly fresh, local produce and thus command a high price. Takabe, in particular, is considered one of the highest class fish in the market. Column A of Table 18 shows the price at which fish are sold to the middlemen at the Kozushima Coop auctions. It should be noted that between the middlemen and the Tsukiji wholesale companies the price is risen to 1.5 to 2 times the price of column A. In contrast, column B shows the average price of fish sent to the Tsukiji market in Tokyo from fisheries all over the county. As a subject for future consideration, it has been suggested that the Fisheries Cooperative obtain a cargo vessel which would enable them to ship their products directly to the consumer market wholesale companies, thus increasing the fishermen's share of the profit. In order to realize such a plan, it will be necessary to:

(1) increase overall production to support the additional overhead cost of maintaining a cargo vessel capable of transporting fresh fish.

(2) induct members into the coop who have the ability to do the job presently done by the six middlemen, namely collecting information on the various markets and making decisions as to the proper destination for shipments of products.

(3) maintain sufficient cold storage facilities to allow the coop to regulate the timing of their shipments according to fluctuations in volume of production and conditions in the market, in order to maintain favorable selling prices.

At present the cold storage facilities maintained by the coop are being used only to store bait and to store fresh produce awaiting shipment temporarily, or when a cargo vessel is unable to reach port due to weather conditions. There are no facilities at present which could be used to store produce for longer periods as would be necessary for controlling shipment to maintain price levels.

Principal fishes caught



Takabe

Grunt



Kozushima Fisheries Cooperative. The 2nd floor holds the Cooperative's offices, and the first floor is store space for rent.

Cooperative business activities by "net group"

THERE ARE about 80 members who are voluntarily affiliated to Kozushima's "net group", and these members hold all the authorized rights to drive-in type bottom lift net fishery operation in the island. This fishery group was first organized in about 1910, and the following is a summarized history of this organization:

On Kozushima, from the beginning of the nineteenth century, there existed a fishery group, consisting of (A) boat-owner fishermen contributing boats and (B) laborer fishermen (mostly under 30 years of age), engaged in pole-and-line fishing for skipjack and primitive stick-held dip net fishery. Both A and B were hereditary roles. During the off-season of pole-and-line skipjack fishing and stick-held dip net fishing, each member (B) engaged individually in activities such as seaweed gathering, angling and gillnet fishing from their own small boats.

In the 1980's, drive-in type bottom lift net fishery was introduced to the island. This was a fishery that required not only the large fishing boats of the A group but also a number of small boats owned by the B group laborers.

After this, pole-and-line fishing for skipjack and stick-held dip net fisheries both went into decline, and around 1910, the boat-owning group A and the labor-supplying group B brought an end to the old regime and formed the new net group by mutual agreement, which raised the B group to a managerial status in the new system.

At first eight "net groups" were formed. However, business failures reduced this number to three by 1960, and by the 1970's only one group remained.

The "net group" has four officials who manage the group by council. These include a chief sponsor, two associate sponsors, and one sponsor in charge of net

repair.

During the lift net fishing season, the members of the net group must supply the group with their own privately owned boats and themselves as laborers on these boats. Younger members who do not yet own a boat of their own supply only labor. The nets and other fishing materials are bought communally by the net group and become their communal property.

The members of the net group receive their pay from the gross sales margin, according to a pre-determined pay scale based on the contribution of the individual member in labor and boat use (called the "shiro"), after such expenses as the (1) Fisheries Cooperative's sales commission-7%, (2) fishing boat fuel costs, (3) fishing gear depreciation, (4) repair costs for boats, gear and machinery, and (5) other expenses have been deducted. (See Table 19)

After researching the drive-in type bottom lift net fishery for "takabe" of Kozushima, we can summarize the factors which have enabled this type of cooperatively managed fishery by independent fishermen to exist as follows:

- (1) There is the ability to conduct a type of fishery that requires a large amount of labor, and there are sufficient marine resources to support this fishery.
- (2) There is a lack of local capital for investment which is made up for only by each of the members of the

Table 19 Method for dividing fishery profits

Method of calculation

$$\text{Pay for individual member} = \left(\text{Total sales} - \text{Total expenses incurred} \right) \times \frac{\text{Shiros for individual member (boat/labor)}}{\text{Total number of shiros}}$$

Pay scale

	"shiro" per boat	"shiro" per labor
Work boat	1.25	1.3
Divider net boat	1.25	1.3
Drive-in net boat	0.6	1.2
Divers boat	0.8	1.1
Large net boat	1.25	1.1
Transport boat	2.8	1.1
Young member	—	1.3
Officials allowance	—	0.1
Old net repair man	—	0.7
Reserve fund for the group	11.4	
Total number of shiros (as of August of 1984)	152.1	

Calculation example (1983: Total sales ¥210 mil. and gross sales margin ¥132 mil.)

(1) For an official offering a work boat:
 $\text{¥132,000,000} \times \frac{1.25 + 1.3 + 0.1}{152.1} = \text{¥2,305,000}$

(2) For a young member offering labor alone:
 $\text{¥132,000,000} \times \frac{1.3}{152.1} = \text{¥1,128,000}$

- (3) There are no outside sources willing to invest large amounts.
- (4) It is a type of fishery that is profitable

- enough to cause young laborers to seek a career here.
- (5) It is an isolated island community that historically has a strong sense of social solidarity.



A group of elderly fishermen repairing nets.



Young fishermen having lunch on board the fishing boat



The wives of the fishermen engage in vegetable growing in the spring and fall while in the summer they run private lodging houses. The photograph shows lodging house owners greeting tourists from an arriving passenger boat.



After the younger fishermen have finished it is the senior fishermen's turn to have lunch. This order is strictly observed on board the fishing boat.

Note: In Kozushima inter-marriage within the village has traditionally been the dominant pattern. Marriages have tended to be decided among the young people themselves based on the intercourse of heterosexual age groups rather than by the parents. As a result, a kind of dual family consciousness exists in which matri-lineage and patri-lineage are treated with essentially the same importance. This has meant that rather than a patri-lineal "clan" consciousness, a much looser "community" consciousness has predominated, allowing the members of the community to work freely and eagerly in a communal type business system. However, since 1970, there has been increased contact with people from outside the island, which is causing a gradual change in this situation.

In Japan there are two other types of systems by which, like the "net group", private individuals unite voluntarily to function as a legally instituted fisheries cooperative union, as follows:

- (1) A fisheries cooperative union which acts independently in one particular area or one particular type of fishery.
- (2) An independently acting "fishery producers union" made up of a small number of people making a joint investment.

REFERENCE MATERIALS:

- (1) "General Research Report on Cultural Assets of Izu Islands" by Mr. Masao Gamo and his staff
- (2) "Development of Fishery System in Kozushima" by Mrs. Masayo Shiono
- (3) "Local Characteristics and Transition of Agriculture and Fishery in Kozushima" by Mr. Hideo Koike
- (4) "Structure of Drive-in Type Bottom Lift Net Fishery in Kozushima" by Mr. Tamenori Nagano

Aided by: Kozushima Fishery Cooperative Union/Wakago Fishery Cooperative Union/Oshima Branch, Tokyo Fishery Experimental Station