

A desired solid system of fish distribution, processing and cold storage

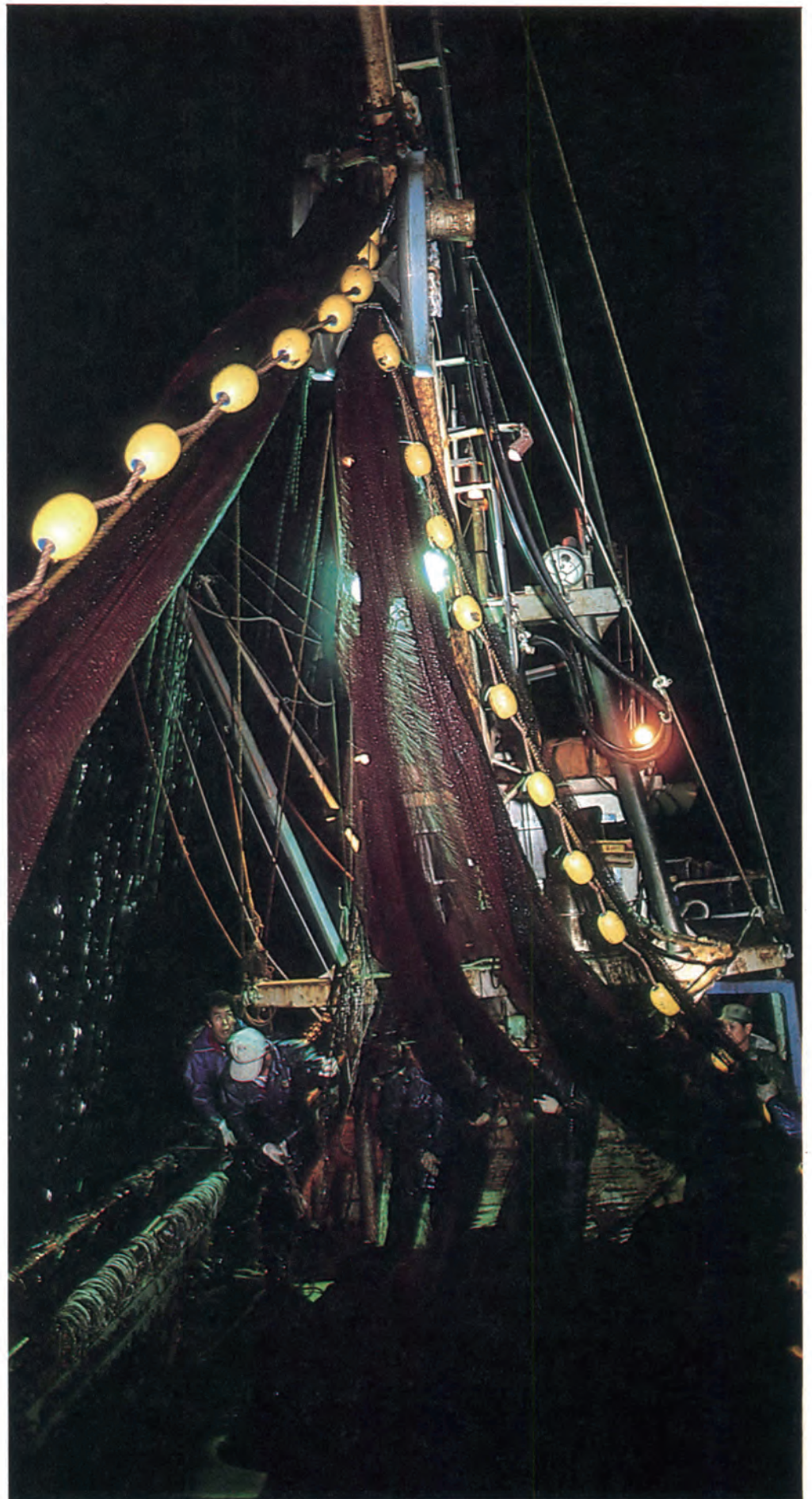
Middle/small-scale surrounding net fishery

RECENTLY IN JAPAN, the increase in catches by large-scale surrounding net fishery has made surrounding net the largest single fishing method in terms of size of total catch. With the onset of the "200-mile zones", trawlnet fisheries, formerly the largest single fishing method, were forced to phase out their operations in overseas fishing grounds, thus contributing to the relative increase in the size of the catch by surrounding net fishery operated mainly in Japanese waters. However, in addition to this, another big reason for the relative increase in the size of surrounding net catches was the introduction of electronic equipment

which enabled surrounding net fishermen to increase the catching efficiency of their operations, particularly for the increased fish resources such as sardine and anchovy in Japanese waters, to an amazing degree. Surrounding net fishery in Japan is divided into three classes, large-scale (boats of over 40 tons), middle-scale (boats of 5 to 40 tons), and small-scale (boats under 5 tons), for which the total catch by class for 1983 was as follows:

- Large-scale 3,581,643 tons (78%)
- Middle-scale 932,156 tons (20%)
- Small-scale 92,174 tons (2%)

Total 4,605,973 tons



Net hauling by the crew of a 19.9-ton class fishing boat.



Mackerel and horse mackerel are being caught in this 19.9-ton class purse seine operation.

(Note): Large-scale surrounding net fishing operations are licensed directly by the Ministry of Agriculture, Forestry and Fishery, while middle-scale operations are licensed by the prefectural governments based on limits set by the Ministry of Agriculture, Forestry and Fishery, and small-scale operations are licensed at the discrimination of the prefectural governments alone.

Three basic principle

Large-scale surrounding net fishery accounts for more than 70% of the total surrounding net catch, and is divided into three major types of operations including; (a) "Northern Surrounding Net Fisheries" catching members of the mackerel, sardine and anchovy families in the northern Pacific off-shore waters of Hokkaido and North-east Japan, (b) "West Japan Surrounding Net Fisheries" catching mainly mackerel, horse mackerel and sardine in the East China Sea, and (c) "Pelagic Surrounding Net Fisheries" catching skipjack and tuna species in the fishing grounds of the mid-west Pacific.

However, in this issue we will introduce middle and small-scale surrounding net operations in coastal waters, as exemplified by the fisheries of the Shizuura area of Numazu City, Shizuoka Prefecture. The operations we have chosen to report on make use of net boats in the 19.9 ton and 8~9 ton classes.

For the successful propagation of fisheries

in a given area the fishing operations must be created to fit the production system and economic conditions of that area. There are three basic principles that must be considered when such fishing operations are being created:

(1) The fishery must be operated within an organically integrated network of production, processing and distribution operations.

(2) A balance must be maintained between resources, production and demand, and in the case of a drastic change in any one of these three elements, the other two must be adjusted correspondingly.

(3) Cold storage and/or local processing facilities must exist in order to allow the fisheries to accommodate for fluctuations either in the size of the catch or the amount of demand.

Therefore, in order to establish fishery as a regional industry it is essential that the region offers a stable and mature social and economic base and that a high level of technological expertise also be available. In other words, for mass-catch fisheries such as surrounding net fishery, the most important requirement for a successful operation is the existence of well-established systems of raw fish transportation (distribution), processing and freezing, that will enable the fishermen to keep the price level of their catches stable in times of large catches.

A fishing community centered around surrounding net fishery

■ A traditional fishing village engaged in net fishery

Suruga Bay is a bay that extends 65 kilometers inland, and has a width of 55 km at the mouth of the bay (between Omaezaki Point and Irozaki Point). A branch of the Kuroshio Current enters the bay and creates a circular current pattern within the bay. As a result, we find here a variety of fish including coastal water fish, such as sardine, mackerel and horse mackerel, as well as migrating fish such as skipjack and tuna that ride the Kuroshio Current into the bay.

Since old times, all types of net fisheries, including beach seine, boat seine, anchor seine, set net and gill net have flourished in Suruga Bay. In shoal areas angling and long-line fishing have also been carried on. In addition to this, there is a large sunken reef right in the middle of the mouth of the bay that is a feeding ground for all types of fish fry and a gathering point for migrating

Fig. 1 Suruga Bay and Kuroshio distributaries



fish, making this bay one of the best fishing grounds in Japan.

The Shizuura Fisheries Cooperative draws its members from six scattered villages built on areas of coastal flatland along the eastern end of the bay. There are about 500 regular members in the Cooperative who land a combined total of between 1.5 and 2 billion Yen worth of fish a year. Surrounding net fishery is the Cooperative's mainstay, with sardine and mackerel family accounting for over 90% of the annual catch.

This area is a rias-type coast with mountains coming down close to the coast. With a lack of good farm land, the people of this area have long depended primarily on fisheries for their livelihood.

According to local historical records, in the 27th year of the Meiji Era (1894) there were 27 large-scale beach seine fishing units catching skipjack and tuna, and 50 beach seine fishing units catching sardine family fishes, in the Shizuura area. Census figures show that in 1889 the population of Shizuura was 4,711 people (674 households), but by 1914 this number had grown to 7,182 people (979 households). Because of the fact that beach seine, which was conducted as a cooperative fishery by the community members, is a waiting-type fishery, at times the tuna migrations would decrease, and when this coincided with poor seasons in the sardine catch the fishermen were forced to develop off-shore fishing operations. Around 1900 the large-scale beach seine operations catching tuna were replaced by surrounding net with purse line, and the beach seine operations catching sardine were gradually replaced by the purse seine which was first introduced in 1910. Although the purse seine was recognized immediately as a very efficient fishing method, due to conflicts with beach seine and set net fishermen, the purse seine at first was restricted to be operated only in the winter season. It wasn't until 1940 that the year-round operation of purse seine was permitted, marking the beginning of a golden age of purse seine fishery that con-

tinues until today.

■ A general description of the Shizuura Fisheries Cooperative

The official accounting report for 1982 gives us the following facts about the Cooperative's present compositions.



Shizuura Fisheries Cooperative

• Cooperative members

Regular members	504
Associate members	678
Total	1,182

• Fishery operation units (Licensed number of units)

(1) medium-scale surrounding net	3 fleets
(2) small-scale surrounding net	14 fleets
(3) boat seine	95 fleets
(4) small-scale trawl net	34 boats
(5) stick-held dip net	2 boats
(6) mackerel dip net	2 boats
(7) pole-and-line angling for skipjack and tuna in adjacent seas	1 boat

• Fishing boats

0 to 5 tons	276 boats
5 to 10 tons	26 boats
10 to 20 tons	38 boats
20 and over	6 boats
Total	346 boats

• Annual production

Year	Catch (tons)	Gross sales (million ¥)
1980	33,000	1,908
1981	26,000	1,492
1982	29,000	1,528

• Catch by species

Species	Catch (tons)	Gross sales (million ¥)	Average price per kilo (¥)
mackerel	6,000	535	89
sardine	21,800	593	27
others*	880	400	454
Total	28,680	1,528	—

* (Note): Others includes frigate mackerel 294 tons, anchovy fry 246 tons, saury fish 162 tons, horse mackerel 63 tons.

• Cooperative business activities

- Sales activities
gross sales of catches.....1,528 (million ¥)
- Purchasing activities
 - fuel and lubricating oil 222 (")
 - other fishing materials ... negligible
 - Total 222 (")
- Ice manufacturing and cold storage
 - ice 38 (million ¥ in 1982)
 - cold storage fees 54 (")
 - frozen commodities 31 (")
- Credit activities
 - monies on deposit in 1982 1,645 (")
 - monies on loan in 1982 1,735 (")

• Facilities

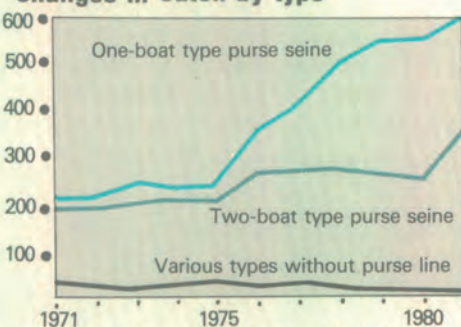
- Cooperative offices: 2-story ferro-concrete bldg. 1,008 m²
- Landing/selling facility: 1-story ferro-concrete bldg. 1,230 m²
- Fishing gear storehouse: steel-frame slate 639 m²
- Stockhouse for selling materials: pre-fab 28 m²
- Refrigerator: ferro-concrete slate 1,194 m², 1500 ton capacity.
- Ice hold: ferro-concrete 587 m², 200 ton capacity.
- Ice machine: 30 tons/day
- Quick-freezing equipment: 40 tons/day
- Truck scale: 1 unit, max. capacity 40 tons
- Vehicles
 - regular passenger sedan 2
 - truck 1
 - subcompact car 1
 - fork lift 5

An outline of surrounding net fishery

Surrounding net is a type of net fishery method that utilizes one of two basic types of nets, a purse net with a purse line or one without, and the operating method can involve either one boat or two. Although a variety of fish are caught by this method, including sardine family, horse mackerel and mackerel family, skipjack family, tuna family, yellowtail, dorado, Atka mackerel, etc., it is the sardine, horse mackerel and mackerel that make up over 90% of the catch. While there is little difference between the types of fish caught by the different types of purse seine operations, those using 1 boat or 2 boats and those using a purse line or not using one, fishermen in the different regions still must choose the type of fish they will catch according to the season. At present the overwhelming number of operations use a purse line, while those not using one can only be found today in a few distinct regions of Japan.

Traditionally speaking, 1-boat purse seine developed primarily in Western Japan, and 2-boat purse seine developed primarily in Central Japan. Recently, however, due to a number of reasons which we will discuss later, there is a nationwide trend of change-

Table 4 Middle and small-scale surrounding net fisheries: changes in catch by type

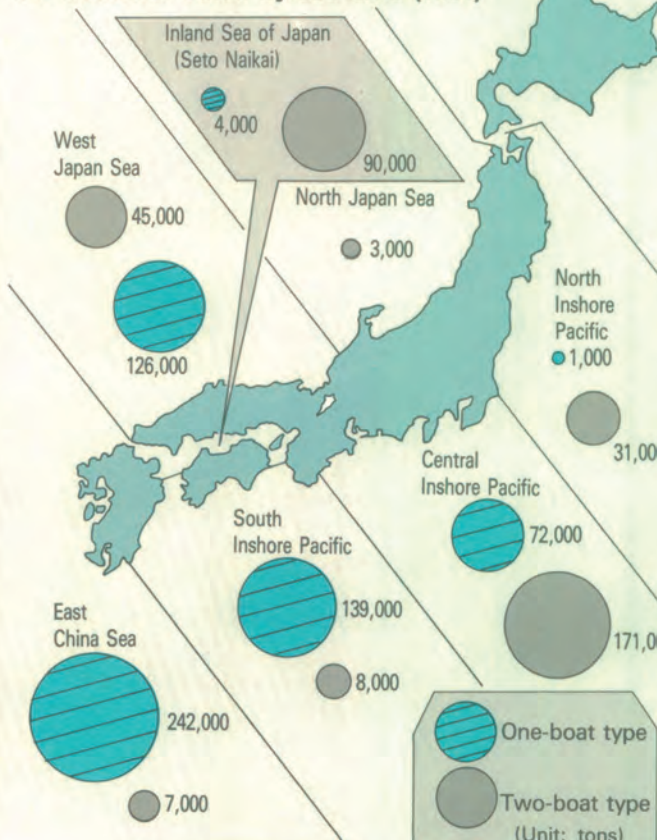


(Production statistics by the Ministry of Agriculture, Forestry and Fishery)

over from 2-boat to 1-boat operations. The increase in catch by 1-boat operations since 1975, that can be seen in Fig. 3, is a direct result of an increase in the sardine resources on the one hand, and on the other hand it also reflects an increase in the number of 1-boat operations.

With regards to the middle and small-scale surrounding net fisheries, the boats used in both 1-boat and 2-boat operations are mainly of the 10 to 20 ton classes. To accommodate licensing standards, boats of the 14.9 and 19.9 ton classes are the most popular in Japan.

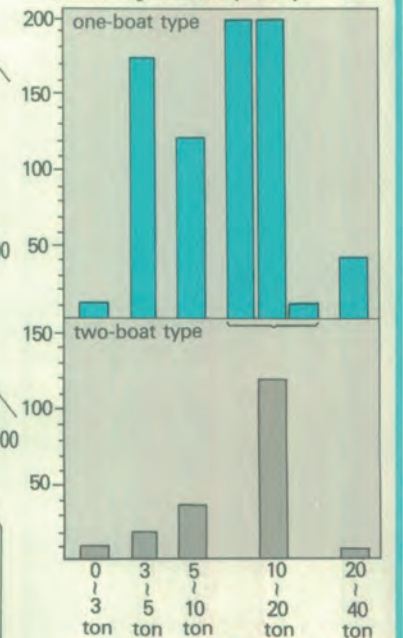
Fig. 3 Middle and small-scale surrounding net fisheries: catch by sea area (1981)



(Production statistics by the Ministry of Agriculture, Forestry and Fishery)

Hokkaido
● 10,000

Table 5 Middle and small-scale surrounding net fisheries: number of fishing units by class (1981)



(Statistics by the Ministry of Agriculture, Forestry and Fishery)



■ Neighboring fish markets and fish processing industries supporting the surrounding net fisheries

Prior to the recent renovation of Shizuura's fish landing and refrigeration facilities, fishermen of the Shizuura Fisheries Cooperative landed their catches mainly at the neighboring port of Numazu. In 1981 a total of 36,700 tons of marine produce were landed at Numazu port, at a total value of 29 billion Yen. In addition to this, another 25,000 tons of fresh fish and processed fish products were brought into Numazu from nearby ports and fish markets. Numazu is also the home of

some 265 companies producing a variety of processed marine products, the total production of which was 50,000 tons in 1981. This figure represents a full 20% of the total national production of processed sea foods, 242,000 tons.

As these data clearly show, the Numazu port with its fish market is not simply another fishing port in a producing area, it is in fact one of the most important gathering points for marine products in the entire country. The two biggest factors that have made Numazu the important center of the fishing industry that it is today are its solid distribution system and its local processing industry.

One-boat purse seine for sardine and mackerel by the Shizuura Fisheries Cooperative

In Shizuoka Prefecture there are 31 purse seine fishing fleets now in operation, and of these 17 belong to the Shizuura Fisheries Cooperative. In 1981 the purse seine fishery boats of Shizuura Cooperative landed a total 17,000 tons of fish, which is roughly half of the total catch within the prefecture, 35,000 tons. This figure also represents 83% of the combined catch of all the regular members of the Shizuura cooperative, 21,000 tons.

All 17 fleets of Shizuura are engaged in the 1-boat fishing method. Here is a breakdown of the net boat sizes:

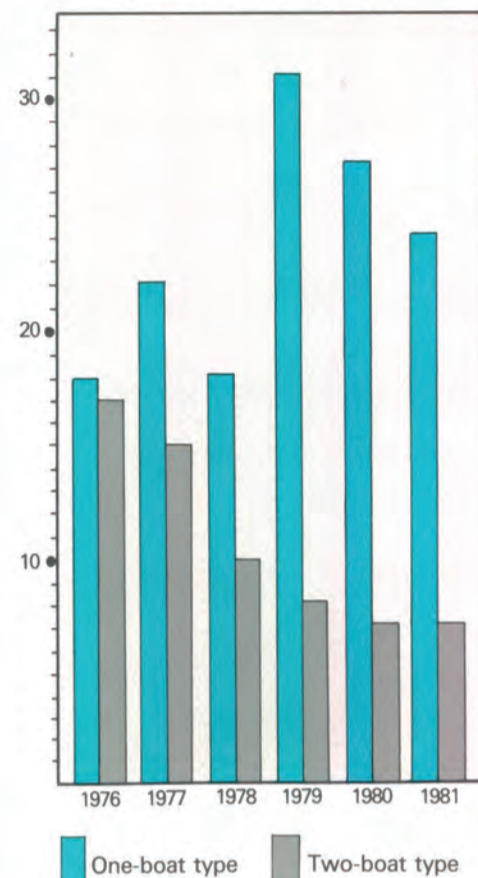
middle-size • 39.9 ton 3 boats
 " • 19.9 ton 4 boats
 " • 14.9 ton 1 boat
 " • 8-9 ton 3 boats

small-size • 4.9 ton 6 boats

(Note): Although 39.9 ton boats are officially recognized as middle-size boats, in fact, with regards to functional capacity they are the same as most large-size boats when used for surrounding net fishery.

Although originally both 1-boat and 2-boat purse seine operations were carried on together in Suruga Bay, as Table 1 shows, the 1-boat fishing method began to replace the 2-boat method in the latter half of the 1970's. The reason for this changeover lies in the following technological innovations that were tested and incorporated into the fishing operation one after another.

Table 1 Number of purse seine fishing units in Shizuoka Pref.



(Statistics by Shizuoka Agriculture and Forestry Statistic Information Office)

As shown in table 2, the 1960's saw the changeover from non-powered boats to powered ones in purse seine operations, and then in the 70's we see the changeover from the 2-boat to the 1-boat fishing method. In the meantime, net hauling became mechanized, synthetic net materials came into use, and electronic equipment of various types became a part of the fisherman's gear. As a result, first of all, catching capability improved, and secondly, labor needs were greatly reduced. The main goal of these innovations was to cut down on labor costs and thereby increase profits. For example, a 2-boat operation using 39.9 ton boats require a work crew of 25-26 men. With the new innovations this number was soon reduced to 17-18 men. This reduction was made possible primarily through the introduction of power blocks and side rollers.

Table 2 Thechnical renovations adopted in Shizuura purse seine fishing boats

~ 1960	Non-powered boats
↓	
1961 ~ 1965	Switched to powered two-boat operation
• 1961	Fishfinder adopted
• 1960 ~ 1963	Net hauler adopted
• 1961 ~ 1962	Switched from cotton net to synthetic fiber net
• 1967 ~ 1968	Nylon net adopted
↓	
1975 ~ 1980	Switched to powered one-boat operation
• 1970	Power block adopted
• 1975	Radar adopted
• 1976	Sonar adopted
• 1977	Loran adopted
↓	
Present	

Table 3 Facts about operations by Shizuura purse seine fishing boats

Purse-seiner size	Fleet	No. of crew incl. owner	No. of fishing days per year	Break-even point in catch value (estimation)
39.9-ton class	Purse-seiner	35	130 to 150	¥350 mil.
	Transport boat			
	Lamp boat			
	Skiff			
19.9-ton class	Same as above	14	Same as above	¥150 mil.
9.9-ton class	Purse-seiner	10 to 12	120 to 130	¥70 to 80 mil.
	Transport boat			
	Lamp boat			
4.9-ton class	Purse-seiner	5 to 6	Same as above	¥50 mil.
	Lamp boat			
	(used as transport boats, too)			

Yamaha Fishery Journal

There is another factor, besides the desire to reduce labor, that contributed to the change in fishing methods. That was the fact that small-sized fishing boats of the 5 to 9 ton classes were able to change over to fishing in off-shore waters when it became necessary due to changes in the migration patterns of fishes coming into the bay. Originally, small-sized boats were used for catching primarily horse mackerel in the central waters of the bay. Beginning around 1965, however, the horse mackerel schools stopped coming into the bay in sufficient numbers, forcing the fishermen to change over to catching primarily anchovy and mackerel. Then in the beginning of the 70's there was another change which saw spotted mackerel and sardine become the fishermen's main source of income, and along with this change the fishing grounds moved farther off-shore. The fishermen were gradually drawn closer to the "Se-no-umi", the largest fishing ground in the area for sardine and mackerel family fishes.

Fig. 2 Purse seine fishing villages in Shizuoka Pref.

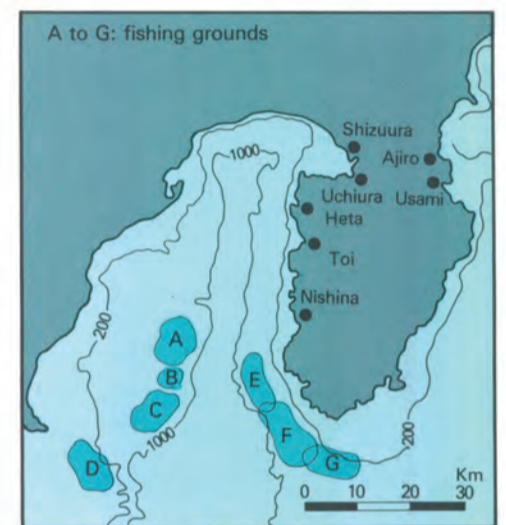


Fig. 2 shows the sardine and mackerel fishing grounds that are presently in use by the purse seine fishermen of Suruga Bay. Of the fishing grounds shown here, larger fishing boats of the 14.9 and 19.9 ton classes use all seven of the fishing grounds, while smaller boats of the 5 to 9 ton classes are unable to reach the two outermost grounds, D and G. The highly productive "Se-no-umi" grounds, represented by A, B and C on the map, are fished extensively not only by the Shizuura fishermen but by fishermen from all the fishing villages in Suruga Bay. The following table shows how the different sized fishing boats function: (Table 3)

Although the different managing bodies use different standards and methods, within the Shizuura Fisheries Cooperative the general rule for distribution of income is to first subtract between 20 and 25% from the gross sales for direct expenses (fuel/oil, ice and other provisions) and then to divide the remaining income 50/50 between the boat owner and the crew. The crew then proceeds to divide their share among themselves based on proportions determined by the individual's job and his work experience. From the boat owner's share he must in turn pay taxes and depreciation on the fishing boat and equipment.

One-boat (19.9-ton class) type purse-seine fishing method

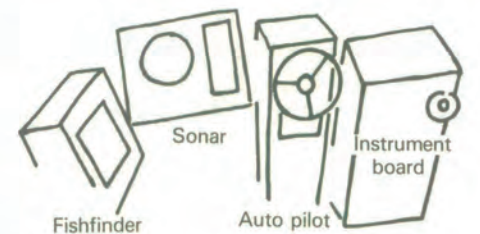
FISHING BOAT

A fishing fleet

	Tonnage	Main engine	No. of crew	Remarks
Purse-seiner	19.0	Max. 550 hp	8	
Transport boat	18.0	Max. 350 hp	1	Equipped with a fishfinder
Transport boat	9.9	Max. 300 hp	1	
Lamp boat	14.9	Max. 380 hp	1	
Lamp boat	14.9	Max. 300 hp	1	
Skiff	2.0	Max. 40 hp	1	

Purse-seiner's main specifications and equipment

Hull	F.R.P.
Gross tonnage	19.9 tons
LOA	16.5 m
Beam	4.08 m
Draft	1.32 m
Main engine	Max. 550hp (Rated 150hp)
Fishing gear	1. Net hauler Max. capacity: 6 tons Hydraulic pressure: 150kg/cm ²
	2. Power block 1
	3. Side roller 3
	4. Purse wire winch 1
	5. Capstan 1
	6. Purse wire reel 1
	7. Auxiliary capstan 2



Transport boat with a fishfinder

- Fish locating instruments
1. Radar
 2. Fishfinder
 3. Color-display fishfinder
 4. Sonar



Lamp boat

Fish-luring lamp:

1. On both sides of bridge—2KW × 4
 2. Underwater lamp—2KW × 1
Total 10KW
- The max. number of boats is 2. The intensity of light can not exceed 10KW per boat.
 - The underwater fish-luring lamp is put under water at a depth of 4 to 5 meters. The source of light must be placed lower than the keel.



FISHING GEAR

Fig. 4 Purse-seine fishing gear

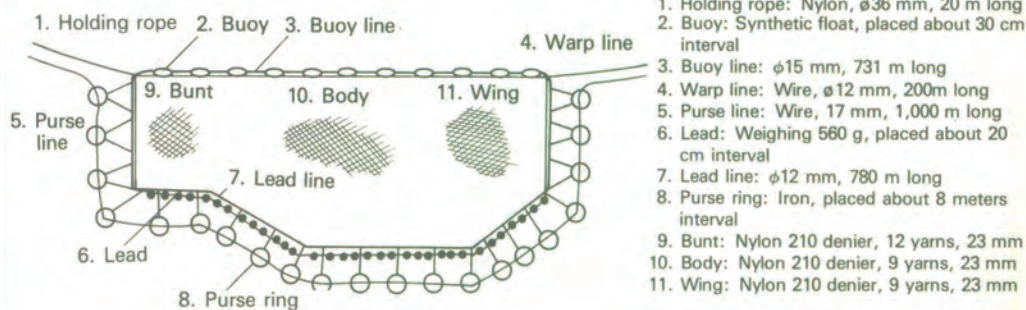


Fig. 5 Layout of purse seine fishing gear

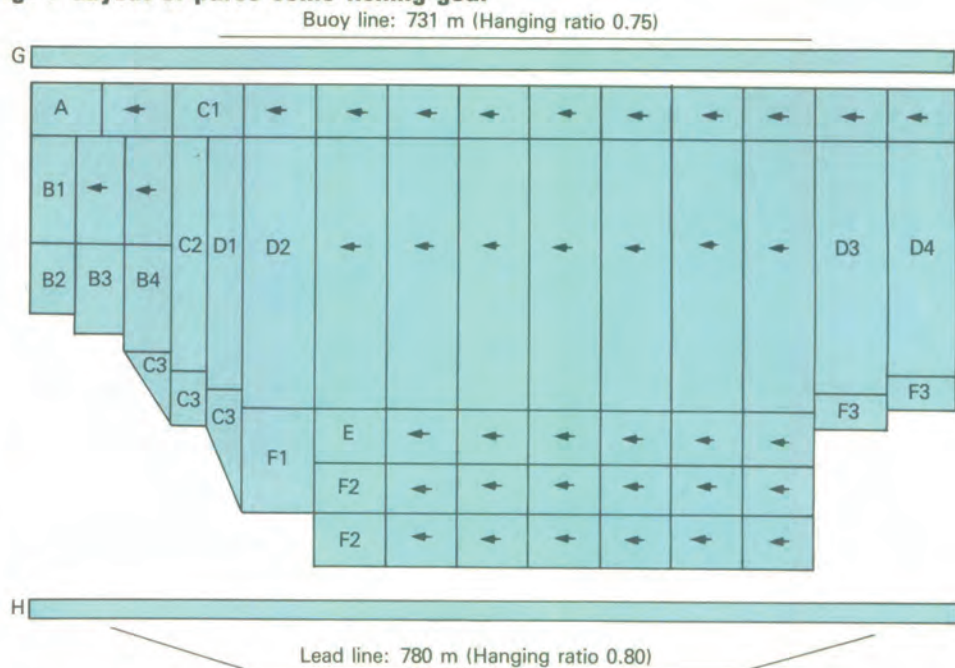


Table 6 Specifications: Purse-seine fishing gear

Name	Sign	Material	No. of yarns	Mesh size	Depth	Length
Bunt	A	Nylon	210D. 18y.	23 mm	200	75 m
	B1	Nylon	210D. 12y.	23 mm	2,800	75 m
	B2	Nylon	210D. 12y.	23 mm	2,000	75 m
	B3	Nylon	210D. 12y.	23 mm	2,400	75 m
Body	B4	Nylon	210D. 12y.	23 mm	2,800	75 m
	C1	Nylon	210D. 12y.	23 mm	200	75 m
	C2	Nylon	210D. 12y.	23 mm	6,000	75 m
	C3	Nylon	210D. 12y.	23 mm	400~900	75 m
	D1	Nylon	210D. 9y.	23 mm	6,400	75 m
	D2	Nylon	210D. 9y.	23 mm	6,800	75 m
	E	Nylon	210D. 9y.	28 mm	400	75 m
Wing	F1	Nylon	210D. 36y.	60 mm	200	75 m
	F2	Nylon	210D. 36y.	60 mm	100	75 m
	C1	Nylon	210D. 12y.	23 mm	200	75 m
	D3	Nylon	210D. 9y.	23 mm	6,400	75 m
Selvedge	D4	Nylon	210D. 9y.	23 mm	6,000	75 m
	F3	Nylon	210D. 36y.	60 mm	400	75 m
	G	Nylon	210D. 60y.	34 mm	20	975 m
	H	Nylon	210D. 60y.	34 mm	20	975 m

(No. of meshes)

OPERATION

Facts about operation

- No. of fishing days per year: 130 to 150

From sunset till sunrise (about 10 hours)

It takes about 2.5 hours to get to the fishing ground.

Operation time:

1. Net casting-5 to 6 minutes
2. Purse line hauling-20 minutes
3. Net hauling-40 to 50 minutes

- No. of operations per day: 2 to 3

Fishing method

The fleet owner must judge operational

feasibility by weather and sea conditions. The fleet leaves port at such a time that it can get to the fishing ground at sunset. The fleet owner gets on board the purse-seiner and the master fisherman (employed) on board a fishfinder-equipped transport boat.

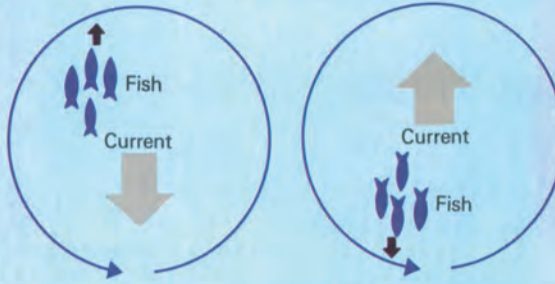
After the fleet gets to the fishing ground, the purse-seiner and two transport boats begin to seek a school of fish by means of a fishfinder over their assigned sea areas while maintaining mutual telephone communication. This operation is performed with special care. It is not rarely the case that even two or three hours are spent before the net is cast.



Net casting starts.

19.9-ton class boat

5 to 9-ton class boat



The net is allowed to drift into the water of itself. The roller is fitted to the stern.



Purse line is hauled in by purse wire winch.



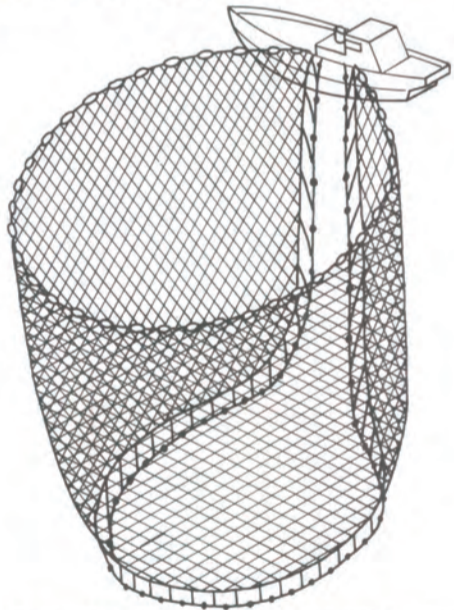
The bunt is hauled in by hands with the aid of side-roller.

OPERATION



Catches are taken in fish holds.

Fig. 6 Surrounding the sea area



The master fisherman decides on the timing of net casting by taking into consideration all essential factors such as fish species, the size and density of a school of fish and the depth of water where the school has been located. The lamp boats are then brought to a right position above the school. Fish-luring operation starts by lighting all luring lamps. In the meantime, the purse-seiner begins its net casting operation as directed by the

master fisherman. The holding rope is released from the stern of the purse-seiner with its end being held by the skiff. The purse-seiner lets out the net from the stern in order of the holding rope, bunt, body, wing and warp line while moving at full speed around the lamp boats. In the case of a 19.9-ton class boat, this operation must be performed against a current (with a current in the case of a 5 to 9-ton class boat).

When the operation is finished, the net surrounds the sea area of 731 meters round and 200 meters deep.

Then the purse-seiner receives the holding rope and the end of the purse line from the skiff. The holding rope is hauled in and the end of the buoy line is tied to the bow bitt.

Net hauling begins with the wing side first by means of the net hauler and power block on the stern while purse lines (on both ends of the net) are being rolled round the reel on the bow deck to purse the net.

When net pursing is completed, the crew on the bow deck begin to disconnect the short bridles from the purse rings by threes or fours to meet the speed of net hauling, thus allowing the net to be taken on the stern deck. The net is then folded up in good order for the next casting.

The lamp boats stay in the middle of the surrounded sea area until the net is completely pursed. After confirming the finish of net pursing, these boats move to lure the school to come toward the bunt. All lamps are put out when luring is completed.

When the purse-seiner has hauled in the wing and body, one transport boat ties the buoy line of the bunt to the side. In the meantime, the purse-seiner begins to haul

in the net by means of the side roller. Fish are scooped with a big dip net when they come up to the surface of the water.

About three net castings are performed a day. In the case of a big catch, one casting can put an end to the operation of the day. It is only the fleet owner that can decide whether or nor the operation should be continued.

MANAGEMENT

■ Incomings and outgoings

• Annual catch value -	¥150 to 200 mil.
• Minimum catch target (daily) -	¥1 mil.
• Fishery expenses (daily) -	
(1) fuel 3kl	¥200,000
(2) Ice 10 tons	¥100,000
	Total ¥300,000

■ Invested capital

- (1) Fishing boat - About ¥500 mil. are needed to make up a fleet (¥150 mil. for a purse-seiner).
- (2) Fishing gear - ¥20 mil. per net set. One fleet has 2 or 3 sets on hand.

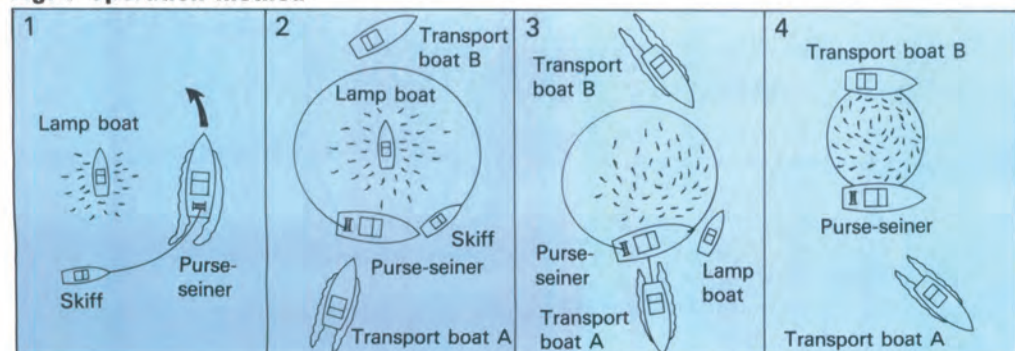


Fishes are sorted by species any by size for shipment to the market.



Total catch from three castings amounts to 20 tons (¥1 mil.). Spotted mackerel make up 80% of the catch and, mackerel scad and oaka-muro 20% (Oct. 12, 1983).

Fig. 7 Operation method



Spotted mackerel



Mackerel scad



Oaka-muro (*Decapterus russelli*)

One-boat (8~9-ton class) type purse-seine fishing method

FISHING BOAT

A fishing fleet

	Tonnage	Main engine	No. of crew	Remarks
Purse-seiner	8.38	Max. 300 hp	7	Equipped with a fishfinder
Transport boat	8.60	Max. 310 hp	1	
Lamp boat	8.00	Max. 270 hp	1	
Lamp boat	9.00	Max. 135 hp	1	

Note: The above tonnage is chosen so that it is also suitable for other types of fishing operations than purse-seine fishing.

Purse-seiner's main fishing gear

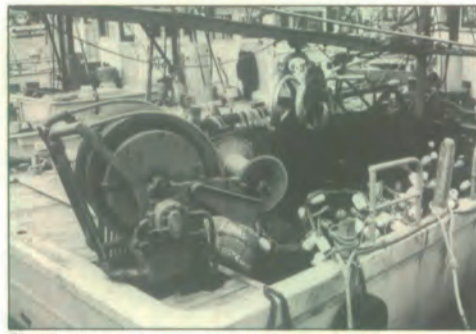
1. Net hauler 1
2. Power block 1
3. Side roller 1
4. Purse wire winch (upright type) 2
5. Purse wire reel 1
6. Auxiliary capstan 2



Purse wire winch and reel (bow deck)

Fish locating instrument:

- (1) Purse-seiner
 - * Radar * Fishfinder * Sonar
 - * Net sonde
- (2) Transport boat
 - * Radar * Fishfinder * Sonar



Net hauler and power block (stern deck)

FISHING GEAR

Fig. 8 Purse-seining net

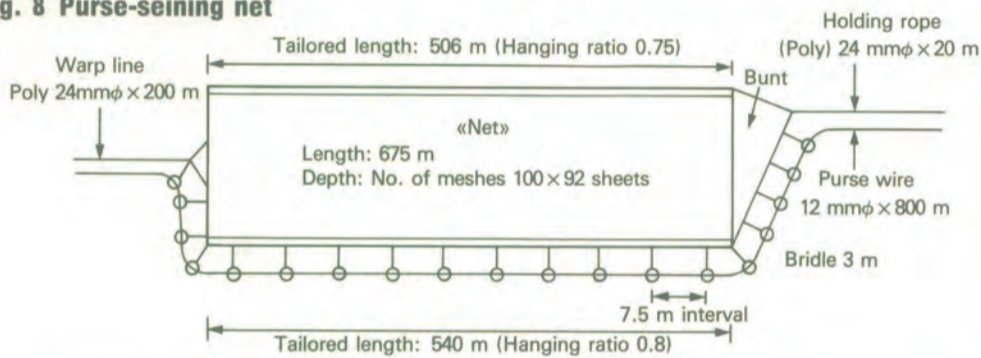


Table 7 Net specifications

Fish sought	Material	Thickness	Mesh size
1. Horse mackerel and mackerel	Nylon	210D 9 - 12 y	28 mm
2. Adult sardine	Nylon		16 mm
3. Half-grown sardine	Nylon		12 mm
4. Sardine fingerling	Nylon		9.7 or 10 mm

OPERATION

Facts about operation

- No. of fishing days per year:
 - 1 Purse seine 120
 - 2 Other types of fisheries 40
 Total 160
- Fishing hours: Same as 19.9-ton class

- Operation time:
 - Net casting and purse wire reeling—12 minutes
 - Net hauling—40 minutes
- Mean catch amount per net casting: Variable; the largest catch can amount to about 30 tons per casting.

Table 8 Annual operations schedule

Fishing method	Month											
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
One-boat purse seine	(sardine)											
	(mackerel)											
	(adult and half-grown sardine)											
Sweetfish fry dragnet												
Two-boat seine (sardine fry)												
Small trawl net												
Yellowtail fry catching (seed for farming)												

Fishing method

General fishing method is the same as the

19.9-ton class fishing method, except that a buoy is used instead of a skiff.

MANAGEMENT

Incomings and outgoings

- Annual catch value-
 - Purse seine: Approx. ¥80 mil.
 - Other fisheries ¥10 mil.
 Total ¥90 mil.
- Minimum catch target (daily)- ¥500,000
- Fishery expenses (daily)-
 - (1) Fuel 1kl ¥70,000 to ¥80,000
 - (2) Ice 0.15 ton ¥20,000

Invested capital

- (1) Fishing boat- About ¥200 mil. (market value) are needed to make up a fleet.
- (2) Fishing gear ¥10 mil. per net set.

Let's take a look at differences between 19.9-ton class boat operation and 9-ton class boat operation.

The former uses a large-size net capable of catching 50 to 60 tons of fish per casting, while the latter uses a much smaller one capable of catching only 30 tons at best. The difference in physical productivity is shown in terms of a difference in annual catch value. But it is significant to note that according to the recent agriculture economy investigation report (the Ministry of Agriculture, Forestry and Fishery), the size of a boat results in little difference in profit rate. This means no scale merit works here.

At Shizuura area each of the crew can earn ¥2.8 to 3.0 mil. per annum whichever fleet he may join.

The latter can maintain the same rate of profit as the former for the following reasons:

- (1) 19.9-ton class boats and larger are

used exclusively for purse seine fishing operation, while under 10-ton class boats can be used not only for purse seine, but also for small trawl net, boat seine, etc. Therefore, an unexpected poor catch in purse seine can be made up for by the catches of other fisheries.

- (2) A large-size boat is operated with the primary aim of increasing the amount of catch, while a small-size boat aims at catching prime fish species, rather than mere increase of whatever catch.
- (3) A small-size boat is much speedier (19 to 23 knots) than a large-size boat (8 to 9 knots). It can get to a good fishing ground more quickly than a large-size boat. It can also return port in time for the very profitable first auction of the day.

Characteristics of Two-boat purse seine

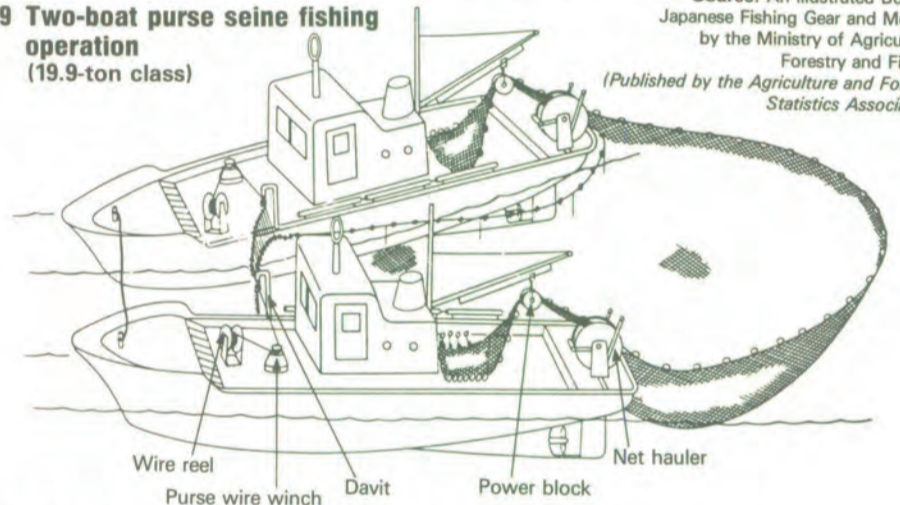
The fishing season and ground of this fishery is the same as one-boat purse seine. This fishery is operated to catch mainly sardine, anchovy, horse mackerel, mackerel and yellowtail.

The fishing method is also the same as one-boat purse seine, except for the following points:

- * Operation is usually limited to the daytime.

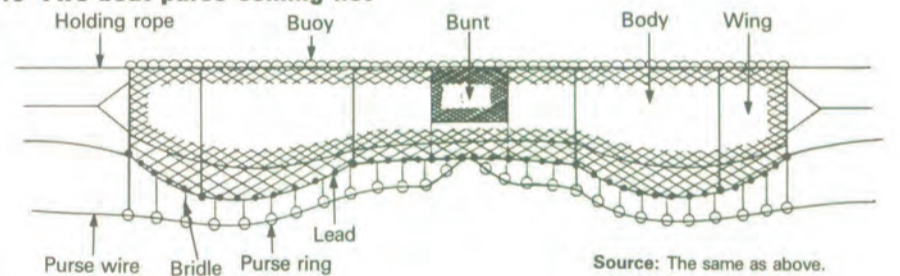
- * Two purse-seiners of the same type share the load of a net with their bows linked.
- * Each purse-seiner is equipped with a purse wire winch and a net hauler.
- * Time needed for each casting and purse wire reeling is reduced by half. This means the number of daily castings is increased, thus resulting in a better catch.

Fig. 9 Two-boat purse seine fishing operation (19.9-ton class)



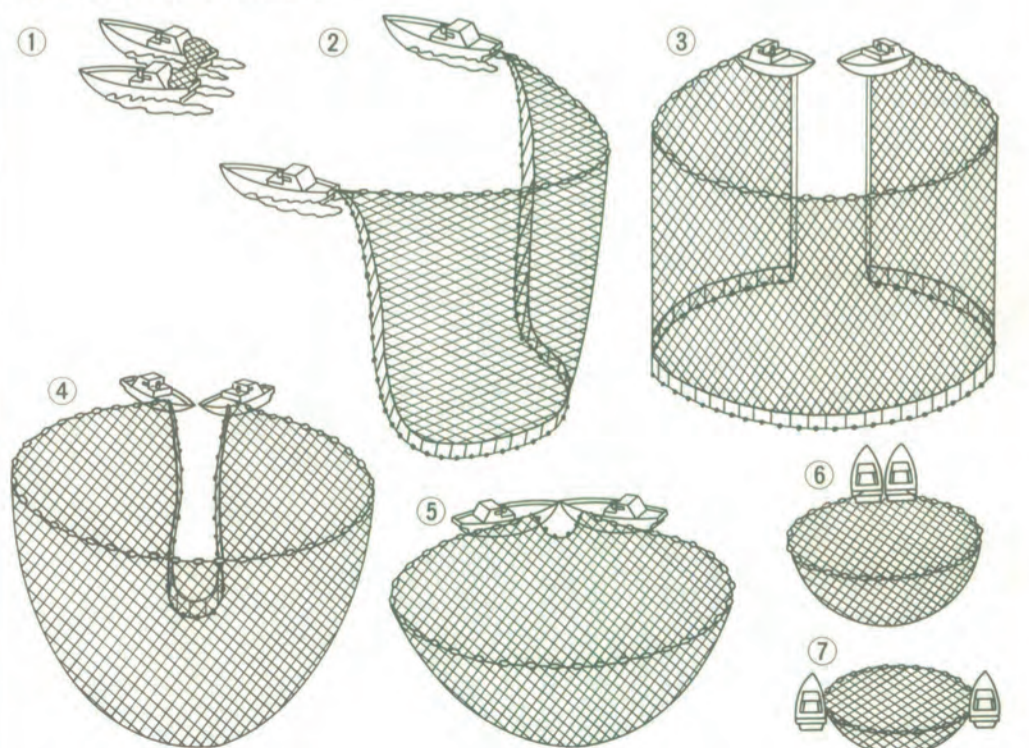
Source: An Illustrated Book of Japanese Fishing Gear and Method by the Ministry of Agriculture, Forestry and Fishery (Published by the Agriculture and Forestry Statistics Association)

Fig. 10 Two-boat purse seining net



Source: The same as above.

Fig. 11 Operation method



- (1) Sharing the load of a net and moving forward with their bows linked.
- (2) Separating from each other and casting a net when a school of fish is located.
- (3) Surrounding the school.

- (4) Pursing begins.
- (5) (6) Net hauling
- (7) The bunt is positioned between two boats and fish is scooped with a big dip net.

Table 9 Various two-boat purse seine fishing operations

Fishery	Sardine & horse mackerel purse seine	Luring-lamp type sardine & horse mackerel (purse seine)	Gizzard shad purse seine	Hemisamph purse seine	Sardine purse seine	Sardine purse seine
Fishing ground	Kujukuri-hama Chiba Pref.	Kii channel Wakayama Pref.	Amakusa-nada Kumamoto	Shiranui-kai Kumamoto Pref.	Osaka Bay	Suruga Bay
Water depth	Under 50 m	40 ~ 80 m	40 ~ 60 m	30 ~ 40 m	Under 50 m	200 ~ 300 m
Catch	Sardine, horse mackerel, gizzard shad, black porgy and grunt	Anchovy, horse mackerel, grunt, mackerel, mackerel scad and marusoda (<i>Anxix tapeinosoma</i>)	Gizzard shad	Hemiramph	Anchovy, sardine, mackerel, barracuda, Umazura-hagi (<i>Navodon modestus</i>) and harvest fish	Sardine, horse mackerel and mackerel
Fishing season	All year round (peak—Sept. to Dec)	All year round (peak-Apr. to Jul.)	Oct. to Apr. (peak—Oct. to Dec.)	Nov. to May (peak—Dec. to Mar.)	Jun. to Nov.	Aug. to Nov.
Fishing boat (purse-seiner)	Under 5 tons	Under 5 tons	Under 5 tons	Under 5 tons	19.7 tons	19.9 tons
No. of crew	24 ~ 30	35 ~ 40	6 ~ 8	6 ~ 8	25	32
Net size (Buoy side tailored length)	300 ~ 350 m	Approx. 600 m	100 m	70 ~ 240 m	500 m	200 m
Net material	Nylon/ Cremona	Cremona	Cremona	Cremona/ Nylon	Nylon	Nylon
Mesh size	28 ~ 22 mm	Body 16 mm Wing 18 mm	38 mm	Body 22 ~ 20 mm Wing 19 ~ 18 mm	11 ~ 10.8 mm	Body 11.6 ~ 11 mm Wing 9.8 mm

Two types of purse seine fishing operation

The relative advantages and disadvantages of one type and the other can be generalized into the right table, thus showing that one-boat type is more suitable for off-shore fishing operation:

A good choice must be made between these two types by taking into consideration all conceivable factors, such as obtainable labor power, invested capital, fish species sought and fishing ground conditions. For example, in the nighttime one-boat type operation can catch a large school of fish by means of a luring lamp but this type is found less advantageous than two-boat type using two boats of the same type powered by the same horsepower engines when it aims at catching quick-moving sardine fry which are used as live bait for skipjack pole-and-line fishing.

Table 10 Comparison between two types of purse seine fishing operations

	One-boat type	Two-boat type
Advantages	<ul style="list-style-type: none"> *Easy to save labor *Can be operated even on rough sea conditions (wind velocity of up to 15 m/sec.), thus increasing the number of fishing days. *Reduced capital investment *Reduced operation expenses (especially fuel cost) 	<ul style="list-style-type: none"> *Can be operated even in shallow or reefy waters. *Reduced time for net casting and hauling *Easy net hauling even in swift currents.
Disadvantages	<ul style="list-style-type: none"> *Difficult to operate in shallow or reefy waters. *More time needed for net casting and hauling. *Difficulty of net hauling in swift currents. 	<ul style="list-style-type: none"> *Difficult to save labor. *Can not be operated on rough sea conditions (wind velocity of over 7 to 8 m/sec.) as two boats share the load of a net. *More operation expenses (especially fuel cost).

SEEKING A NEW RENDEZVOUS

The search for a direction for development of the surrounding net fisheries of Shizuura

When the Fisheries Cooperative of Shizuura received a subsidy from the national government in 1981 they immediately put the money to use in renovating their facility for processing large landings of fish, and by 1983 completed the construction of a new ice-making facility and a large-sized refrigerated storage facility. At the same time they began to search for ways to improve their distribution system to insure higher and more stable producers' prices for their catches, and also for ways to increase the consumer market for mass-catch fish and thereby increase the fishery incomes of the cooperative members. According to an unofficial statement by Cooperative officials, the single most important problem in the improvement of the distribution system is the improvement of the sales system for raw fish. Although at this point it is still too early to evaluate the effects of the Coop's attempts to improve their raw fish sales, there is clearly a need for careful consideration of the economic circumstances. Let us take a look, now, at the important problems in the economic environment of Shizuura.

■ Present distribution of catches

The 19.9 ton class surrounding net boat operators that we spoke to in Shizuura gave the following description of the distribution of their catches:

Because of the fact that the use and the price of fish varies greatly according to the size of the fish and the species, the fisher-

men must constantly make strategic decisions as to where to land their catches, based on the contents of their catch and

the present market conditions. These decisions are reflected in the data in table 11. Looking at this table we can see several trends concerning the way fishermen of the Shizuura area land their catches. Sardine catches tend to be fairly evenly divided between Shizuura and Numazu. In short, the fish which are suitable for con-

Fish caught	Size	Use	Distribution of catch	Price per Kg
Sardine	large (over 18cm) middle (12-18cm)	feed for fish culture	over 90% of catch landed at Shizuura port	¥10-15
	small (6-12cm)	not caught	none	
Mackerel	large (35-40cm) middle (30-35cm)	for consumption as fresh fish	all landed at Numazu port	¥300-400
	small (25-30cm)	"kezuribushi"	all landed at Shizuura for local processing	
Spotted mackerel	no size discrimination	"kezuribushi"	all landed at Shizuura port	¥60-80
Frigate mackerel	no size discrimination	"kezuribushi"	all landed at Shizuura port	¥150-230
Horse mackerel	large (over 100g)	consumed as fresh fish	landed at Numazu port	¥1500-3000
	middle (70-120g)	salt dried	landed at Shizuura port	

Table 12 Size of catches landed by port and fish type (1981)

(Unit: tons)

Fish caught	Shizuura port		Numazu port	
	A	B	A	B
Sardine	9,063	17,259	26	4,240
Mackerel	9,483	7,716	4,640	16,012
Horse mackerel	51	—	13	369
Muro-aji (Decaptevus muroadis)	123	20	330	793

A: Catch by local cooperative-owned boats
B: Catch landed by local or non-local boats

sumption as fresh fish, thereby commanding the highest price, like large/middle sized mackerel and horse mackerel, are landed primarily at Numazu where large numbers of middlemen gather at the Numazu Fish Market to bid for the catches. On the other hand, fish which will be used for feed for fish culture operations, such as sardine, and fish which will be used for processed foods, such as small mackerel, are landed at the Shizuura port (Shizuura Fishery Cooperative Market). In order to strengthen the business base of the Fishery Cooperative in Shizuura, cooperative officials encourage their members to land a larger percentage of their catches, especially fresh consumption fish, at the Shizuura market. However, in order to get the members to cooperate with this policy, the cooperative first has to provide a sales system and handling facilities that will satisfy the fishermen. This is why the cooperative at Shizuura built the facilities mentioned earlier.

(Note): Originally, the term "fresh fish for consumption" meant fish that were packed in ice immediately after catching and shipped to the consuming areas as quickly as possible. However, recently, with the advances in freezing and refrigeration technology and the increased availability of refrigerated shipping services, more and more of the fresh consumption fish are frozen at some point in the distribution process and then thawed again at the retail market before selling. These "once-frozen fresh fish" are sold at the market for nearly the same price as non-frozen fresh fish.

■ Transformation in the local processing industry

In Numazu City 50,000 tons of assorted processed marine products were produced in 1981. The main processed foods included salt-dried horse mackerel and "mackerel-bushi" (a semi-processed product for use in making "kezuri-bushi"). In Numazu there are 260 shops engaged in the production of salt-dried horse mackerel, and 40 shops producing "mackerel-bushi". Here are the production figures for 1981:

Salt-dried horse mackerel—24,000 tons, ¥30 billion, 51% of national production
Mackerel-bushi—9,000 tons, ¥4 billion, 40% of national production.

(1) Originally the production of salt-dried horse mackerel was a local industry in the Suruga Bay area for which the raw materials were supplied exclusively by the fishing boats of the same area. However, beginning in the middle 60's a new shipping process was developed which involved packing lightly salted, quick-frozen fish in styrofoam crates (an insulating material), for shipment. This made it possible to expand their market to the large urban areas, thus launching an age of mass-production. At that time there was a decrease in the catches of horse mackerel in the Suruga Bay area which resulted in a lack of resources for the processing industry. In response to this the processors turned to the surrounding-net, mass-catch fisheries of Western Japan in Kyushu for the raw materials needed to increase their production. Then in the period from 1977 to 1981 when the Western Japan surrounding-net fisheries also began to suffer from poor catches, the Numazu area producers avoided a crisis by buying additional raw materials from Holland, Korea and Ireland. At present the percentage of fish caught locally for the Numazu area processed fish industry does not amount to more than 2 or 3%.

(2) The mackerel-bushi processing industry grew as a result of an increase in demand for a seasoning product known as "kezuri-bushi pack". Suruga Bay fisheries provide 60% of the raw materials for this industry with the rest coming by means of land transportation from the fisheries of Chiba Prefecture. At present there is no increase being seen in the demand for mackerel-bushi, which means that surplus mackerel must be sold at even lower prices for use as feed in fish culturing.

(Continued on the next page)
Yamaha Fishery Journal

Mackerel-bushi processing



Boiling very well



Oil pressing



Drying

Salt-dried horse mackerel processing



These are popular as souvenirs of the area



After soaking in salt water for one night, horse mackerel are cold-dried

Salt-packed mackerel



These salted mackerel are a quality product for use in "Sushi" restaurants.



After disemboweling, the fish are slit along the back, opened and packed with salt.

Sardine "niboshi" processing



Dried sardine fry

(Continued from the previous page)

(3) With species of the sardine family there is a sharp distinction made between the different species and the different sizes of the fish. These factors determine how the fish will be used. This results in considerable fluctuations in the price the producer will get for his catches. (Table 13)

This shows why, as we mentioned earlier, 5 to 9 ton boat fishermen seek to increase their incomes by catching fry and fingerling. However, in addition to this, with the presence of a solidly established processing industry and sales network capable of handling fresh fish, catches of mature fish can also be an important part of the fisherman's income. But, the catch amount of anchovy suitable for food processing like "niboshi" has shown a drastic decrease since the first-seventies, and the local production of processed food only amounts

to 3,000 tons a year. On the other hand, in recent years the catch amount of sardine has increased, but due to the fact that fresh sardine is in relatively small demand and as processed food it has a lower commodity value than anchovy, the most of the sardine catch must be sold for feed.

In short, while some local members of the processed foods industry have completely turned their backs on the local surrounding-net fisheries, other simply can not offer enough of a buffer function to maintain stable fish prices against increased fishery production.

Considering these conditions, the recently completed frozen storage facility of the Shizuura Fisheries Cooperative, which allows the coop to control the rate of shipment of fish in times of large catches, is the single biggest factor contributing to the stability of prices for fish caught by cooperative members.

■ Characteristics of price structure for mass-catch fish and changes in the central wholesale market

In recent years, in spite of the increase of catch of mackerel and sardine, the consumer demand for these fish has failed to grow. There are several factors which can explain this lack of increase in consumer demand, such as;

- The improvement of living standards has brought a shift in tastes away from the mass-catch fish.
- The growth of the fish culture industry has brought an increase in demand for fish as feed material, thus upsetting the framework of the market for mass-catch fish.
- Improved fishing methods have reduced the product value of mass-catch fish. Perhaps the best explanation, however, lies in a basic lack of structural unity between the highly developed fishery production and the highly developed marine product market system. The Japanese marine product market is developed around the distribution of fresh fish. However, since the first-sixties the following notable changes have occurred in the central wholesale market in the consuming areas: (a) Increase in shipments of frozen goods (20% in 1965 → 35% in 1976) and a decrease in shipments of fresh fish (50% → 27%) (b) Increased dealings in goods from outside the market, consisting mainly of imported frozen marine products. (c) Increased sales of standardized products such as frozen processed foods. In addition to these factors, it must also be noted that because the profit margin on

mass-catch fish is small for the middlemen and retailers, in the large city consuming area markets, where the basic marine product prices are determined, there has been a tendency to avoid mass-catch fish.

The future will continue to hold many problems that the fishery industry of Shizuura will have to face, and if they are going to be successful in their attempts to establish a stable, growing industry there are a few basic measures that they will have to take.

- By making full use of freezing and refrigeration facilities, they will have to improve their ability to regulate their shipments of products to the market
- They will have to develop a "cold chain" to get their products to smaller local markets in the interior as a means to increase sales.
- They will have to secure large quantity buyers such as supermarkets and consumer co-ops.
- They will have to use their small-scale fishing boats as a means to catch fish other than sardine and mackerel that can be sold as fresh fish. (The addition of fish other than the mass-catch fish will also contribute to the establishment of Shizuura as an effective fish market)
- They will have to develop new processed foods using mass-catch fish in order to encourage the growth of the local processing industry. Quite recently, local processors have begun to make use of the catch of sardine as raw material for "denpu"*. It appears that this new product will develop a good market.

* "Denpu" is a Japanese taste food. Powdered fish-meat is boiled hard with sugar and soy.

Table 13 Uses of sardine family fishes

Fish caught	Size	Use	Price level
Sardine	large	fresh consumption fish	B
	medium/small	(1) fish with little fat—processed foods (2) fish with fat—feed for fish culturing	B C
Anchovy	medium/small	(1) low-fat fish—processed foods (2) high-fat fish—feed for fish culturing	B C
Sardine/ Anchovy	fingerling	live bait for pole-and-line angling	A
Sardine/ Anchovy	fry	for processed "shirasu niboshi" (boiled and dried anchovy fry)	A

(NOTE): Produces, price level: A>B>C
Yamaha Fishery Journal