

Qualities of different fishing gears and fisherman's strategy

Boat Seine Variations (Japanese names: Patchi-ami and Gochi-ami)

The catch: Boat Seine (Patchi-ami)



The catch: Boat Seine (Gochi-ami)

IN ORDER TO develop successful coastal fishery through the establishment of effective techniques for catching marine products with high market value, the first requirement is to develop the capability to catch a sufficient amount of fish in proportion to the labor requirements of the fishing process chosen, and this process must be one that takes into consideration the traditional fishing gears of the given region and also the life cycle and movement habits of the fish that is to be caught.

The second requirement is that the use of this fishing gear and method be properly managed on a continuous basis by a commercial fishery structure within the fishing village and surrounding area, and that the right social and economic conditions exist to provide for a sufficient income for the people involved in the fishery. The following is a list of these necessary social and economic conditions:

- (1) There must be sufficient resources of some salable type of marine product to support a given number of fishing families on a permanent basis.
- (2) There must be a sufficiently large market for the marine products within reach of the fishing village, and a marketing system or processing facilities must be available to the fishermen.
- (3) The fishing method must be one that is acceptable to the fishing

community. For example, there must be sufficient manpower available to conduct the chosen fishing method, and a proper governing system must be created to prevent friction with fishermen involved in other types of fisheries.

In this issue we will look at two types of fishing methods presently in use throughout the region of Western Japan from the standpoint of fishing gear adaptation. Both of these methods are variations of boat seining, one of which is called in Japanese "Patchi-ami" and the other called "Gochi-ami". From here on we will refer to the former as Type A boat seine, and the latter as Type B. Type A is a small scale net fishing method that is used as an alternative to a surrounding net to catch fish living near the surface in coastal waters such as sardine, anchovy and Japanese sand lance. Type B is another small scale net fishing method used instead of a small scale trawl net to catch fish living near the bottom in coastal waters such as red sea bream, barracuda and lizard fish. Both of these fishing methods have been improved and modified to better fit the movement habits and fishing ground conditions for the fish being caught in the different regions, resulting in a number of variations in the net configuration.

Boat Seine Type A

(Japanese name: Patchi-ami)

THIS TYPE OF FISHERY uses the largest net of any boat seine fishery, which is pulled by two boats of up to 20 tons. At present there are about 700 groups involved in this type of fishing operation in the western and central regions of Japan's Pacific coast, with a large number being concentrated along the Inland Sea of Japan (Seto Naikai) and other bay areas. Among the fish that are caught by this method are sardine, anchovy and anchovy fry, sand lance and cuttlefish (Sepiidae), with sardine and anchovy making up the large majority of the catch. (See figures 1 and 2) The most common fishing method used for

catching members of the sardine family involves the use of a surrounding net or purse seine, which were developed originally for catching sardines in areas where they exist in abundance such as the Pacific coast of Eastern Japan, the Japan Sea coastal waters and the East China Sea area. Modernization has brought about a change in the net construction from a no-purse-line configuration to one with a purse line, and at the same time there has been an increase in the size of boats used. This has made possible the mobility to catch the large and mid-sized sardines that migrate over large areas of the waters surrounding Japan. On the other hand, in the bays and the shallow coastal waters of Western Japan the sardine resources have showed extreme fluctuation in numbers that has made it impossible for fishermen to rely solely on the catch of sardine for their livelihood and forced them to include the catching of anchovy, sardine fry and anchovy fry. The development of the Type A boat seine, a small scale fishing method specially adapted to this varied catch, has proved to be one of the biggest advances in fishing technology in this region in recent years.

Fig. 2—Distribution areas and fishing grounds of sardine



Fig. 3—Distribution areas and fishing grounds of anchovy



(Data from the Fishery Agency)

Sardine: Sardine eggs are laid in the months of December to February. The eggs hatch in the coastal waters where the fry begin to form schools as they grow into fingerlings, and at the same time they begin to ride branches of the Kuroshio Current into the Inland Sea from both the channels that enter from the east and west. During this phase boat seine fishery is conducted in the open sea and in the channels to the Inland Sea to catch these fry. The sardine continue to grow rapidly from spring into early autumn, and schools of half-grown to mature sardines form fishing grounds in the Inland Sea. In autumn the yearling sardines avoid the drop in water temperature in the Inland Sea by migrating once again to the open sea, thus eliminating the Inland Sea fishing

grounds. **Anchovy:** Anchovy born in the open sea spawning grounds during March and April (this is called the spring born population) migrate to the coastal waters 2 or 3 months later than the sardine and proceed to migrate into the Inland Sea in much the same way as the sardine as they mature. However, in the case of anchovy, as mentioned earlier, some mature schools will spawn in the Inland Sea during the summer or autumn season, resulting in the addition of a summer born population or an autumn born population to the fishing resources. In other words, populations born in the different seasons and migrating in different areas form fishing grounds in all the areas almost year-round.

Note: In Japan *Sardinops melanosticta*, *Engraulis japonica*, and *Etrumeus micropus* are all referred to as members of the sardine family.

Fig. 1—Patchi-ami (type A boat seine): Catch by prefecture (1981)

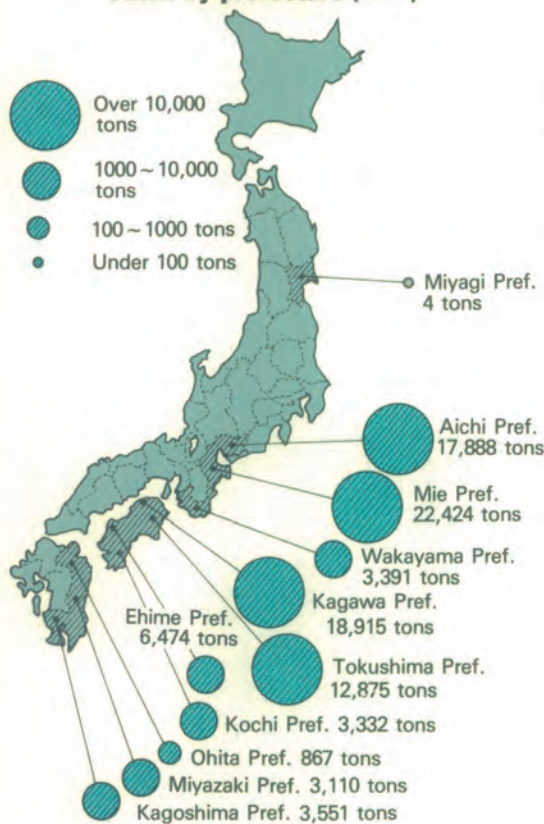


Table 1—Patchi-ami (type A boat seine): Catch by species

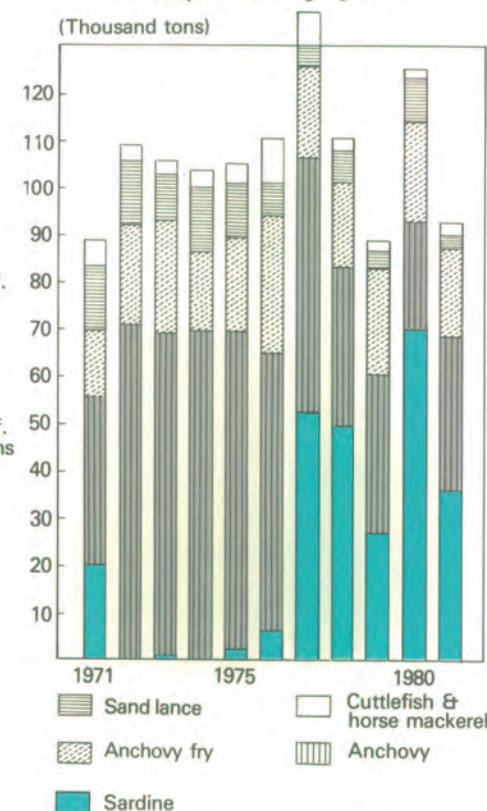
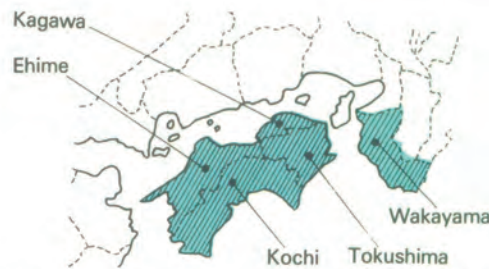


Table 2—Comparison of fishery conditions by region (1981)

Prefecture	Fishing ground	No. of fishing units		Sardine family catch (tons)	Make-up of catch (%)			
		Type A boat seine	Other boat seines		Sardine	Anchovy	Round Kerring	Fry
Kagawa	Inland sea area	34	54	22,088	13	79	...	8
Ehime	Inland sea & channel	31	367	13,602	23	67	...	10
Wakayama	Channel area	100	47	5,156	38	...	2	60
Tokushima	Channel area	83	38	25,068	80	6	...	14
Kochi	Off-shore area	300	6	13,551	62	5	8	25

Data from the Ministry of Agriculture, Forestry and Fishery



When comparing the catches of the different regions, we see that in general the catch by Type A boat seine can roughly be divided into the following two patterns:

- (1) Mass catch of mature and immature anchovy and/or sardine: The main fishing grounds are in the Inland Sea and

fishing activities are concentrated in the summer months. Although the fishing season is relatively short at less than 100 operating days a year, the catch per boat per operating day is large.

- (2) Fisheries catching anchovy fry and sardine fry: The main fishing grounds are in the open sea and the channels to the Inland Sea. Because this type of fishery is characterised by going out to sea for long periods to search for newly born populations, the number of operating days per year is large, ranging from 120-30 days to as much as 200 days, but the catch is relatively small.

Note: The Inland Sea=The Inland Sea of Japan (Seto Naikai)

Characteristics of the resources and fishing grounds

NOW LET US look at the characteristics of the resources and the fishing ground patterns of the sardine family, which makes up the majority of the catch for fishermen using the type A boat seine in the coastal waters of Japan.

Sardine: In the coastal waters of Japan there are four main sardine populations that spawn in the (i) West coast of Kyushu - Sanin off-shore area, (ii) Noto Peninsula west off-shore area - Aomori off-shore area of the Japan Sea, (iii) Hiuga-nada area-Tosa Bay area and (iv) Boso Peninsula off-shore area. The water temperature in the spawning areas ranges from 12°C to 19°C. In the warmer sea areas and the coastal waters the laying of eggs occurs early from December to February, while the remaining majority of the eggs are laid in the period from February to May. Eggs are laid in areas where warm currents mix with the coastal waters. After hatching the fry gradually gather into schools and live in coastal waters with an abundance of the plankton which the fry feed on. During the fry and fingerling stages of their life cycle the sardine live at a depth of 20 to 30 meters in the coastal waters having the optimum water temperature. As they reach sexual maturity and grow into adult fish they move to deeper water areas where they repeat a cycle of hibernating migration → spawning migration → feeding migration. **Anchovy:** Anchovy live in areas with the

same type of water conditions as the sardine, and their life cycle follows the same general pattern. However, anchovy are able to live in areas with a larger range of water temperatures, from about 10°C to 30°C, and whereas the sardine will migrate over large areas of ocean, the anchovy will stay in one area migrating mostly from deep water to shallow water and back again, making their life pattern different from the sardine.

Although most spawning is done in the period from March to June, anchovy have the ability to spawn at any time the right sea conditions are available. This means that at almost any time of the year except winter you will find groups of anchovy migrating into the coastal waters one after another to be caught by the various fisheries. The anchovy resources around Japan are divided into several regional populations at present including; (1) the Main Land Pacific population, (2) the Kyushu Pacific population, (3) the West Kyushu coast population and (4) the Japan Sea population. It is noteworthy that the sardine and anchovy fisheries are operated on different seasonal schedules from one another. Let us now look at how the Type A net fishing methods have evolved in the Inland Sea of Japan and its neighboring areas to fit the behavior patterns of the sardine family in the different stages of the life cycle.

Development of commodities and changes in fishery production

THE VARIATIONS in the Type A boat seine fishing method are not a result solely of such natural factors as distribution of resources and geographical aspects of the fishing grounds. The variations also reflect the social and economic changes in the society supporting the fishing industry, and how the individual fisherman chooses to answer these different conditions. Because sardine fishery is a mass catch type of fishery it has traditionally had to bear the handicap of low market prices. Because of this fact, the sardine fishery industry has always supported itself and continued to grow and develop by selling a majority of the catch for non-edible use while the minority has gone to edible use either as fresh or processed fish.

In addition, the sardine fishery industry has historically been the victim of fluctuations from good catch years to bad catch years. In the bad years the fishermen have (1) turned to catching a different type of fish, or increased the variety of species being caught; (2) increased the fishing grounds by moving

farther out to sea, or introduced new fishing methods; or else they have (3) reduced the scale of the fishing operation to meet the change in conditions.

In order to understand the choices that the fishermen have made to change their fishery in the past, it is necessary to look at the history of the development of products for the market. In other words, we need to look at the commodity value of the marine products involved.

Although all of these products fall under the one name "sardine", in Japan depending on the size and the species there is a big difference in the way the products are used, resulting in considerable differences in wholesale prices for the various categories. While sardines are caught at all stages of their life cycle, it is the fry that are sold at the highest price, with fingerlings and half-grown sardines to be used for processed food being the next in value.

In Japan "sardines" are used in three major ways; (1) as fresh fish for human consumption, (2) as the material for processed foods,

Table 3—Products made from sardine and anchovy in Japan

Growth stage	Market Name	Body length		Use/Processing categories												
		Sardine	Anchovy	Fresh	Simple dried	Salted and dried	Edible	Boiled and dried	Dried shirasu	Canned	*Tsukudani	Non-edible	Fish oil	Fish scrap	Fish meal	Culturing feed
Fry: Second half period	Shirasu	up to 3.5 cm after yolks consumed.	Same as sardine	●												
Fingerling	Hirago *(Kaeri)	3.5 cm ~ 6 cm	35mm ~ 5cm		●						○					
Half grown fish: First half period	Ko-ba	6cm ~ 12cm	5cm ~ 7cm		●						●	○	○	○	○	○
Half grown fish: second half period	Chu-ba	12 ~ 18cm	7cm ~ 9cm	○								○	○	○	○	○
Adult fish	Oh-ba	over 18cm	over 9cm	○								○	○	○	○	○

● Products of extremely high value ○ Products with value
 Note: The above body lengths are just standard ones. Body length divisions differ from one region to another or from one season to another.

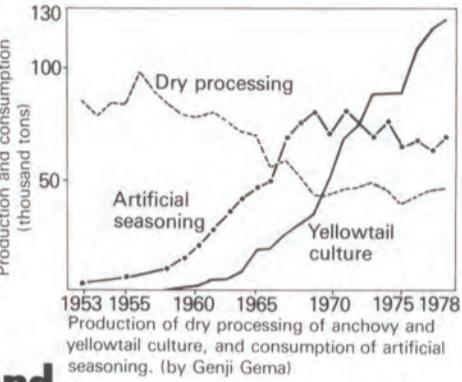
*Tsukudani: Boiled and soy-seasoned food
 *Kaeri: Anchovy fingerling's common name

and (3) for uses other than human consumption. Table 2 shows the products for which sardines are used at present. Of course, the type of sardine that the fisherman chooses to make his primary catch or supplementary catch depends on the resource conditions and the fishing grounds available to him, but also another factor that has an extremely important impact on his decision is what sales systems or processing facilities are available to him. The business decisions that the fisherman makes are motivated on the following three factors:

- (1) Response to demand
- (2) Adjusting production methods to minimize costs and maximize profits
- (3) Pursuit of highest overall income and lowest expense levels.

In the following pages you will look at some actual examples of these factors at work.

Facts About Operation



Meeting changes in demand

Supplying bulk feed for the culture farming of yellowtail Tsuda Area, Tokushima Pref.

DURING THE 1960'S in Japan there were two major changes in the demand for sardine family fishes.

- (1) With the development of yellowtail fish farming there was a sudden growth in the demand for sardine as feed.
- (2) The Japanese taste became more westernized resulting in a drop in demand for "Niboshi", small dried anchovy for human consumption. One example of this was the widespread switch from niboshi sardine as a traditional flavoring to the artificial flavoring monosodium glutamate.

- (3) Catch of sand lance fry (Apr.—May)... sold as material for making processed foods such as "Tsukadani".
- (3) Catch of anchovy fry (Oct.—Nov.)... this is the highest priced "sardine" for human consumption, the processing methods are the same as those mentioned in the article described later for the case of Wadajima. Because of the overwhelming catching power of the Wadajima area, however, the catch here is very small.

Traditionally, Japanese sardine fishermen had engaged in the sale of both fresh fish and processed niboshi, but with the decrease in demand for niboshi most switched to mass catching of mature sardine for sale as feed for fish farming enterprises. The Type A boat seine fishery of Tsuda area in Tokushima Pref., which we will introduce here, is a typical example of this change-over.

The fisheries here concentrate mainly on catching mature anchovy and sardine of fingerling to half-grown size. The usual daily catch is in the range of 12 to 13 tons, although in good seasons it will range to 50 or 60 tons. In areas where there is a fish farming operation the catch that will be sold as feed can be delivered to the fish farm directly as fresh fish. However, since there is no such operation in the area of Tsuda Town, the fishermen have equipped their homes with freezing facilities so that they can freeze the catch on freezing tray before shipping them to the nearest fish farm.

As can be seen in the below table, in order to secure a year-round fishery operation the fishermen of this area add the following three supplementary catches, all of which can be caught with the same Type A boat seine operation:

- (1) Catch of mature Japanese sand lance

Fig. 4—Map of fishing grounds for type A boat seining operations of Tsuda area, Tokushima Pref.

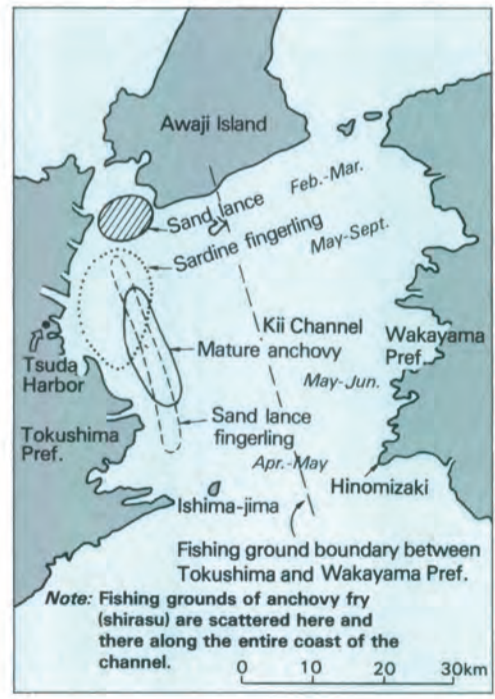


Table 4—Fishing calendar

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Mature sand lance		■	■									
Sand lance fingerling				■	■							
Mature anchovy					■	■	■	■	■			
Sardine fingerling and half-grown					■	■	■	■	■	■		
Anchovy fry (Shirasu)										■	■	

Fishing method

The bows of two fishing boats are tied together and the two share the load of the net as they head for the fishing ground. After reaching the fishing ground and locating a school of fish by means of a fish finder on the searching boat, the boats carrying the net position themselves up-current from the school. Then advancing with their bows still connected the two boats first lay out the bouys and then the bag net into the water. At this point the rope connecting the two bows is released and the two boats head off in opposite directions to the right and left at full speed, laying out the main net and the wing nets as they go. When all of the nets are in the water the two boats turn 90° and begin to run parallel to each other in the direction of the school laying out the tow rope until it goes to the right length that will bring the mouth of the net to the same water

depth as the school of fish. When the proper depth is reached the towing then begins. To begin the net hauling operation, first of all the two net boats come together and their bows are once again tied together, after which the net haulers that are positioned on each of the boats are used to reel in the tow rope and wing net onto the reels. To pull in the main net the crew stand on the stems of the boats and haul it in by hand. When the bag net reaches the surface a transport boat is called up to the stern of the net boats where it picks up the bouy and hauls in the bouy rope to pull up the tail of the bag net. The crew of the transport boat then untie the tail of the bag net and dip the catch out from there by means of a dip net and loaded into the hatch of the transport boat. The transport boat takes the catch from each net hauling one by one back to the port to unload.

Fig. 5—Overall view of net

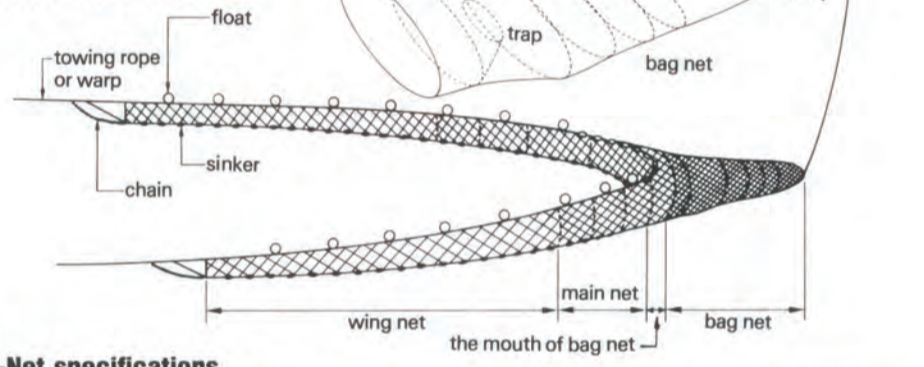
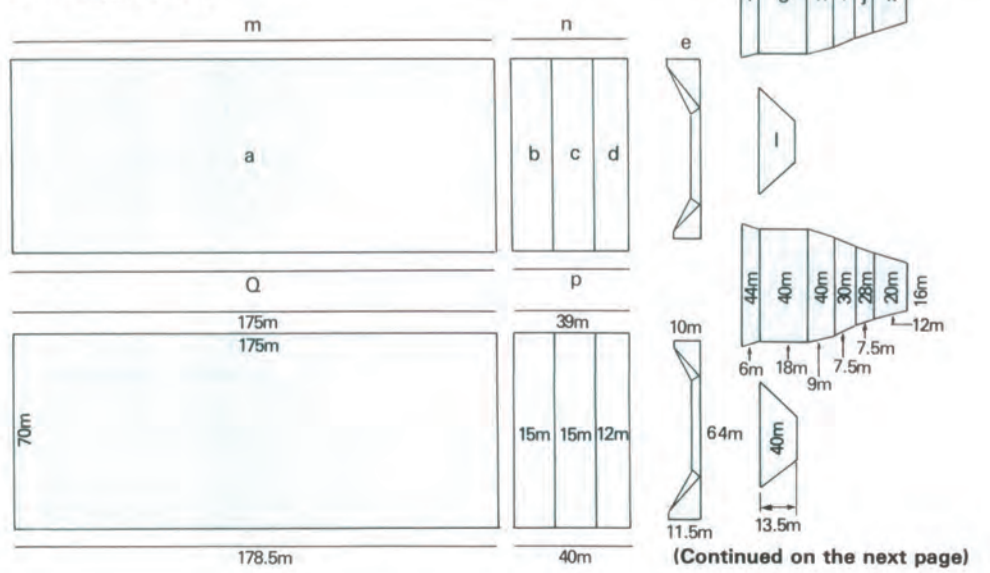


Table 5—Net specifications

Name of parts	Mark	Material	Thickness	Mesh size	Quantity
Wing net	a	Polyvinyl alcohol	11 mm	240 cm	2
Main net	b	Polyvinyl alcohol	8 mm	120 cm	2
	c		7 mm	60 cm	2
	d		6 mm	30 cm	2
Mouth of bag net	e	Polyvinyl alcohol	6 mm	24 cm	2
Bag net	f	Nylon	No.4 (0.329 mm) x 4 yarns	0.5 mm	2
	g			(Japanese minnow net-105 yarns)	2
	h				2
	i				2
	j				2
Trap (Inside of bag net)	k	Nylon	*	0.5 mm	2
	l				2
Sale rope	m	Polyvinyl alcohol	18 mm (diameter)	—	2
	n			2	
Head rope	o	Polyvinyl alcohol	18 mm (diameter)	—	2
	p			2	

Fig. 6—Design of net



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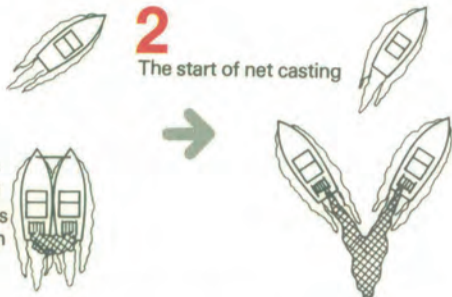
Boat Seine Type A

(Japanese name: Patchi-ami)

(Continued from the previous page)

Fig. 7

1
Searching boat notifies net boats of position of the fish. (In some cases fish finding is done from the net boats)



2
The start of net casting



5
Bringing in the catch (The transport boat makes use of a derrick)



4
Net hauling (running forward at low speed)



school should be chased by towing the net in a zigzag pattern. One towing should last about two hours. The towing speed should be a strong 2 knots. About four tows can be done in one day.

Note: Since mackerel and horse mackerel have a tendency to escape by swimming in a forward direction after entering the net, the fishermen of this region do not consider this type of net suitable for catching these types of fish.

Relationship between the fish's behavior patterns and the fishing method

- (1) The case of anchovy adults and sardine fingerlings:**
The netting of the fish school should be done as quickly as possible. During towing it is all right to shift in a lateral direction once, but you should not tow in a zigzag manner. Adult fish have a strong schooling instinct and they tend to swim along the wing net and gather in the bag net quickly. The towing time depends of course on the schooling conditions, but in general one towing should last from 10 to 20 minutes or at most 20 to 30 minutes. The towing speed should be about 1.5 knots. Between 7 and 8 tows can be done in one day.
- (2) The case of anchovy fry and sand lance:**
Because small fish tend to scatter, the

3
Towing (1.5—2 knots)
(However, speed varies according to fish behavior)



Minimizing production cost and maximizing profits with a family run fishing business

Anchovy "Niboshi" processing
Ibuki Town, Kannonji City

TABLE (6) shows the changes in the numbers of groups operating sardine family fisheries throughout Japan between 1955 and 1975. The changes that can be seen in these figures are a result of the following background causes:

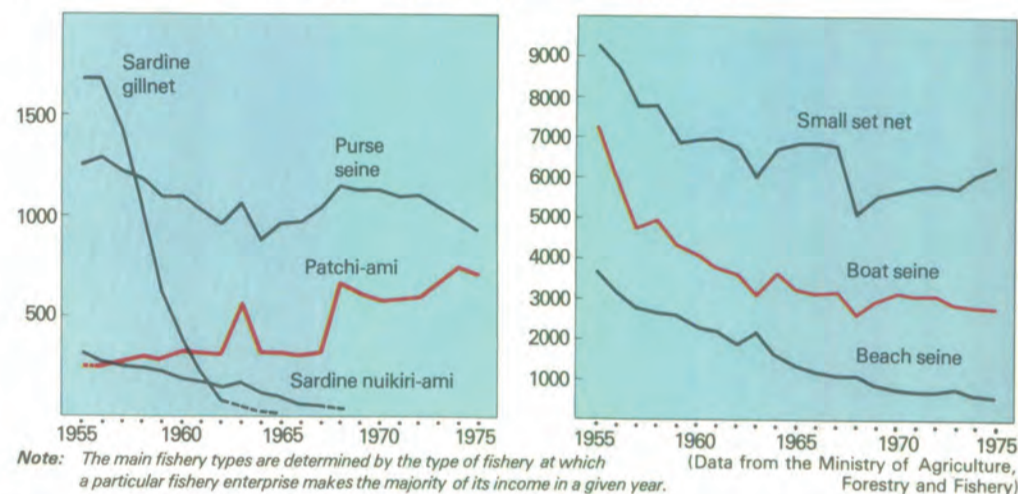
- The inefficient passive or waiting type fishing methods were replaced by active off-shore fishing methods.
- Large-scale net fishing methods requiring a large number of workers were improved by the introduction of labor saving operating methods.
- Instead of relying solely on sardine catches, fishermen increased their overall catch by including a number of other species of fish.

Another noteworthy change was the switch-over by many fishermen in the Western Japan shallow sea and inland sea areas from purse seine and beach seine methods to the Type A boat seine fishing method. Especially

in the Inland Sea (Seto Naikai) area, which relied mainly on the purse seine for catching sardine family fishes, the 1960's brought a decrease in the sardine resources and at the same time continued low market prices. These two factors along with a sharp rise in labor costs combined to force many fishing operations into extreme financial difficulties. With Japan's rapid industrial recovery and development along the Inland Sea area starting in the late 1950's, there was a rapid shift in the labor force from primary industries to secondary industries, making it impossible to maintain a cheap labor force for the fishing industry. The sardine fishing industry responded to these changes by shifting their operations from the traditional purse seine method which required 40 to 50 laborers per fishing unit to the Type A boat seine method which requires only 6 to 10 laborers per fishing unit.

As an example of these changes in fishing method let us take a close look at the case

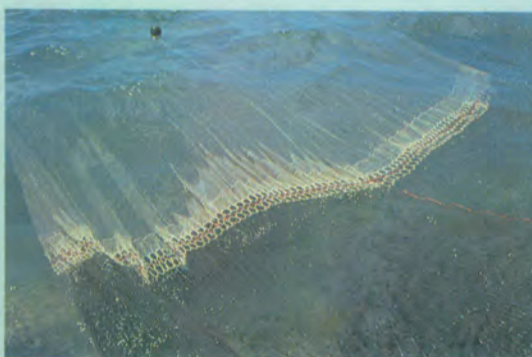
Table 6 — Number of fishery enterprises by main fishery type



Two net boats during towing



Bag net is being hauled in on the stern deck.



The connecting point of the bag net mouth and the bag net itself.



The transport boat pulls up next to the bag net.

Type A boat seine operation for mass-catch of feed-use anchovy Tsuda Town in Tokushima Pref.



The catch is put in the live fish hold of a transport boat.



Fish transport boat



The net hauler seen from the stern. The corrugated pipe seen over the bridge is a fish pump used for especially large catches.

Anchovy "Niboshi" processing Ibuki Town, Kannonji City



Washing with salt water



Boiling (in 5 - 6 percent salt solution)



Entering the drying room. The dryer features two modes: a cool blower (22-23°C for 17-18 hours) and a hot blower (40°C for 15-16 hours).



Sorting by size



Simple dried anchovy



Shirasu-boshi



The finished product

of Ibukijima, an isolated island in the central part of the Inland Sea. At present on the island of Ibuki there are 18 entrepreneurs involved in Type A boat seine fishery. Out of these 18 entrepreneurs, 15 are ones that have changed over from purse seine fishery. This is an area with abundant resources of anchovy fry and half-grown which make the highest quality "Niboshi" processed foods. This meant that it was possible for these fishermen to rely on the production of high priced niboshi sardine products for their livelihood.

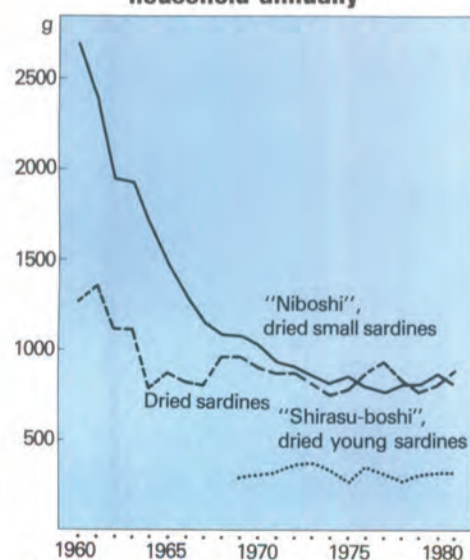
Concerning the problem of securing a sufficient labor force, since the boat seine fishing

method only requires 6 to 10 laborers per unit they were able to make up the major part of the labor necessary from their own family and relatives. For the labor involved in the processing part of the business they found that they could rely mainly on the wives of the fishing households working on a part-time basis. By reducing the scale of their operations they were able to achieve a stable income from the fishing and processing businesses, and by making every effort to introduce labor-saving methods they were able to reduce their expenses, and in doing so raise their income to a sufficient level to support the enterprise.

Table 7—Fishing Calendar

Fish	Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Mature anchovy													
Anchovy fry (Shirasu)													
Anchovy fingerling													
Immature anchovy													
Mature and immature anchovy													

Table 8—Quantities consumed per household annually



"Annual Report on the Family Income and Expenditure Survey" Statistics by Bureau of Prime Minister's Office

Above is a calendar showing the yearly fishing schedule. The months of June to Sept. represent the main fishing season with anchovy fry and half-grown fish being the most important catch. The condition of resources in Nov. and Dec. is considered unstable, while the period from Jan. to Apr. constitutes the off-season during which the fishermen work at other jobs outside the community.

In Ibukijima, in order to insure a fair price for their processed "Niboshi" products, the total production is sold cooperatively through the local Fishery Cooperative Association. As a result of this practice, in 1982 the cooperative was able to build a shipping facility on the mainland of Shikoku to greatly facilitate transportation of the products, which are auctioned off to middlemen directly at the facility.

In recent years niboshi sardines are being re-discovered by many people as a good source of natural protein. This fact is expected to lead to a rise in consumption.

Striving for marginal revenues and marginal cost

The specialized manufacture of high quality "Shirasu-boshi" a gourmet food

Wadajima Town, Komatsujima City

ONE OF THE ON-GOING problems in the fishery business is the problem of finding the proper combination of fishing method and type of fish to be caught, and then based on this the problem of determining the proper scale on which to operate the various aspects of production so as to create a business of the optimum size

to afford maximum profits. Wadajima Town in Komatsujima City is a fishing town involved primarily in Type A boat seine fishery, and is located about 10 kilometers south of the Town of Tsuda mentioned earlier. The fishermen of Wadajima, like the fishermen of Tsuda, use 13.5 ton class fishing boats, but whereas the Tsuda

Table 9—Fishing Calendar

Fish	Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Anchovy fry (Shirasu)													
Sardine fry (Shirasu)													
Sand lance fingerling													

boats are involved in catching mature sardine for use as feed, the boats of Wadajima catch primarily "Shirasu", making for quite a contrast between the two towns.

Among the various dried sardine products, the salted and dried anchovy fry (Shirasu) are considered to be a high-protein, gourmet food and thus given special treatment at the market place, commanding the highest price per kilogram of any fish of the generally low-priced sardine family. Although the catch of Shirasu does not exceed 20 or 30 percent of the total catch of mature fish, it is a sufficient amount to support these family fishing operations.

The catches are sometimes sold directly to local markets as fresh fish, but the majority are shipped as processed goods. Immediately after the catch is landed the fish are boiled and then set out to dry in the sun. However, when the weather prohibits sun drying the fish will be shipped after boiling with no drying stage. This type of product accounts for about ten to twenty percent of the total catch. The sun dried product is called "Shirasu-boshi" and the undried product is called "Shirasu kamaage".

Above is a table showing the yearly fishing

schedule. As one can see, one of the unique aspects of this fishery is that various fry and fingerlings can be caught almost all year long. December and January constitute the off-season, during which time they may go out fishing three or four times a month with the remainder being idle time.

The annual gross income per fishing unit for the shirasu fisheries in Wadajima averages about 10 million Yen less than that of the units in Tsuda catching mature fish (50—60 million Yen). However, because of the fact that total tonnages of their boats are smaller than those used in Tsuda and they are operated by only about half the crew required by the boats in Tsuda, the amount they are able to save on labor and fuel costs is about the same 10 million Yen.

(REFERENCES)

"Sardine resources and life pattern" by Keiichi Kondo (1978) (1971)
"Sardine fishery by purse seine in the Seto Inland Sea past and present" by Genji Gema and others (1981)

Table 10—Type A boat seine: Facts about operation

	Tsuda	Ibukijima	Wadajima
Number of fishery units	4	18	45
Fishing boats			
1. Net boats	13.5 ton × 2	8-9.9 ton × 2	13.5 ton × 2
2. Transport boats	9.9 ton × 1	5 ton × 3	7.0 ton × 1
3. Fish searching boats	5.0 ton × 1		none
Number of workers per fishery unit	on sea: 12-13 on land: 6-7	on sea: 12-13 on land: (including part-time) 12-13	on sea: 6
Product type	Frozen	Niboshi	Niboshi "Kamaage" (boiled)
Producer's selling price (price per kilogram)	•Mature & halfgrown anchovy for feed ¥19 •Anchovy for Niboshi processing..... ¥55 •Sardine fry for feed ¥90-100 •Sand lance for feed ¥90-100	Anchovy niboshi products .. ¥600-800	Dried-shirasu 1 ¥1200-1300 2 ¥2500-3000 Shirasu ("Kamaage") ¥500-600
Annual gross sales (including processed foods)	50-60 million yen	about 130 million yen	30-40 million yen
Operating expenses			
1. Labor wage	about 50 million yen 17-23 million yen	unknown about 40 million yen	about 30 million yen unknown
2. Fuel expenses	8-9 million yen	about 20 million yen	unknown
3. Depreciation amount	about 10 million yen	unknown	unknown

Boat Seine Type B

(Japanese name: Gochi-ami)



A GOCHI-AMI or Type B boat seine is a net with a high ratio of shrinkage in the center section of the net. When being pulled by the tide the center section of the net expands into a large bag shape. This type of net is towed along reefs or near the sea bottom to catch the demersal fishes living there. The unique quality of this fishing method is that it can be used to catch bottom fish in fishing grounds with rough or rocky bottoms where it would be impossible to use a trawl net.

Although this type of fishery falls into the category of boat seine, because of the fact that it is thrown in one particular spot to catch the fish there by intimidating them and then surrounding them, it can also be thought of as an intimidation type of fishing method. This is a method with a high selectivity of catch, and it includes a number of variations depending on the type of fish being caught.

Although the Type B boat seine is used throughout Japan, we will introduce here the fisheries of the Chikuzen sea area off Kyushu (Fukuoka, Saga, Nagasaki Prefectures), which has long been famous for this type of fishing and presently has a large

concentration of such fishing operations. In the main fishing areas the Type B seine operations can be divided into four basic variations.

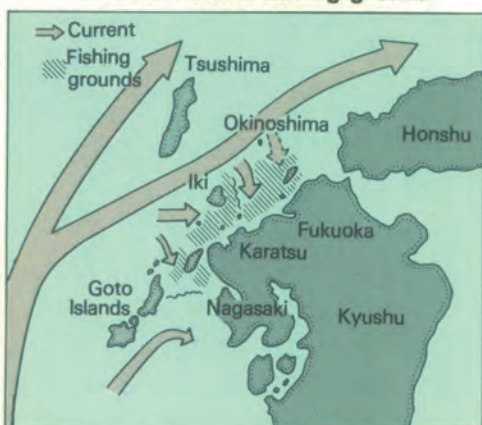
- (1) Hand hauled net operating from one boat (5 tons or less/18hp engine or less)
- (2) Roller-hauled net operating from one boat (5 tons or less/18hp engine or less)
- (3) Net operated from two boats (5—15 tons/18—35hp)
- (4) Net operated from two boats in off-shore waters (5—15 tons/35—70hp/with fishfinder)

Since this area is blessed with good fishing grounds for the most highly priced fish in Japan, red sea bream and chidai (*Evynnis japonica*) a large number of fishing operations have developed in this area using the Type B boat seine method, which is especially effective for catching members of the sea bream family. There are presently more than ten fishing villages involved primarily in this type of fishery, and all of them have developed sound, independent fishing enterprises by paying careful attention to the trends and changes in the sea bream resources, as well as the changes in the market conditions.

Fish resources and fishing grounds in the Chikuzen sea area

T HE CHIKUZEN SEA AREA is under the influence of major warm currents and their branches. The warm Tsushima Current which is a branch of the Kuroshio Current flows between Tsushima Island and Iki Island into the Japan Sea. In addition, around the Goto Island chain and Iki Island channel several branch currents are formed, which flow off to the right in a clockwise motion and turn into counter streams that directly influence these sea bream fishing grounds.

Fig. 8—Tsushima current and the type B boat seine fishing ground



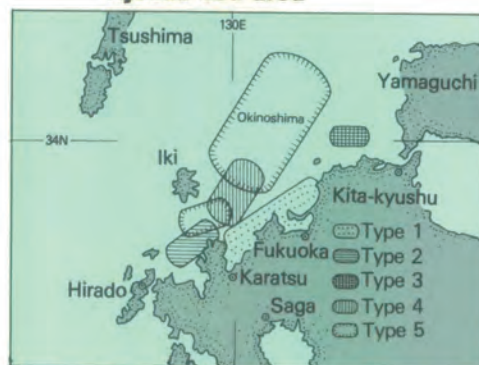
By The Fukuoka Fisheries Experiment Station

These currents meet with the coastal waters to form boundary tidal waters (coastal front) and areas of eddies and upwellings. This type of water condition helps to bring floating eggs into the coastal fishing grounds as well as providing a good growing environment for the fry and fingerlings after hatching. As a result, all kinds of fish propagate here in abundance, especially the red sea bream family for which this area has long been known as the most productive fishing

ground in Japan.

In addition to the red sea bream, other bottom fish that are caught in the Chikuzen sea area by type B seine include, "Chidai", threeline grunt, silver whiting, lizard fish, barracuda and porky. The fishing grounds in this area can be divided roughly into 5 types based on the type of fish. These five types are shown in the diagram below:

Fig. 9—Various B type boat seine fishing grounds in northwestern Kyushu sea area



By The Fukuoka Fisheries Experiment Station

- Type 1. Silver whiting is the main fish caught by Type B seine operating from one boat
- Type 2. Sea bream family is the main fish caught by Type B seine operating from one boat
- Type 3. Lizard fish family is the main fish caught by Type B seine operating from one boat
- Type 4. Threeline grunt family is the main fish caught by Type B seine operated by two boats
- Type 5. Red sea bream family is the main fish caught by Type B seine operated by two boats

Variations of Type B boat seine fishing gear and fishing methods

T YPE B SEINING can be performed from either one boat or two. Also, regarding the shape of net there are two basic types, one being a flat net (without bag net) which billows into a bag-like shape as it is pulled, and the other which actually has a cylindrical bag net attached to the central part of the main net. However, the basic

operation of both types of nets is the same. Here is a description of the operation.

The basic operation process for one boat and two boat Type B seining is shown in the separate diagram on page 8. The following is a table showing the size of nets used for catching the different types of fish in the different areas. We can see from this table that

Table 11—Comparison of net sizes

Area	Type	Main catch	Head rope length	Bag net height
Fukuoka, Nishiura	Two-boat operation	Red sea bream, etc.	45m	20.2m
Fukuoka, Fukuyoshi	Two-boat operation	Grunt and red sea bream	38.4-40.5m	30m
Saga, Tobo	Two-boat operation	Grunt and red sea bream	38.4-40.5m	45m
Saga, Tobo	One-boat operation	Sillaginoid and barracuda	27m	18m
Nagasaki, Aou	-	A) Red sea bream and grunt	22.5m	15m
		B) Red sea bream lizard fish and barracuda	22.5m	15m
		C) Lizard fish and barracuda	18m	6-6.5m

the nets used by two boat operations are roughly twice the size of those used in one boat operations.

In a study conducted between 1967 and 69 Fisheries Experiment Stations for the prefectures of Fukuoka, Saga and Nagasaki, in which a guage was attached to a model boat to measure the size and shape of the net during operation, it was found that among the various factors that were thought to determine the catch effectiveness of a net operation, namely (1) the sectional area of the mouth of the net (the width and height

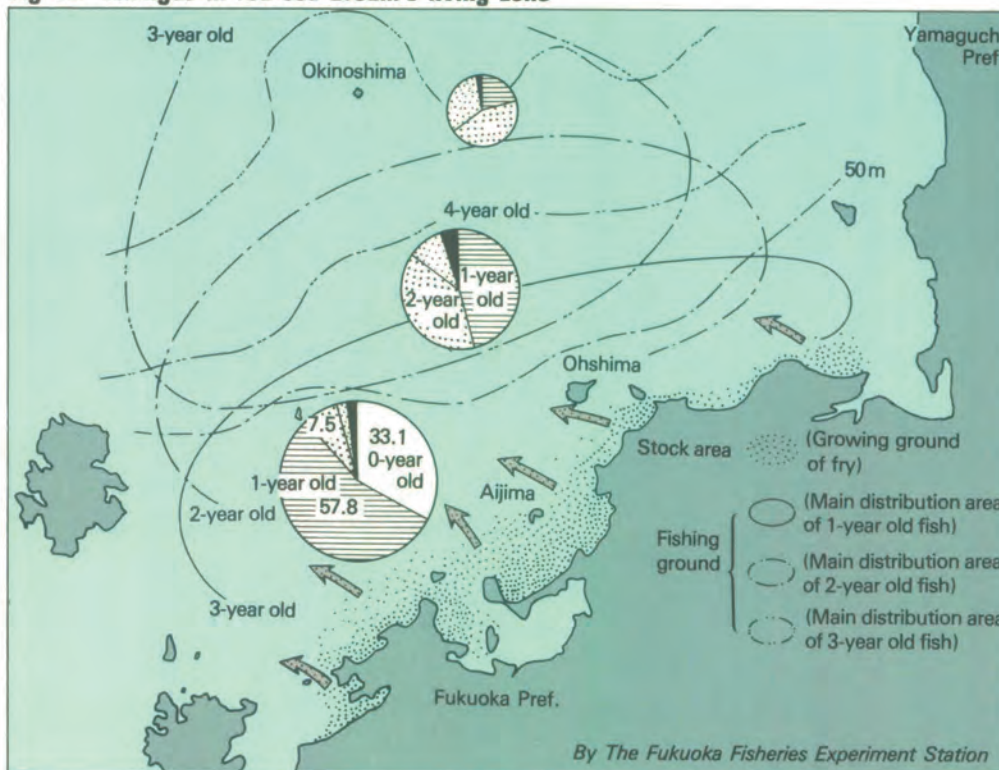
of the mouth of the net during towing), (2) the area over which the tow is made (the total area encompassed by the net during towing), (3) the backward speed of the boat during net hauling, (4) the speed at which the net is hauled in, and (5) sweeping distance (the distance that the net moves while it is being closed), the factors which correlated most directly to the number of fish caught by one towing (correlation coefficient 0.8) were the sectional area of the net mouth and the area over which the net was towed.

How the red sea bream's life cycle relates to fishing ground use

O VER THE YEARS the highly priced sea bream has been caught by a variety of methods. For example, they have been caught by angling and long line near natural reefs at 40 to 60 meters of depth, middle to large sized fish have been caught by bottom gill net, and in shallow waters small scale trawl nets and set nets have caught sea bream as just one of a number of assorted fish. One of the unique qualities of the Type B boat seine method used in the Chikuzen sea area, however, is that its catch, includes sea bream of all ages from yearlings to spawning adults (body length ranges from yearlings of about 7cm to six or seven year old fish of 60 to 70cm). Of this family, the red sea bream spawns in its off-shore spawning grounds mainly in the months of April and May. The eggs begin to hatch as they are being carried to the coastal waters by the warm currents. When the fry reach the shallow coastal waters they enter a period of life near the bottom, where

they grow along with the warming of the waters in May and June to fingerlings with a body length of about 5cm. During this stage of their life cycle they spread out their habitat into areas with a depth of 20 to 30 meters, until September when the water temperature begins to drop, at which time the fish begin to migrate to deeper waters where they will enter a hibernation stage. They remain in hibernation in deep water until March of the following year, after which they begin to migrate toward shore in April and May as one year old fish and enter the stock of fish catchable by the coastal fisheries. This cycle of migration from deep waters to shallow waters continues to repeat itself until the fish reach the age of three. At the age of four, however, they change to a larger migration pattern that includes a migration to the spawning grounds in off-shore waters. Figure (13) provides a rough sketch of the above mentioned life cycle and migration patterns.

Fig. 10—Changes in red sea bream's living zone



By The Fukuoka Fisheries Experiment Station

At present the various type B seine operations use different areas of this fishing ground according to the following patterns:

- (1) Hand-hauled net operated by one boat...coastal and bay waters with a depth of 20 meters or less
- (2) Roller-hauled net operated by one boat...coastal waters
- (3) Net operated by two boats...sea areas with a depth of 40 to 100 meters
- (4) Off-shore two-boat net operation...waters with a depth of 100 to 120 meters

Here we should make special note of the existence of fishing grounds that have been

created by means of an artificial reef. Traditionally the two-boat seine operations have fished extensively along the natural reefs at depths of 40 to 60 meters that are scattered around the Okinoshima Island area. In addition to these, recently the fishermen have succeeded in creating artificial reefs which attract fish on their feeding migration, thus creating new fishing grounds that increase production. These reefs are sea areas having a sandy bottom. The making of artificial reefs was first tried by fishermen in this area a little over sixty years ago, and now it is going on constantly.

Changes in the Type B boat seine operations

T YPE B BOAT SEINE operations for catching sea bream have developed into the four basic types mentioned above. As regards the size of fish within

the sea bream resources that are caught by the different types of operations, we can divide them into two groups as follows:

*one boat seining...small fish (0 to 1 year of



Courtesy: Japan Marine Co., Ltd.

age) make up most of the catch, with 2-3 years old as the next largest group. *two-boat seining...the main part of the catch is middle sized fish, with the rest of the catch made up of small fish and large fish (4 years or older)

However, the development of fisheries in recent years has brought some changes to the Type B seine operations. Let us summarize these changes here.

(1)Increasing development of off-shore operations--Since the late 1960's there has been an increasing move toward the exploitation of off-shore grounds running as deep as 100-120 meters. In particular, in 1979 higher horsepower engines were approved for fishing boats, causing an immediate growth in the number of two-boat off-shore operations. Although this change brought about a decrease in the number of small-sized fish being caught, it brought an increase in middle and large fish catches. At the same time the fishermen began to bring in large catches of mature "Chidai" in the autumn, thus helping to make up for the seasonal fluctuations in the red sea bream catches.

(2)Traditionally the one-boat hand-hauled Type B seine was a method developed or catching primarily silver whiting in the shallow sea areas. As a result, the few red sea bream fingerlings that were caught along with the silver whiting were sold at low prices as miscellaneous fish. However, star-

ting around 1965 we began to see the development of red sea bream fish farming enterprises and there was an immediate rise in demand for sea bream fingerlings for "seeding" fish farms. Fishermen began to sell the fingerlings to the fish farms in their live state. Then in around 1969 we began to see one-boat Type B seine operations specializing in catching red sea bream fingerlings. Based in the state of the resources, the prefectural authorities now license a certain number of groups to engage in this type of fishing for a specified number of days a year. (3)Increase in the number of multi-functional fishing operations--With the growth in intensity of fishing ground use the composition of the catch of the individual fishery operations is changing constantly. In the last ten years or so the catch of barracuda in some areas of the western part of the region has been decreasing, while in the same area the catches of lizard fish species have continued to increase. In the eastern areas of the fishing grounds the fishermen have made up for the decrease in sea bream catches by going after threeline grunt, causing the appearance of "sea bream+threeline grunt type" two-boat Type B seine operations. Generally speaking, in recent years there has been a continuing trend towards keeping sea bream as the main catch but to supplement it with an increasing variety of "side catches" of other fish.

Type B boat seine fishery management patterns and problems

NEXT, LET US take a look at the ways in which the fishing family's motivation for catching fish and their efforts to sell their catches are reflected in the success of their fishery business.

We have already seen how such things as moving out to exploit new off-shore fishing grounds, catching fingerlings, trying to catch a larger variety of fish etc. have been used to improve fishery conditions in light of changes in the region. However, we also must recognize the fact that fishing households operating with the same technology in the same area will often show quite a difference in degree of success in their business. For example, in Aou-ura in Nagasaki Prefecture there are close to 100 one-boat type B seine operators in business. When we look at the figures for their fishery incomes we find that they fall into three groups, an upper, middle, and lower income groups. The middle income group makes roughly twice as much as the lower group, while the high income group makes about 4.5 times the income of the lower group. What could be the reason for such a difference?

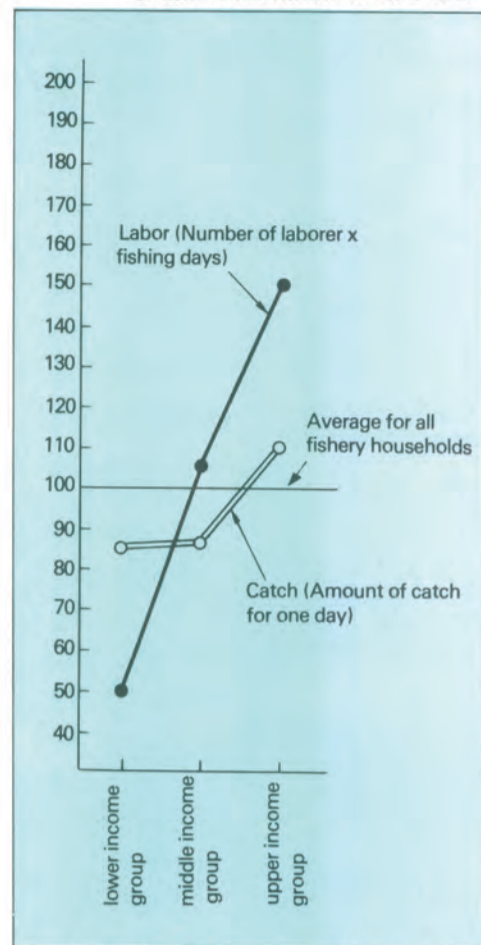
Of course, the difference between the individual fishery enterprises shows up in the amount of catch, but the goal of the fishery business is to increase income by selling the largest possible catch at the best possible price. These are the factors around which the fishing family builds its strategy of

business.

In contrast to the eastern part of the Chikuzen sea area which flows out directly into the Japan Sea, the western part, where the fishing town of Aou-ura is located, is a sea area enclosed by a number of islands. The fishing grounds here licensed by the prefecture consist of two or three areas of limited size. In spite of this fact there are a large number of fishermen operating here. As a result, Type B seine fishermen here in the Chikuzen sea area are operating at a higher concentration than anywhere else in Japan. In order to increase the size of their catches the fishermen of the western area cannot simply move farther and farther out into the Japan Sea, as the fishermen in the eastern part have done, or build artificial reefs off where to increase their fishing grounds. Therefore they have been forced to develop the grounds available to them to the fullest extent possible. The motivation of a fisherman to improve his catch shows up immediately in the number of days a year that he goes out fishing. The middle income families put in roughly twice the number of work days as the lower income families, while the higher income families will put in about three times as much. All of the higher income fishing families will go out fishing at least 170 days a year, far more than average for the Chikuzen sea area.

Next, let us take a look at the differences between the middle and high income

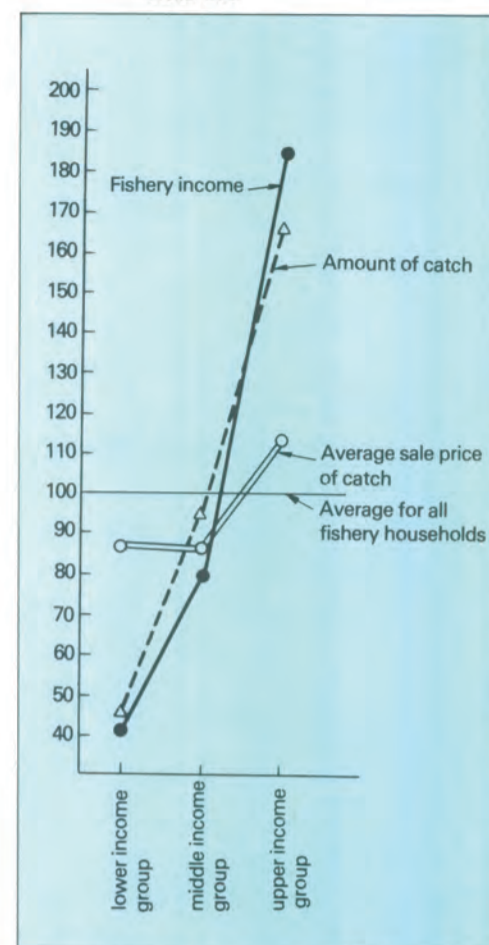
Table 12—Classification of labor input and per capita productivity for type B one-boat seine in Aou-ura



(note) These figures come from "The report on a survey of Type B boat seine operations in Northwest Kyushu" by the Fisheries Experiment Stations of Fukuoka, Saga and Nagasaki (1970)

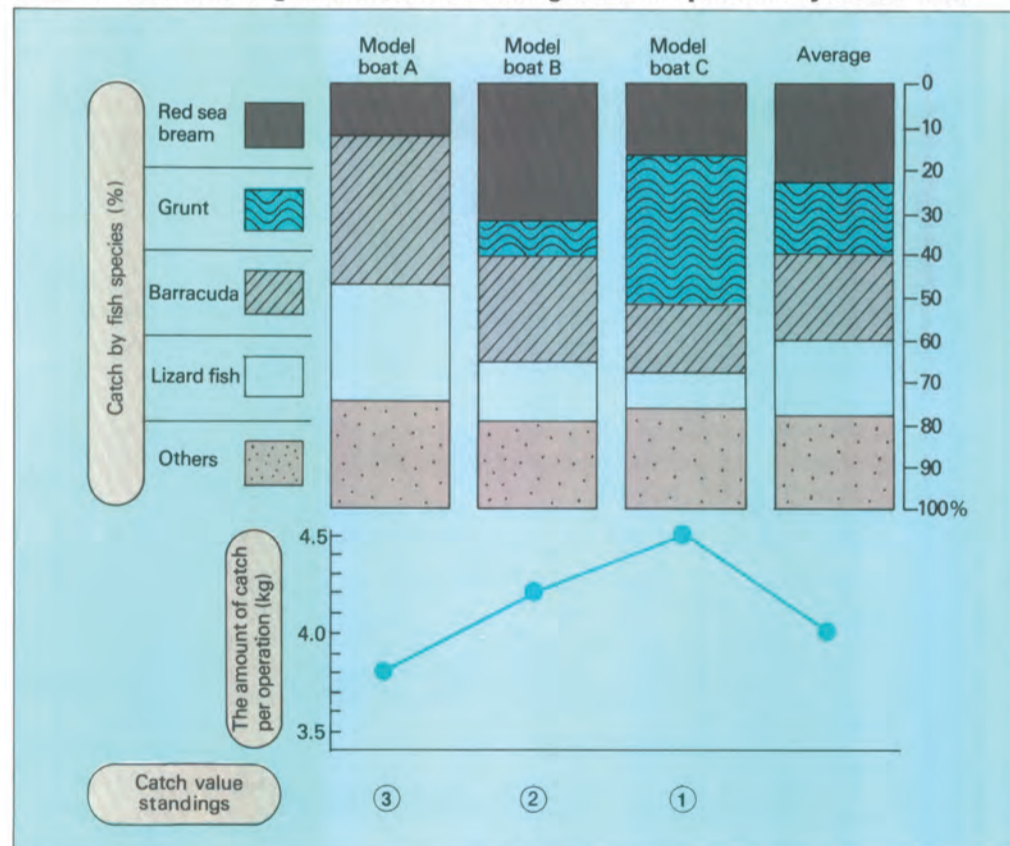
groups. The figures show that the higher income group puts in 1.4 times more work days than the middle income group. However, their catch amounts to a surprising 2.5 times that of the middle group, meaning that there is a remarkable difference in the work productivity between the two groups. A big factor behind this difference is fishing technology. The higher income fishermen are the ones who have put in years of study on fishing techniques, they have made improvements in their fishing gear that have allowed them to successfully throw nets on reefs that people had thought where impossible to fish, and in this way they have increased their catching ability to the very limit.

Table 13—Classification of productivity of type B one-boat seine in Aou-ura



In addition to increasing the overall size of their catch, the higher income fishing family also makes every effort to improve the value of their catch by trying to catch the high priced fish such as red sea bream as much as possible. In Aou-ura there are basically three types of selective catches that the fishermen try to catch, "sea bream+threeline grunt" (high class), "sea bream+barracuda+lizardfish" (middle class), and "barracuda+lizardfish" (low class). The average sale price per ton for catches by the higher income group is 113 compared to 86 for the middle group and 87 for the lower group. It is interesting to note that there is virtually no difference between the prices for the middle and lower groups.

Table 14—Aou-ura, Nagasaki Pref.: One-boat gochi-ami operation by model boat



Care in the treatment of the catch and skillful marketing are also important factors in value of fishery products. Valuable red sea bream, for instance, can be put in the fishing boat's live fish hold when they are caught and taken to port alive or as live as possible. Then at the port they can be packaged for shipping live, or immediately before packaging they can be processed by the "ike-shime" process and marked as "ike-shime red sea bream" to increase their market value. Another improvement in marketing here that occurred in 1973 was the purchase of a 36 ton transport boat by the local fishery cooperative. This enables the fishermen to ship their catches directly to the markets

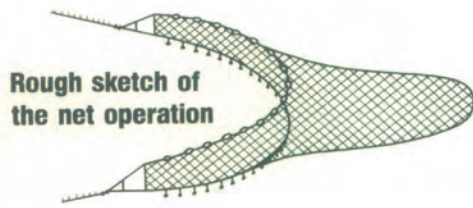
where they can get the best prices.

note
"Ike-shime": In this process fish are killed instantaneously by puncturing the spinal bulb, and then immediately packaged to prevent deterioration of the freshness of the product.

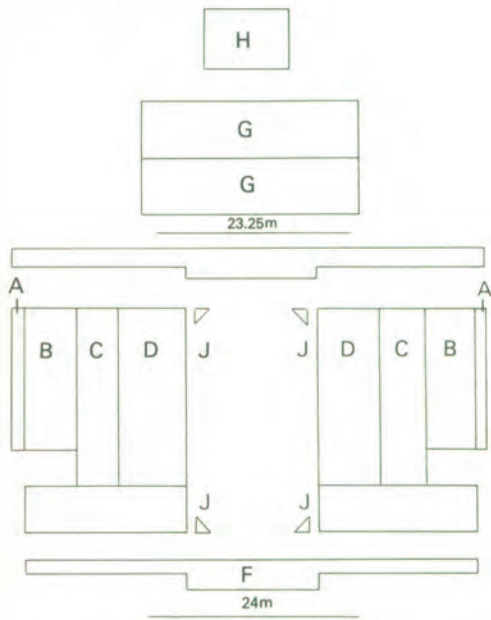
In these ways the fishing families have used their management abilities to the fullest in establishing their individual businesses in harmony with the environmental conditions, and by sharing and cooperating with each other in the use of the fishing resources of their area have succeeded in creating a prosperous and harmonious fishing community.

Boat Seine Type B

(Japanese name: Gochi-ami)

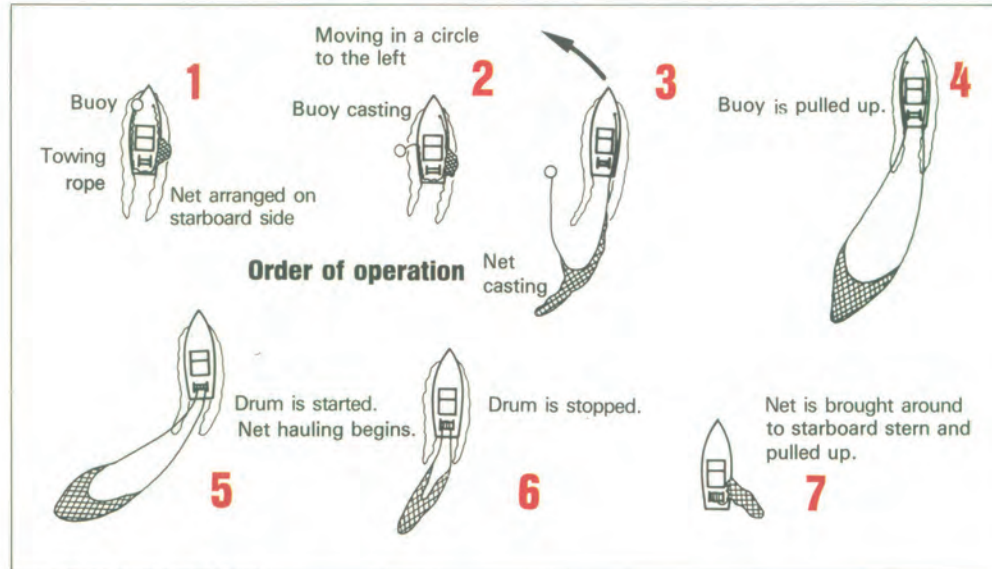


Layout of the nets



Illustrated gochi-ami operation

One-boat gochi-ami seining with bag net
Aou-ura, Nagasaki Prefecture



Specifications of nets

Mark	Name	Material	Standard		No. of meshes		No. of sheets
			No. of yarns	Mesh Size	width	length	
A	Wing net	Nylon	36	61mm	4	4.5	2
B	Wing net	Nylon	6	43mm	100	5.7	2
C	Wing net	Nylon	6	43mm	50	7.2	2
D	Wing net	Nylon	6	43mm	100	7.2	2
E	Upper salvage	Polyvinyl alcohol	30	43mm	5~10	600	1
F	Bottom salvage	Polyvinyl alcohol	40	50mm	5~10	600	1
G	The side of bag net	Nylon	6	43mm	100	800	2
H	The bottom of bag net	Polyvinyl alcohol	8	38mm	150	250	1
I	Shirk net	Nylon	12	43mm	50	7.2	2
J	Upper triangle	Polyvinyl alcohol	30	43mm	25	25	2
	Lower triangle	Polyvinyl alcohol	40	50mm	20	20	2

Fishing method

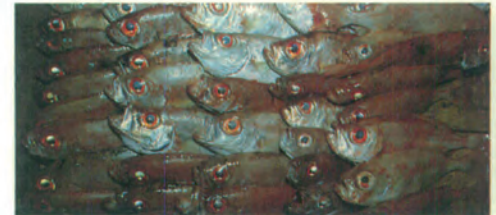
LEAVING PORT in the early morning hours, fishing is continued until just before sunset. First, the buoy is thrown into the water on the port side, after which the boat begins to move in a circle to the left. While circling the left tow rope, net, and right tow rope are laid out into the sea in that order. When the net is fully laid the boat then heads back in the direction of the buoy at full speed. (this takes about 2-3 minutes).

The buoy is pulled up and the end of the tow rope is attached to the drum. The boat then moves forward until the slack in the tow rope is taken up, at which point the drum is started and the net hauling begins. When the bridle section of the net reaches the surface the drum is stopped and the net is hauled in by hand while it is brought around to the starboard stern area of the boat where the bag net will be brought up by hand.

After the catch is brought in it is sorted on the stern deck and the quality fish such as red sea bream are put in the live fish hold and the rest of the catch is kept in ice storage in the main hold on the bow deck.



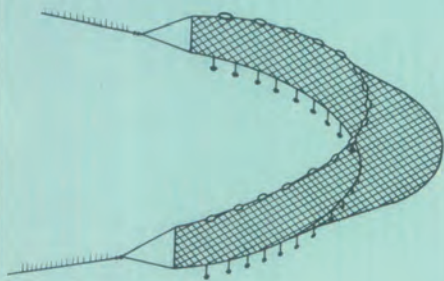
Red sea bream



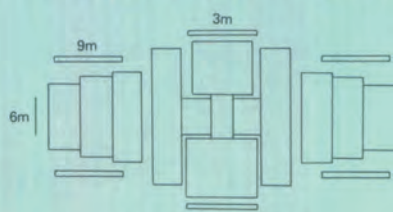
Half-grown Chidai bream

Fishing gear variations

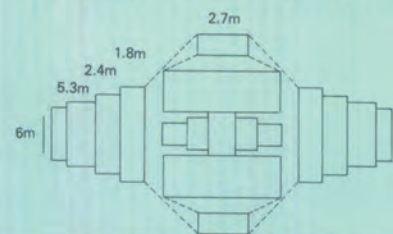
A. One-boat gochi-ami seining without bag net



1. Layout of nets used in Tobo, Saga Pref.

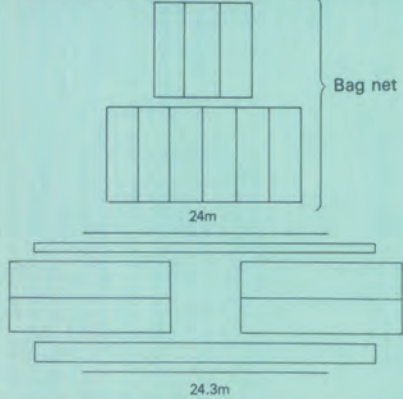


2. Layout of nets used in Kariya, Saga Pref.

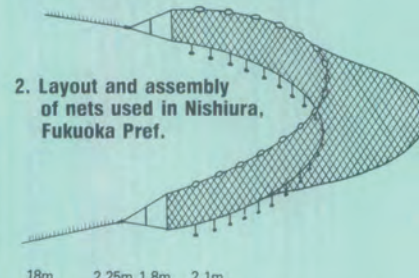


B. One-boat gochi-ami seining with bag net

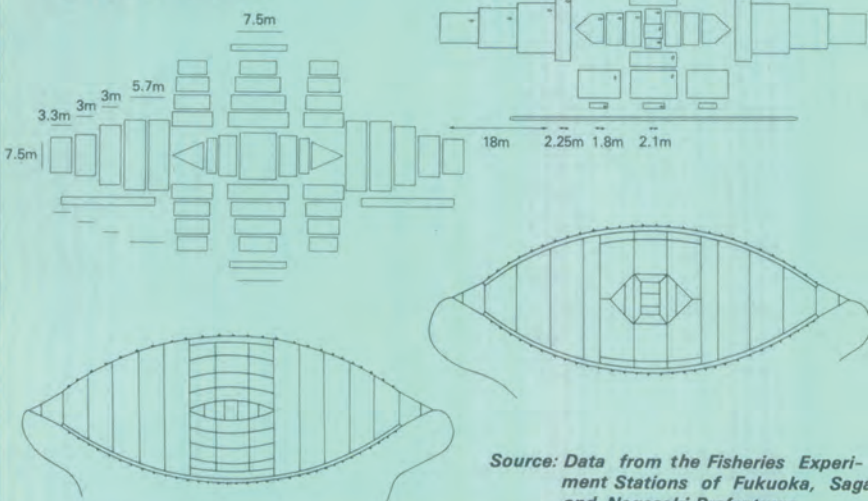
Layout of nets used in Tsuyoshi, Nagasaki Pref.



C. Two-boat gochi-ami seining without bag net



1. Layout and assembly of nets used in Fukuyoshi, Fukuoka Pref.



Source: Data from the Fisheries Experiment Stations of Fukuoka, Saga and Nagasaki Prefectures

One-boat gochi-ami seining with bag net (Aou-ura)



Throwing net



Upright type roller



Pulling up the bag net



Tow ropes neatly piled on bow deck



Pulling up the wing net by hand



Nets prepared on stern deck



Amount of catch from one towing