Business Innovation of Japan's Fishing Net Companies and Set Net Fisheries

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■Abstract

Fishing net companies have been responding to the changing times by incorporating the needs of fishers into their businesses. Particularly in the field of set net fisheries, fishing net companies, which formerly were only one of the suppliers of materials for fishers, now handle various aspects such as the proposal of methods to find fishing grounds, the design of fishing nets as well as contracting for fishing net laying, rigging, and repair, the training of successors, the rebuilding of fishing grounds that are no longer profitable, the utilization of fishing grounds where fishing was suspended, and finding customers for fish catches.

At the same time, by entrusting part of the work to fishing net companies, fishers are able to operate under adverse circumstances such as fishery resources and population declines, fish price declines, and technology disruptions. In recent years, set net fisheries have attracted attention as the core of coastal fisheries, but the form of the current industry is being shaped as fishing net companies change their relationships with fishers.

This paper clarifies the process by which fishing net companies specializing in set net fisheries have, since the oil crisis, expanded the scope of their business by taking on work that used to be done by set net fishery workers. It also points out to the extent possible issues that are becoming apparent as the division of labor between fishing net companies and fishers in the set net fishery industry progresses.

■Introduction

Fishing net companies have expanded their business areas by addressing the challenges faced by fishers. At the same time, this expansion of business areas has allowed fishers to continue producing while adapting to environmental changes.

This paper clarifies how individual fishing net companies have changed their business content since the oil crises as the structure of the Japanese fishing industry changed, and how the relationship between fishing net companies and fishers has changed in the process. Particular focus is placed on the field of set net fisheries, where reorganization is progressing with increased involvement of fishing net companies.

The fishing net industry is small in size and is not a field that has been subjected to thorough analysis. Major prior studies include that by the Economic Division, Fisheries Policy Planning Department, Fisheries Agency (1950) on the impact of the removal of controls , that by the Research Division of The Norinchukin Bank (1953) on the process of introducing synthetic fibers, that by Nakamura (1957) focusing on changes in the industry structure in that process, that by Yobuko (1977) looking at the impact of the 200 mile exclusive economic zone (EEZ) problem, and that by Yamamoto (1980), among others. These studies discuss the fishing net industry, focusing on changes in the external

environment that occur on the supply and demand sides for raw materials. Rather than investigating problems inherent to the fishing net industry, the focus of research so far has been is on how one sector of the textile industry or one material supply sector of the fishing industry is dealing with changes in the external environment. Consequently, as the fishing net industry has shrunk, interest in it as a research subject has also diminished.

On the other hand, in recent years, there have been studies that point out that the relationship between fishers and fishing net companies is changing in certain fisheries fields. Matsuura, Tamaki and Shimizu (2018) focused on set net fisheries, which have become an important part of coastal fisheries, and they introduce cases of fishing net companies that provide management support to fishers, rebuild fishing grounds, and provide technical guidance to fishers. Baba (2018) points out cases where set net fishery managers delegate part of the work to fishing net companies, resulting in rising management costs, and cases where a private company from outside the region, in cooperation with a major fishing net company, enters a no-longer exploited fishing ground on behalf of a local fisher.(Note 1) However, the focus of these previous studies is on set net fisheries and their contractors, and they are not in-depth analyses of on how the relationship between fishing net companies and set net fishers has changed as the structure of fisheries has changed.

As confirmed in this paper, in the set net fishery field, fishing net companies, which used to be only one of the material suppliers for fishers, make various efforts to maintain the set net fishery industry, such as proposing fishing ground utilization methods for fishers, including switching to other fish species, contracting for fishing net repair and fishing net rigging work, the training of successors, the sale of catches, the restoration of fishing grounds and the reproduction of fishing grounds that are no longer exploited. In this way, the business areas of fishing net companies have expanded especially since the oil crisis, and there are some fishing net companies that earn more from the designing, rigging, repairing, etc., of fishing nets than from fishing net manufacturing.

Fishers have been facing successor issues ahead of farmers, and with regard to set net fisheries, fishing net companies have been changing the structure of the industry by commercializing the response to various local issues, changing the division of labor with fishers, finding substitutes for fishers' labor force, and also cooperating in the restoration of fishing grounds. The existence of such fishing net companies can be said to have created the current set net fishing industry, which is attracting attention as a place for new employment among young people.

Following an explanation of the structure of the fishing net industry, we will examine how fishing net companies have responded to the oil crisis, the problem of the EEZ, and the environmental changes since the 1990s. In particular, we will consider changes in the relationships of set net fisheries, which have close relationships with fishers, look at proposal-type projects such as fishing ground restoration projects and examples of national initiatives, and to the extent possible, discuss future issues.

This paper is based on interviews with several fishing net companies in addition to the papers and books listed in References.(Note 2)

(Note 1) Baba (2018), having defined set net fishery management, which accounts for a large number of local fishers such as self-employed set net fisheries, cooperative set net group fisheries, and corporate set net fisheries that have developed from cooperative set net group fisheries, as "conventional local set net fisheries", holds that while set net fishery management has endured amidst the coexistence of conventional local set net fisheries and corporate managed set net fisheries by business enterprises, it is becoming increasingly

difficult to maintain set net fisheries locally, and as such changes take place, there are cases of both local and outside fishing net companies making inroads.

(Note 2) In the process of writing this paper, interviews were conducted with several fishing net companies and partner companies, such as Asaya K.K., NITTO SEIMO CO., LTD. (NITTO SEIMO), HOKUMO CO.,LTD. (HOKUMO), and Momoi Fishing Net Mfg. Co., Ltd.

1. Overview of the Fishing Net Industry

The fishing net industry is an industry that supplies fishers with fishing nets as fishery materials. Fishing nets vary depending on the type of fishery. The main types are nets for fishing such as trawl nets, boat seines, purse seines, gill nets and set nets, as well as nets for laver culture and large fish farming.

The 2018 sales volume of fishing nets was 6,656 tons, and the sales amount was 14.79 billion yen(Note 3)(Ministry of Economy, Trade and Industry (METI), "Yearbook of Current Production Statistics—Textiles and Consumer Goods Statistics"). 2018 exports were 2,613 tons and imports 1,013 tons, with most of domestic fishing nets produced domestically (Ministry of Finance, "Trade Statistics of JAPAN").

Fishing net companies purchases chemical fibers such as nylon, polyethylene, and polyester, which are the raw materials for fishing nets, from textile manufacturers, and make them into netting by raw yarn processing, twisting, and weaving. Next, the fishing nets are completed through a process called rigging whereby they are fitted with other fishing gear such as ropes and floats to turn them into the actual form of nets used at fishing grounds. In some cases, all these processes are carried out by a single company, but there are also fishing net companies that are responsible for only some of these processes, such as the production of the raw yarn and twisted yarn, and fishing net rigging.

Mechanization and automation for the yarn twisting and weaving processes are progressing, but the types and combinations of fibers, mesh size, specific gravity, height, strength, color, etc., selected depend on the target fish species, geographical conditions, practices, resource status, and fishers' preferences and prices. As a result, fishing nets are high-mix low-volume products (Note 4). Moreover, the rigging process for finishing a fishing net for use on site is performed manually and remains labor intensive. Major fishing net companies have affiliated subsidiaries and partner factories, and these factories are responsible for some processes and can accommodate sudden orders.

Trawl nets and purse seines having a short service life and high frequency of renewal, the main focus has been on fishing net manufacturing. However, set net fishing nets having a useful life of 10 to 25 years (Note 5) , regular repair and antifouling processing of the various part, as well as laying and rigging at fishing grounds, have become an important business for fishing net companies, and there are now fishing net companies whose ancillary fishing net related businesses bring in more revenue than fishing net manufacturing proper (Note 6).

Fishing nets are producer goods that directly affect catch volume, and owing to their high cost they are not readily replaceable. Sales representatives of fishing net companies regularly visit their clients, i.e. fishers and distributors, to form close relationships, and by understanding the use status of fishing nets and fishing gear, the conditions at fishing grounds, the timing of fishing net replacement, and so on, and quickly responding to front-line issues, they are able to build long-term relationships with fishers.

Although fishing nets produced in Japan are more expensive than fishing nets produced overseas, they are highly competitive against imports because of their high quality, the

relationship of trust between their salespeople and customers, and the ability of manufacturers to handle detailed orders.

Fishing net sales channels include direct sales to fishers, sales to fishers via fishery cooperatives, and sales to fishers/fishery cooperatives via sales agents. This variety of sales channels comes from existing practices, geographical conditions, accounts receivable collection risk mitigation, and so on (Note 7). At distributors, sales representatives of fishing net companies form close relationships with fishery cooperatives and fishers, and some of them handle more than distribution operations, for example by offering in-house rigging, repair, and laying services.

Due to the diversity of fishing nets to be produced, useful life, and relationships with fishers, each fishing net company has its own area of specialization. Many fishing net

Table 1 Location of headquarters of fishing net companies, number of offices, number of employees, shipment value

(Units: Company, offices, person, million yen, employees/offices)

location by prefectures	Number of member companies (FY2018)	Census of Manufacturers (as of June 2017)			
		Number of offices	Number of employees	Product shipment value, etc.	Number of employees/ offices
Aichi	20	15	387	783	25.8
Mie	12	8	121	270	15.1
Ishikawa	4	8	323	405	40.4
Okayama	4	4	111	101	27.8
Tokyo	3	-	-	-	-
Kagoshima	2	1	5	X	5.0
Shizuoka	2	1	12	X	12.0
Ehime	1	1	30	X	30.0
Kumamoto	1	2	297	X	148.5
Hiroshima	1	5	295	1,623	59.0
Osaka	1	1	4	X	4.0
Oita	1	2	54	X	27.0
Tottori	1	-	-	-	-
Wakayama	1	1	8	X	8.0
Hokkaido	-	17	245	350	14.4
Nagasaki	-	4	84	185	21.0
Toyama	-	3	62	81	20.7
Iwate	-	3	25	20	8.3
Saga	-	1	114	X	114.0
13 other prefectures	-	15	231	-	15.4
Total	54	92	2,408	---	26.2

Source: Ministry of Economy, Trade and Industry (METI), Census of Manufacturers, The Japan Net Manufacturers Association website

Note 1: In addition to fishing net companies that are not members of the Japan Net Manufacturers Association, there are cases in which the subsidiaries of member fishing net companies are not listed, so the actual number of fishing net companies is considered to exceed this figure.

2: The symbol "X" are adopted, in the case that the data figure can be supposed as the campany's data, due to the small size of the survey's target group.

companies had as their purpose the supply of fishing nets to the main fisheries of the region, and some companies were founded in the early modern period of Japan (Azuchi-Momoyama to Edo periods) or before the second world war (Note8).

As of June 2017, there are a total of 92 domestic businesses with more than 4 employees in the fishing net manufacturing industry across 29 prefectures (Note 9) , and 2,408 people work in the fishing net manufacturing industry (Note 10) (Table 1). The average number of employees per business is 26.2.

There is a large agglomeration of fishing net companies in the Hokuriku region, with numerous main factories and rigging factories of set net manufacturers. Ishikawa Prefecture alone counts eight such business facilities employing a total of 323 people. In Aichi and Mie prefectures, where the development of the fishing net industry occurred in conjunction with that of the local spinning industry, there is an agglomeration of mostly small fishing net companies. Broken down by prefecture, Aichi Prefecture has fifteen fishing net manufacturing-related business facilities employing 387 people, and Mie Prefecture has eight such business facilities employing 121 people. Hokkaido too has fishing net factories belonging to companies all over Japan, and it counts the largest number of fishing net manufacturing-related business facilities. Hokkaido has many small factories that perform labor-intensive work, such as the rigging factories for set nets for salmon fishing in the northern and eastern parts of Hokkaido. Hiroshima Prefecture has five business facilities, consisting mainly of flagship plants of some of the largest fishing net companies in Japan, employing a total of 292 people engaged in the development and production of fishing nets. Kumamoto Prefecture, which borders the Ariake Sea, where laver culture is thriving, has two production bases of culturing net companies, and 297 people who are engaged in the fishing net manufacturing industry. All domestic production bases are small and distributed across the country for each type of fishery.

The number of business facilities has decreased significantly over the years, declining from 400 in the 1980s to the early 1990s to 184 in 2000, and 92 in 2017, a fact that attests to the restructuring that is taking place in this industry (METI's Census of Manufacturers). The number of members of the Japan Net Manufacturers Association (Note 11) has also been decreasing, from 312 companies in 1980 to 54 companies in 2018, or just one sixth. Mie and Aichi prefectures, where there are many subcontractors and partner factories of major fishing net companies, have seen particularly significant declines, with Mie Prefecture experiencing a fall in production at major fishing net companies to one twelfth of 1980 levels, and Aichi Prefecture a decrease to one sixth (Note 12). Thus restructuring is progressing in the fishing net industry.

(Note 3) However, the Japan Net Manufacturers Association estimates the scale of the industry at 50 billion yen (https://seimou.exblog.jp/935914/).

(Note 4) In the case of set nets, as the skill level of fishers improves, some fishers who initially used to use strong and heavy fishing nets for fear of damage, switch to thin and light fishing nets to facilitate net hauling.

(Note 5) This depends on the expected number of years of use of fishing nets for fixed gear fishery management, which is the target of 'project of comprehensive measures for fisheries structural reform' (http://www.fpo.jf-net.ne.jp/gyoumu/hojyojigyo/01kozo/kozo_nintei.html).

(Note 6) However, in recent years there have been cases of major fishing net companies absorbing partner factories in danger of going under. HOKUMO conducted a review of its production system when a partner company collapsed in 2009 due to the Noto Peninsula Earthquake, and integrated three partner companies in the prefecture to set up a directly managed factory (Yomiuri Shimbun, November 14, 2009).

(Note 7) Each region has distributors that are closely related to fishers. These include Asaya K.K. (founded in 1850) and Mitsui Corporation (founded 1923) in the Tohoku region, and Kikutani

MOKICH SHOUTEN Co., Ltd. (founded in 1869) and Mitani Senguten Inc. (founded in 1961) in Western Japan.

(Note 8) The following information regarding the founding/establishment and factories of the various companies are based on the information provided on the respective companies' websites. Ishikawa Prefecture has a large concentration of fishing net companies, including main factories and rigging factories of Daido Gyomou K.K. (founded in 1946), Tyugai Net (founded in 1907), and HOKUMO CO.,LTD. (established in 1943). Aichi Prefecture is home to the production bases of several fishing net companies, including ICHIKAWA Fishing Net Co., Ltd. (founded in 1910), Osada Fishing Net Co., Ltd. (founded in 1915), TOYONEN Co., Ltd. (founded in 1925), and Kinoshita Fishing Net Mfg. Co., Ltd. (founded in 1933). Likewise, Mie Prefecture is home to the production bases of a number of fishing net companies, including AMIKAN Corporation (founded in 1794), and Nippon Kenmo Co., Ltd. (established in 1933). In both Aichi and Mie prefectures, an agglomeration of fishing net companies has formed along with the development of the textile industry. Other major companies include NITTO SEIMO CO., LTD. (established in 1910), Japan's largest fishing net company, with particular strength in knotless nets, Ehime Prefecture-based Asahi Mojiami K.K. (established in 1926), which produces moji (minnow) nets for small fish, and DAIICHI SEIMO CO., LTD (founded in 1954), which handles mainly laver culture nets. NICHIMO CO., LTD. (founded in 1910), formerly Japan's leading fishing net manufacturer, has downscaled its fishing net business operations. In addition, fishing net companies that have been in operation for over one hundred years include NAGAURA NET CO., INC. (founded in 1781) in Oita Prefecture, Tokyo Seiko Rope Mfg. Co., Ltd. (whose predecessor was established in 1887) in Aichi Prefecture, Kagoshima Gyomou K.K. (founded in 1901) in Kagoshima Prefecture, and KASUMI Corporation (founded in 1910) in Tottori Prefecture.

(Note 9) Fishing net manufacturing industry business facilities as defined in the METI's Census of Manufacturers refers to facilities that actually manufacture fishing nets and does not include non-manufacturing facilities such as business offices.

(Note 10) Source: METI's 2017 Census of Manufacturers. Some establishments that are classified as rope manufacturers are also considered to engage in fishing net production.

(Note 11) Members are expected to take actions that promote the improvement and development of SMEs that are engaged in the manufacture of fishing nets and other types of nets (limited to nets manufactured using trawler knot machines, knotless net making machines, Raschel machines, moji net making machines, or standard knot machines (the Japan Net Manufacturers Association website).

(Note 12) In 1980, Mie and Aichi prefectures alone accounted for 85% of all fishing net companies in Japan, with 145 companies and 124 companies, respectively, but currently, Mie Prefecture has only 12 such companies, and Aichi Prefecture just 20 such companies, and their share of fishing net companies now amounts to only about 60%.

2. Structural Changes in Japanese Fisheries and Adaptation of Fishing Net Companies in Response to the Oil Crisis

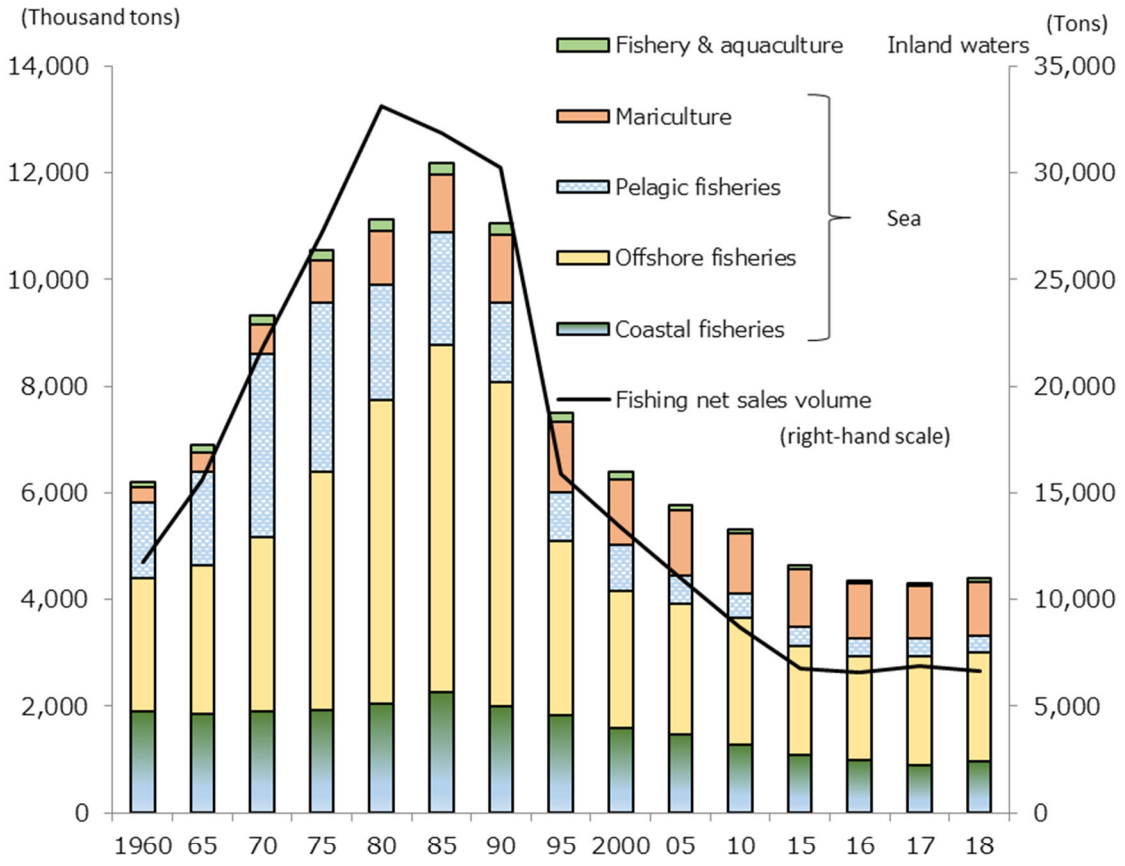
2.1 Structural changes in Japanese fisheries

Japan's fishing net industry, whose sales volume increased with the expansion of Japanese fisheries after the war, was greatly affected by the two oil crises of the 1970s and the stagnation of the pelagic fishery industry due to the establishment of the EEZ. Japan's fishery production exceeded 10 million tons in 1972, went on to peak at 12.8 million tons in 1984, and maintained levels of over 10 million tons of catch until 1990 by placing more emphasis on offshore and coastal fisheries, but by the end of the 1990s, owing to fishery resource fluctuations and declining fish price, production fell by half to 6 million tons, and in 2018, it decreased to 4.4 million tons, or just one third of its 1984 peak (Figure 1).

Due to reduction of pelagic fisheries and changes in fishery types due to the oil crisis and the the establishment of the EEZ, the sales volume (shipment volume) of fishing nets, which exceeded 30,000 tons in the 1970s and 80s, fell below 10,000 tons in the 90s, and declined to just 6,656 tons in 2006, or one fifth of peak levels.

In the 1980s, the decline in fishing net production was limited to some areas as the result of efforts to expand sales channels by fishing net companies, which yielded certain results (Note 13), as well as due to solid growth of offshore purse seine fishing of Japanese sardines [*Sardinops melanostictus*] and fish net fishing, which were in favor again owing to their energy saving merit and the recovery of salmon resources and took up some of the slack caused by the decline in pelagic fishing. Some fishing net companies also shifted their product focus to ground nets, such as nets for the construction industry and nets for sports facilities (Note 14).

Figure 1　Domestic fishery production and fishing net sales volume



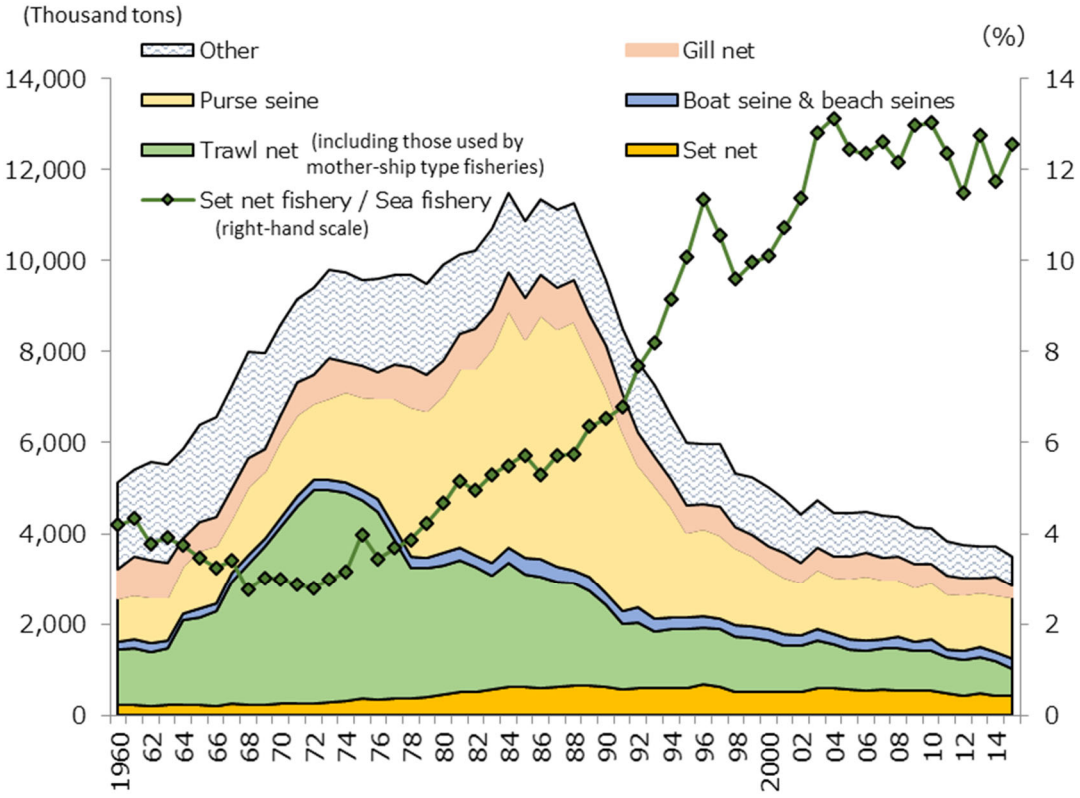
Sources: Ministry of Agriculture, Forestry and Fisheries (MAFF), "Statistics of Fisheries and Aquaculture Production", "Census of Manufacturers"; Ministry of Economy, Trade and Industry, "Yearbook of Production Statistics", "Yearbook of Textiles and Consumer Goods Statistics", "Yearbook of Textiles Statistics" (consecutive annual editions of each of the sources listed above)

Note: 2000, 2005, and 2010 figures include ground nets. 1960-1975: Shipping volume, 1980-2018: Sales volume

However, the decline in total catch volume from the early 1990s inevitably led to lower production of fishing nets, even for purse seine fisheries and set net fisheries (Figure 2).

With the additional factors of the appreciation of the yen and increasing competition from East and Southeast Asian countries, fishing net companies were unable to make up for the decline in domestic demand through exports (Note 15). In 1989, exports of fishing nets from Japan amounted to 6,154 tons, but they fell to the 2,000-ton range in the mid-90s,

Figure 2 Catches by type of fishery, share of set net fisheries



Source: MAFF, "Statistics of Fisheries and Aquaculture Production" (consecutive annual editions)

and as of 2018, they remain in this range (Ministry of Finance, "Trade Statistics of JAPAN").

(Note 13) For example, NITTO SEIMO expanded its sales channels as oil prices soared by replacing its existing fishing nets with knotless nets. Knotless nets are less bulky and lighter than ordinary fishing nets, so large fishing nets can be carried by small fishing boats. An added benefit is corresponding reduction in fuel cost. (UEDA (2020)).

(Note 14) According to an interview survey, the renewal frequency of sports nets and construction nets is not as high as that of fishing nets, and accuracy is not a requirement, so the contribution to sales of these products was low compared to fishing nets.

(Note 15) In the 1990s, the net making machines required to produce fishing nets were also manufactured in China, South Korea, Thailand, and India, enabling the production of fishing nets at low-cost factories in Asian countries, and posing a threat to Japanese products. In areas from which Japan's fishers were excluded due to the 200-mile fishing range regulation, fishing was promoted, and as a result, the production of fishing nets was boosted in the various coastal countries concerned, making it difficult for Japanese companies to increase their exports (Enomoto (1997)).

2.2 Adaptation of fishing net companies amidst restructuring of the fishing net industry

In response to the oil crisis and the EEZ problem, major fishing net companies have adapted strategically since the 1970s by making changes to their business. Broadly speaking, the companies each responded to the structural changes in the fisheries business by <1> entering the food industry, expanding trading company operations, and outsourcing products, <2> expanding joint ventures with overseas companies to relocate some or most of their production bases overseas and maintain overseas markets, and <3> developing their business with a focus on special net manufacturing, among other things(Yamamoto(1980)) (Note 16).

Since the 1990s, as the entire fishing net market shrinks, such differences in strategies among fishing net companies has become even more pronounced. Among the companies that, following course <1> above, expanded their pelagic division and suffered the most impact from the 200 mile fishing range regulation along with major seafood companies, there were some that sold off or transferred their fishing net business (Note17). Companies that opted for <2> above, requiring them to establish markets and products bases overseas, ceased production of fishing nets at domestic factories and moved production to the Philippines, Indonesia and Mexico.

On the other hand, in the case of <3>, specialization in special net manufacturing, some companies increased the number of types of nets that they handle by acquiring other companies' businesses, others expanded their business areas, and still others pulled out from fishing net manufacturing. In the aquaculture and set net fisheries fields, not only sales of fishing nets but also the proportion of related businesses providing various services were increased.

In particular, among the companies that opted for <3>, fishing net companies with strengths in the set net fishing field entered businesses such as laying, rigging and designing fishing nets from the end of the 1970s, and as the fishing net market contracted, the relative weight of such related businesses increased (Note18). In the set net fishery, which uses fixed-type fishing nets, the role of fishing nets is greater than in other fishery sectors, so fishing net companies and fishers are thought to have had close ties. Fishing net companies expanded into new business areas to compensate for the decline in sales of fishing nets by taking on rigging, laying, and design work that heretofore was performed by fishers.

The expansion of the business areas of fishing net companies in the set net fishery field has progressed in the process of increasing the importance of set net fishery for fishery catches and employment among coastal fisheries, as described below.

(Note 16) As Yamamoto (1980) describes head office locations, types of fishing nets that are strengths, and relations with business partners without specifying company names, this description is a condensation of trends from the supplied information.

(Note 17) NITTO SEIMO acquired the fishing net business of Taito Co., Ltd. in 2005, thereby acquiring strengths in new fishing net fields such as dragnets and trawls to complement its existing strengths in set nets and purse seines and become a diversified manufacturer of fishing nets.

(Note 18) Fishing net company ads from 1990 clearly show that the emphasis is not on net production alone. For example, a NITTO SEIMO ad states “We respond to all customer inquiries, from set net design, set-net fishing vessel design and manufacturing, fishery operations troubleshooting, and fishing net laying to management consulting”. A HOKUMO ad says “We contribute to the stability of set net fishery management with our proprietary total system, which includes fishing grounds surveying, fishing net design and manufacturing,

rigging, laying, and operation guidance and management. Our goal at HOKUMO is to be your set net fishing consultant. Please feel free to contact us".

Kasutani Fishing Net MFG.Co., LTD. for its part promotes its "thorough fishing ground investigation and design by experts" and "operation guidance from laying onward by specialists".

3. Structural Changes in Set Net Fisheries and Expansion of Fishing Net Companies

3.1 Structural changes in set net fisheries

As Japanese fisheries contracted, the weight of set net fisheries increased in relation to other types of fisheries, making this the core category, accounting for 13% of sea fishery and 30% of coastal fishery in terms of catch volume (Figure 2).

There are two types of set net fisheries: fisheries that require a license and fisheries that do not require a license. The former includes large-scale set net fisheries that operate with the set net placed at a depth of 27 meters or more from the sea surface, and set net fisheries whose main catch is salmon in Hokkaido (Note 19). Salmon set net fishery enterprises target mainly salmon, so there are about 70 to 90 annual fishing days, whereas the number of fishing days of large-scale set net fisheries varies greatly depending on the fish species they target. Some large-scale set net fishery enterprises operate only during a specific period of the year, while others fish throughout the year.

Both large-scale and salmon set nets are used by large-scale operations that employ an average of 9.1 maritime workers. On the other hand, small-scale set net fisheries employ an average of 2.6 maritime workers, including family members, and thus operate on a smaller scale compared with large-scale and salmon set net fisheries (Table 2).

After increasing in the mid-1970s, large-scale and salmon set net fishery enterprises gradually decreased in number, dropping to 969 enterprises, but then their number began to increase again, reaching 1,252 enterprises in 2013. Meanwhile, the total number of fishery enterprises, including coastal fisheries and small-scale set net enterprises, fell by half (Table 2). Further, among non-incorporated enterprises that operate large-scale and salmon set nets, the ratio of successors was 30.5%, which is higher than the 12.6% for coastal fisheries (MAFF's 2013 Census of Fisheries). While Japanese fisheries are on the decline, large scale and salmon set net fisheries can be said to constitute a unique fishery sector.

Set net fisheries also play an important role as local working places. According to the 2013 Census of Fisheries, the number of maritime workers is 6,258 for large scale set net fisheries, 5,074 for salmon set net fisheries, and 7,428 for small-scale set net fisheries. Thus set net fisheries account for about 20% of the 96,421 workers employed by coastal fisheries. At small set net fisheries, where half of the workers are family workers, the number of maritime workers decreased from 9,406 in 2008 to nearly 2,000 in 2013. On the other hand, at large-scale and salmon set net fisheries, where most of the workers are employed workers, the number of workers in the 2013 Census increased by 36 and 273 from 6,222 and 4,801 workers, respectively. Workers at large-scale and salmon set net fisheries are considered to consist in large part of U-turn workers (people who return to their hometown) and I-turn workers (people living in an urban area finds employment in a rural area) (Matsuura, Tamaki, Shimizu (2018) (Note 20). As places for production, management, and employment, large-scale and salmon set net fisheries can be seen to be gaining importance.

(Note 19) Fisheries Agency website
http://www.jfa.maff.go.jp/j/enoki/pdf/gyogyoukengaiyou.pdf
(Note 20) According to the 2003 Census of Fisheries, 32.8% of large-scale set net fisheries are male workers under 40 years of age.

Table 2 Number of set net fishery enterprises, maritime workers per enterprise, catches, and catch value

(Units: Enterprise, persons/enterprise, 1,000 tons, 100 million yen)

	1968	73	78	83	88	93	98	2003	08	13
Total number of enterprises	254,118	232,302	217,734	207,439	190,271	171,524	150,586	132,417	115,196	94,507
Incl. coastal fisheries	-	-	206,796	196,190	180,377	162,795	142,678	125,434	109,022	89,107
Incl. set net fisheries	5,816	6,587	7,480	7,393	7,085	6,398	6,110	5,426	4,661	4,119
Large-scale and salmon set net fisheries	711	832	1,217	1,162	1,179	1,126	1,068	969	1,086	1,252
Small-scale set net fisheries	5,105	5,755	6,263	6,231	5,906	5,272	5,042	4,457	3,575	2,867
Maritime workers/enterprise										
Large-scale and salmon set net fisheries	26.4	21.4	14.1	16.7	15.3	14.3	12.9	12.2	*10.1	*9.1
Small-scale set net fisheries	4.3	3.4	3.4	3.5	3.3	3.1	2.9	2.8	*2.6	*2.6
Total catch	8,670	10,763	10,828	11,967	12,785	8,707	6,684	6,083	5,592	4,774
Incl. coastal fisheries	2,004	1,820	1,990	2,137	2,115	1,861	1,582	1,577	1,319	1,151
Incl. set net fisheries	220	292	375	567	648	594	510	605	531	474
Large-scale set net	105	130	181	325	364	309	221	237	263	236
Salmon set net	10	33	50	76	92	121	134	216	126	142
Small-scale set net	105	129	145	166	192	164	154	153	142	95
Total fisheries production value	7,448	14,641	24,512	29,032	27,216	24,881	20,284	15,901	16,279	14,358
Incl. coastal fisheries	1,814	3,465	6,839	7,456	7,687	7,364	6,074	5,009	-	-
Incl. set net fisheries	275	691	1,560	1,729	1,820	1,802	1,367	1,144	-	-
Large-scale set net	134	251	462	636	643	695	573	475	-	-
Salmon set net	37	208	633	561	625	576	349	330	-	-
Small-scale set net	105	232	465	533	552	531	445	339	-	-

Source: MAFF, "Census of Fisheries", "Statistics of Fisheries and Aquaculture Production"
Notes 1. For large-scale set net fisheries, other large-scale set nets until 1993, and from 1998, large-scale set nets; For salmon set net fisheries, salmon and trout set nets until 1988, and from 1993, salmon set nets.
2. Statistics for fishery outputs by coastal and fishery type are available only until 2006.
3. *: In the 2008 Census of Fisheries and the 2013 Census of Fisheries, there is no continuity in the method of counting maritime workers. The number of maritime workers was at its highest until 2003, and after that, the number of maritime workers as of November 1 is listed.

3.2 Business expansion of set net manufacturers

The process of increasing the share of set net fisheries in the Japanese fishery industry in terms of catch volume and jobs corresponded also with efforts by fishing net companies to expand their business areas related to set net fisheries, as described below.

Fishing net companies specializing in set nets are distributed throughout the country. Daido Gyomou K.K. (founded in 1946), Tyugai Net K.K. (founded in 1907), and HOKUMO CO., LTD. (established in 1943), have their headquarters and production bases in Ishikawa Prefecture, which has a robust set net fisheries industry. In addition, Hiroshima Prefecture is home to the production base of NITTO SEIMO CO., LTD. (founded in 1910), the largest fishing net company in Japan. Nagasaki Prefecture is home to the headquarters and production base of Kasutani Fishing Net MFG.Co., LTD. (founded in 1946), which has strengths in small set nets. In terms of large-scale set net handling volume, HOKUMO and NITTO SEIMO have the two highest shares. In addition to their base factories, these two companies have rigging plants in areas where set net fisheries flourish (Note 21).

With regard to the fish net trade, fishing net companies and fishers maintain ongoing relationships. The relationship between a fishing net company and a customer does not end with the sale of a fishing net and collection of payment. Instead, the fishing net company offers subsequent services including rigging, laying and repair, thereby ensuring a long relationship and future orders for new fishing nets. Moreover, at many set net fishing grounds, sales representatives of fish net companies regularly check the business performance of set net fishers and the condition of their nets to ensure that fishers do not fail (Note 22). The major set net manufacturers have established a system that allows them to respond to customer requests through sales offices located throughout the country.

Since the 1970s, fishing net companies have been working on labor saving in maritime operations through the introduction of machinery, and they have also taken on net rigging, laying, and design, tasks that used to be done by fishers. Since the 1990s, by taking part in revitalizing fishing grounds that are no longer profitable, they have strengthened their relationship with fishers. In the following, I would like to examine the introduction of labor-saving equipment, the commercialization of rigging and laying work, and the development of proposal-based business.

(Note 21) Since there are no statistics regarding share by type of fishing net, the data was obtained through interviews with multiple fishing net companies.
(Note 22) In the case of HOKUMO, small-scale net repairs are left to sales representatives to make based on judgment on the spot.

a. Introduction of labor-saving equipment

During Japan's period of rapid growth, labor saving became an important issue owing to the outflow of labor from fishing villages in pursuit of better economic opportunities, plus the fact that catches of set net fisheries were sluggish compared with offshore and pelagic fisheries.

In the late 1960s, fishing net companies worked with fishers and fishery machinery manufacturers to develop labor-saving equipment that would make the fishery industry more efficient and less labor-intensive. Among labor-saving equipment, catch haulers (Note 23) contributed particularly to labor saving. Fishing net companies improved catch haulers, which were popular in other fishery fields, so that they could safely haul set nets (Note 24) and introduced these machines from 1970 (Kawabe (1971)).

The use of catch haulers, which by rotating two rubber ball rollers in close contact with each other, can hoist a net without damaging it and return it to the sea again, spread throughout Japan as soon as these machines became commercially available (Note 25) (Oizuki (2004, 2007)). Using catch haulers, the work of three to five ships could now be done with a single ship, and set nets that used to require thirty people at sea could now

be operated by just fifteen people. As the use of labor-saving equipment such as catch haulers spread, the maximum number of maritime workers per enterprise, which was 26.4 at its peak in 1968, declined to 21.4 in 1973, and 14.1 in 1978 (Note26) (Table 2 above).

The introduction of labor-saving equipment since the 1970s made it possible to increase the efficiency of operations and to use larger sized fishing nets at set net fisheries, but at the same time, the dependence of fisheries on fishing net companies with knowledge of fishing nets and machinery increased, and fisheries could no longer run their operations by relying solely on the experience and intuition of their workers.

(Note 23) The introduction of machines for set net hauling came late compared with long line nets because such machines used to damage the nets, but when a catch hauler capable of hoisting set nets without damaging them was developed by K.K. Kouyou, its use quickly spread throughout Japan. This machine was praised as a "savior" in the fishery industry, which had difficulty securing workers due to the soaring wages caused by Japan's high economic growth (Nikkei Sangyo Shimbun, November 20, 1981).

(Note 24) The action of pulling in a set net to transfer the fish that entered the net onto the ship.

(Note 25) The small size of catch haulers, made possible by the use of a hydraulic device as the driving source, is also said to have contributed to the spread of these machines (Oizuki (2004, 2007)).

(Note 26) While, during this period, the number of salmon set net fishing enterprises, which even at their peak employed a smaller number of maritime workers compared with large-scale set net fisheries, was increasing, the number of workers per enterprise was actually decreasing under the impact of the introduction of labor-saving equipment.

b. Commercialization of rigging and laying

Fishing net companies expanded their business with set net fisheries, a field where the potential for business growth based solely on fishing net sales was slim, by undertaking fishing net rigging, laying, and design work, which fishers used to do themselves, as well as by undertaking fishing ground surveys.

As the expansion of fisheries was limited owing to the two oil crises and the EEZ problem, set net fishing done by the coast as a labor-saving type of fishing was reconsidered, leading to the establishment of new set net fishing grounds and the relocation of some existing ones. In Hokkaido and Iwate prefectures, salmon set net fisheries were newly run by local fishers with little experience, so the capabilities of fishing net companies were required. In addition, there was a shortage of fishers with the required fishing net rigging and laying skills at existing fishing grounds, making it increasingly difficult to deal with changes in the fishing grounds environment.

Let's look at some specific examples of the establishment and relocation of set net fishing grounds. Since the 1970s, each fishing net company that specializes in set nets has established a rigging factory in Hokkaido, where a salmon hatching and release program has produced favorable results (Note27). Salmon catches in Hokkaido were 10,000 tons in 1960 and 19,000 tons in 1970, but increased to 75,000 tons in 1981 as the release program achieved results. This was accompanied by an increase in the number of fishers fishing with large-scale set nets.

Salmon set nets have traditionally been used by individuals and companies, hiring veteran chief fishermen/women from the Tohoku region, and many crew members were from the same region as the chief fishermen/women. However, at the time of the renewal of licenses to the 5th-Term Set Net Fishery Rights in 1974, the Hokkaido Prefectural Government adopted the policy of promoting "collaborations" led by local coastal fishers (New Hokkaido Fishery History Compilation Committee (2001)).

Fishing net companies expanded their business by offering fishing net rigging and laying, and design services that local fishers lacked.

Further, in Iwate Prefecture, the involvement of fishing net companies in set net fishery operations increased. In that prefecture, salmon catches from set nets rose as salmon catches from northern sea fisheries decreased. With the renewal of licenses to the 7th-Term Set Net Fishery Rights in 1984, new licenses were issued and some existing licenses were switched to different fishing grounds, resulting in requests to fishing net companies for water depth surveys and depth contour charts for fishing net installation, and fishing net companies saw an increase in specific fishing set installation-related work (Fishing Development Department, Hokumo Co., Ltd. (2008)).

In Iwate Prefecture as well, licenses were renewed with priority given to locals from the prefecture, and the participation of fishery cooperatives in the set net fishery industry became stronger. Further, the set net fishing grounds licensed to companies outside the region have been undergoing a reorganization in favor of local fishers (Kase (2008)) (Note 28). Like in Hokkaido, fishing net companies expanded their business in Iwate Prefecture by capturing demand for fishing net rigging, laying, and design from local fishers (Note 29).

Fishing net companies themselves actively acquired the fishing net rigging and laying techniques of fishers and incorporated them into their business. HOKUMO, a fishing net company in Ishikawa Prefecture, has been instructed by veteran chief fishermen/women since 1977 to enable its employees to prepare and install fishing gear by themselves, in order to facilitate the introduction of suitable fishing nets in response to the decline in yellowtail [*Seriola quinqueradiata*] resources and changes in fish species. (Fishing Development Department, Hokumo Co., Ltd. (2008)).

Moreover, as fishing net-related technologies were accumulated by fishing net companies, some fishing net companies became responsible for developing successors for set net fishers' workers (fishing cooperative staff in the case of fishing cooperatives). At HOKUMO, technical guidance, including laying, designing, rigging, and repair of fishing nets, was launched in 1988. Some of the fishermen who have completed the training became active in the field as boatmen leading fisheries guidance and contributing to the technical advancement of set net fisheries in the various regions (Note30).

Thus, since the 1970s, fishing net companies have entered the fishing net rigging and laying business, capturing new demand inherent in set net fishing. Further, while accumulating fishing net rigging, laying, and design techniques, some fishing net companies have developed successors, and have in the process achieved a greater presence in the set net fishery industry.

(Note 27) Daido Gyomou established rigging factories in Hokkaido, first in Monbetsu in Northern Hokkaido in 1970, then in Wakkanai in 1979. HOKUMO followed suit, establishing a rigging factory in the east of Hokkaido in Shibetsu in 1982, and NITTO SEIMO likewise in east Hokkaido, in Shibecha.

(Note 28) In Iwate Prefecture, Taiyo Fisheries Co., Ltd. (currently Maruha Nichiro Corporation) withdrew from set net fishery, but as is the case with corporate and non-corporate members of local fishery cooperatives, it is regarded as having switched to joint management with a fishery cooperative. Meanwhile, fishing companies outside the region have no choice but to withdraw from the fishing grounds in the region. In terms of employment, local fishers are said to have been actively seeking to hire their sons or brothers for set net fishery operations as the northern sea fisheries declined (Kase (2008)).

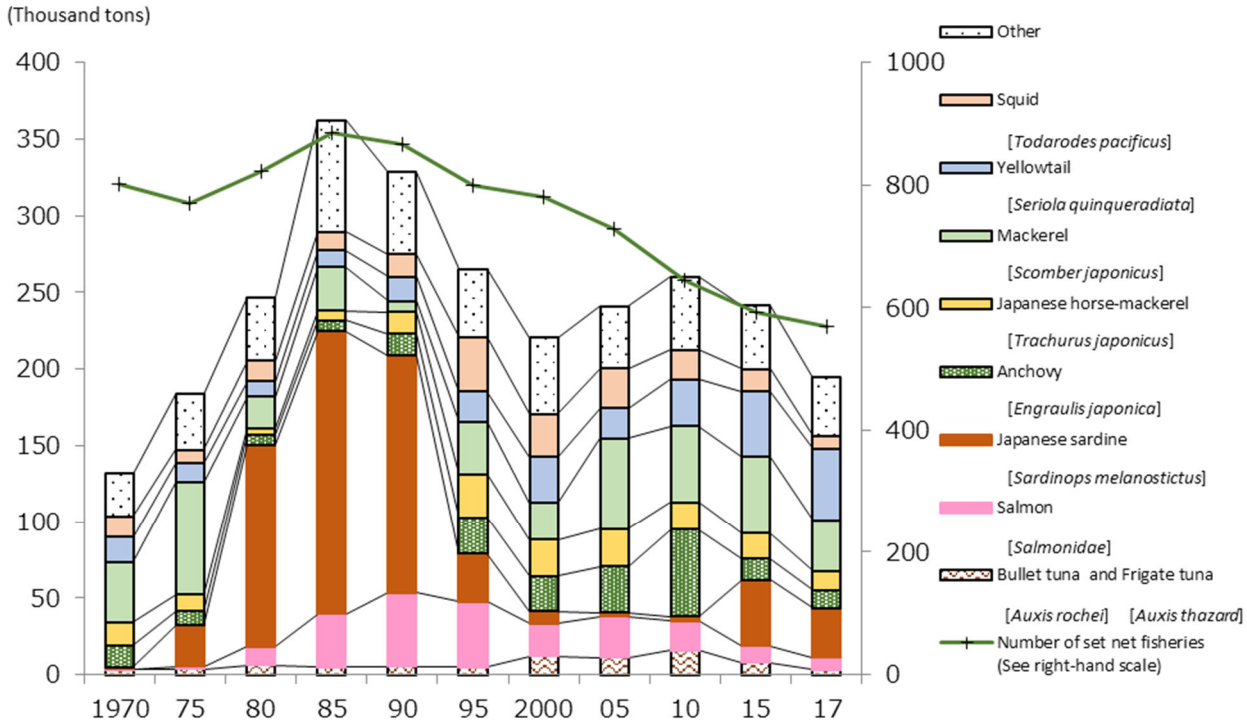
(Note 29) Asaya K.K. material: "The story of fishing gear sellers and fishers since the Edo period"

(Note 30) For example, trainees who underwent four years of training since 1986 are said to have played an active role as chief fishermen/women from their 20s after their training in the set net fisheries managed by fishing cooperatives in Kamogawa City, Chiba Prefecture (Source: HOKUMO: "Forming Our Future Set Net Professionals Who Will Go Out to Sea"). Moreover, trainees at Uminotamigakusya, a training facility for young fishers in Kyoto Prefecture, who also received training in net repair training techniques at HOKUMO.

c. Growth of proposal-based business

From the 1990s, as new fishing grounds for set net fisheries grew scarcer and existing fishers (Note31) became unable to cope due to changes in the environment, such as significant fluctuations in the amount of catches and low fish prices, capital investments stagnated and the number of fishing grounds requiring drastic reform increased. The composition of catches changed drastically during this period. For example, Japanese sardines catches using large-scale set nets decreasing to one sixth, from 185,000 tons to 31,000 tons, between 1985 and 1995, while catches of yellowtail, anchovy, Japanese horse-mackerel, squid, etc., increased (Figure 3).

Figure 3 Large-scale set net fishery catches by fish type, and number of set net fisheries



Source: MAFF, "Statistics of Fisheries and Aquaculture Production" (consecutive annual editions)

Fishing net companies were involved in the rebuilding of such fishing grounds using data accumulated in the fields of rigging, laying, and design (Note 32) (Hirai (2009)). In making proposals for the rebuilding of fishing grounds, each fishing net company analyzed the collected fishing ground information and established a department to carry out investigations and assessments for the purpose of rebuilding fishing grounds (Note33).

In 1992, when NITTO SEIMO reconstructed the Ogusu Fishing Ground in Kanagawa Prefecture at the request of the Yokosuka City Ogusu Fisheries Cooperative (see below), HOKUMO too began rebuilding fishing grounds across the country but mainly in the Noto Peninsula area for the Hanami Oshikiami* Net Cooperative and others, starting with fishery support for Oura-Hane Oshikiami Net Cooperative in Noto in Ishikawa Prefecture in 1995. (*: Large Triangular set nets method widely used as a coastal fishery in 16 to early 20 centuries.)

In addition to such support of local fishers, when it is difficult to rebuild fishing ground locally, there is also a movement to regenerate fishing grounds by inviting fishers from outside the area with which the fishing net company has a business relationship, with the consent of the local fishery cooperatives and fishers. At fishing grounds in places such as Mie Prefecture, Shizuoka Prefecture, Kanagawa Prefecture, fisheries outside the region that developed a business relationship with NITTO SEIMO at fishing grounds whose exploitation has stopped are rebuilding fishing grounds by running set net fishing operations there (Note 34).

To improve the income of fishers, fishing net companies are also strengthening support in the distribution field, for example by providing guidance on how to use the Ikejime fish slaughtering method to ensure maximum fish meat quality, and introduction of sales destinations. NITTO SEIMO has established a domestic fresh fish team to raise the price of incoming net-caught fish (Note 35) (Matsuo, Nagao, Naka (2008)). Since 2006, the company has built a fresh fish sales network with set net fishery companies, and has launched also a new business that mediates between fisheries and the distribution and retail industries. It has created an in-house domestic fresh fish sales and support team that gives fishers guidance regarding sales methods. In addition, since 2015, the company has been serving as an intermediary between regional supermarkets in the Chugoku region and Chugoku region set net fisheries that are its customers, instituting a system whereby supermarkets buy entire set net catches (Note 36) (Soejima and Hosokawa (2016), Soejima (2017)).

Initiatives to rebuild fishing grounds proposed by fishing net companies include improving fishing efficiency, year-round operation, manpower-saving and labor-saving by changing net types and introducing dedicated set nets, and to boost the selling price of fish, expanding live fish shipments, adjusting the timing of shipments, and expanding sales channels. The national government's “Profitable Fisheries Establishment Support Program” is actually being implemented based on fishing net companies' proposal capabilities such as the above. Below are some typical examples.

(a) Rebuilding of Ogusu Fishing Ground

In 1992, the Ogusu Fishing Ground located on the Sagami Bay side of Miura Peninsula in Kanagawa Prefecture near Tokyo was rebuilt in response to a request to NITTO SEIMO for collaboration from the Yokosuka City Ogusu Fisheries Cooperative (Aoki (1994)).

Management of the set net fishing ground was carried out jointly by the Hyoetsu Daibo-Ami, which operated two set net fishery fleet units in Niigata Prefecture, and Yokosuka City Ogusu Fisheries Cooperative, and a chief fisherman was dispatched from Hyoetsu Daibo-Ami to give guidance.

In rebuilding fishing grounds, NITTO SEIMO examined the record of catches at existing fishing grounds, the estimation of caught fish species, fishing ground management, employment conditions, form of operation, fish sales system, forecast of catches, possibility of year-round operation, position and angle of nets, and so on.

During fishing ground rebuilding, easier-to-maintain fishing nets were introduced in response to requests from management and fishermen/women, along with the installation of five catch haulers, and set-net fishing vessels that can be operated by a crew of just twelve people were newly built as part of efforts to save labor.

In addition, the switch from workers from Tohoku and Hokuriku to local workers was promoted. In the 1990s, it was difficult to secure human resources at fishing grounds, which depended on migrant work from Tohoku. Switching to local employment in city suburbs required increasing the value of catches and securing wages comparable to those of other industries (Note 37). To increase the value of catches, operation periods and the targeted species were changed. For example, the conventional practice of catching Japanese Spanish mackerel [*Scomberomorus niphnius*] during summertime fishing was revised to include also middle-sized Japanese amberjack (species of yellowtail, *Seriola quinqueradiata*) and yellowtail [*Seriola quinqueradiata*] in the wintertime to achieve year-round fishing operation.

(b) Rebuilding of Hanami fishing ground

At the Hanami fishing ground located on the Toyama Bay side of the Noto Peninsula in Ishikawa Prefecture, rebuilding of the fishing ground began in 1997 with a proposal by HOKUMO (Sales Department, Hokumo Co., Ltd. (1998)).

In rebuilding the fishing grounds, HOKUMO did so with the understanding of the cooperative head and officers of the Hanami Oshikiami Net Cooperative that a balance would be struck between investments and production, that model fishing grounds would be created by rebuilding everything, and that management of operations such as design and installation would be done by HOKUMO, among other conditions. Since an investment of 340 million yen would be required for fishing vessels and fishing gear, fishing ground assessment was done based on fishing ground location and composition, causal relationships between current fishing net conditions and catches, and comparison with adjacent fishing grounds, and investment effectiveness evaluation was examined in-house by HOKUMO by digitizing all the above data. In such rebuilding projects, the motivation of local fishers is an important factor.

In rebuilding the fishing ground, increasing catches by changing the shapes of the nets and increasing the net entry rate were aimed for, and through the adoption of the purse seine and ringnet method, which enables even greater labor-saving that catch haulers, the set-net fishing vessels for net hauling could be consolidated from three ships to just one, and the crew reduced from 24 to 17 people. In addition, large holding nets for shipping adjustment were introduced for the purpose of improving the added value of catches. The rebuilding project was carried out with the target catch value of 170 million yen, or 10 million yen per person a year.

(c) Rebuilding of Katada Fishing Ground

As talk of the sell-off of a local set net fishery enterprise whose cash flow deteriorated due to poor catches between 1998 and 2000 arose at Katada Oshikiami Net Cooperative in Shima-cho, Shima City, Mie Prefecture, HOKUMO worked to restore business profitability by rebuilding the local fishing ground, which was being exploited mainly by local fishers (Note 38).

For the rebuilding, HOKUMO dispatched two engineers to Katada Oshikiami Net Cooperative, and one of them became a chief fisherman who provided guidance on how to lay and repair fishing nets and run fisheries. HOKUMO also invested some 300 million yen in fishing nets and fishing vessels for Katada Oshikiami Net Cooperative, and as a

result of an arrangement whereby this material would be paid from catch sales over a period of five years, the fishing nets and fishing vessels were supplied at a price closely approximating that of a lease (Note 39).

In rebuilding the fishing ground, stable catches were aimed for by changing the types of nets so as to catch not only yellowtail [*Seriola quinqueradiata*] and middle-sized Japanese amberjack (species of yellowtail, *Seriola quinqueradiata*), but also Japanese jack mackerel [*Trachurus japonicus*] and Japanese common squid [*Todarodes pacificus*], etc. Moreover, the set net fishing system was modified to allow for crews of 15 people, down from 30, to save labor. HOKUMO rigged the set nets and the fishermen/women, while dedicating themselves to the fishing trade full time to reduce the load on the organization, took a pay cut.

As the project got going, Katada Oshikiami Net Cooperative was reorganized from a voluntary partnership with no internal reserves to a corporation, Katada Teichi K.K., to ensure long-term business continuity.

In rebuilding the Katada Fishing Ground, engineers trained in house by HOKUMO went into the area as chief fishermen, and the rebuilding was realized under the guidance they gave local fishermen/women at the set net fishing ground. Following the success of Katada Teichi K.K., HOKUMO formed a team of set net fishing engineers in 2007, and went on to rebuild fishing grounds in Ishikawa Prefecture, Akita Prefecture, and Aomori Prefecture, among other locations.

(d) Profitable Fisheries Establishment Support Program

National measures based on the achievements of fishing net companies to rebuild fishing grounds are also being developed by the Japanese government.

The Japanese government's Project of Comprehensive Measures for Fisheries Structural Reform implemented since 2007 aims to promote energy and cost saving initiatives as fish prices stagnate and fuel and material costs remain high, encourage the shift to operation and production systems that emphasize profitability, and switch to management bodies that are internationally competitive (Note 40).

Through the Profitable Fisheries Establishment Support Program (hereafter, Profitable Fisheries Program), which is one component of the Comprehensive Fisheries Structural Reform Program, the Japanese government will provide financial support to cover necessary expenses of fishery cooperatives and the like that conduct demonstration projects for profit improvement based on reform plans formulated locally. NITTO SEIMO, HOKUMO, and Kasutani Fishing Net MFG., which have fishing ground rebuilding proposal capabilities, are involved from the regional reform plan formulation stage. The Profitable Fisheries Program can be positioned as an extension of fishing net companies' efforts to rebuild fishing grounds in that fishing net companies are involved in all reform plans related to set net fishing.

To date, 20 set net fishery reform projects have been certified, and fishing net companies have carried out in various places fishing ground rebuilding projects that achieved improvement of fishing nets, labor saving for net hauling, improvement of the work environment, reduction of labor costs and fishing equipment repair costs, and stabilization of business operation through year-round operation (Table 3). Among these projects, there are projects aiming at stable operation and effective use of idle fishing grounds by putting two set nets under single management, and there are projects that aim for labor saving by detecting in advance the fish that enter the nets through the use of fish school detectors in order to grasp whether fishing vessels should go out and the number of workers and materials (ice, etc.) required, with fishing net companies tackling

Table 3　Current status of large-scale and small-scale set net fishery management subject to the project of comprehensive measures for fisheries structural reform and outlook following project utilization

(Unit: fiscal year, million yen)

Project name (abbreviated)	Fishery type	Regional project operator	Fishing net manufacturer	Period	Earnings target (current status → 5th year)	
					Catch value	Earnings before depreciation
Maizuru City Area	Large-Scale Set Nets	Kyoto Prefectural Federation of Fisheries Cooperative Association (Kyoto Prefecture)	Hokumo	2012 ～ 16	235.8 → 244.9	10.5 → 31.9
Ajiro Port Area	Small-Scale Set Nets	Tottori Prefecture Fisheries Cooperative (Tottori Prefecture)	Nitto Seimo	12 ～ 14	45.1 → 48.5	－0.6 → 4.6
Hagi Area	Small-Scale Set Nets	Yamaguchi Prefecture Fisheries Cooperative (Yamaguchi Prefecture)	Hokumo	13 ～ 16	24.0 → 39.2	1.3 → 14.8
Kanagawa Prefecture Area	Large-Scale Set Nets	Kanagawa Prefectural Federation of Fisheries Cooperative Association (Kanagawa Prefecture)	Nitto Seimo	14 ～ 16	127.6 → 189.6	－6.8 → 57.1
Takeno Area	Large-Scale Set Nets	Tajima Fisheries Cooperative (Hyogo Prefecture)	Nitto Seimo	14 ～ 17	88.9 → 105.8	11.4 → 21.8
Akita Prefecture Area	Large-Scale Set Nets	Fisheries Cooperative Association of Akita (Akita Prefecture)	Hokumo	15 ～ 19	95.5 → 114.0	26.6 → 34.5
Kagoshima Set Net Area	Large-Scale Set Nets	Kagoshima Prefectural Federation of Fisheries Cooperative (Kagoshima Prefecture)	Hokumo	15 ～ 18	109.4 → 125.1	14.3 → 36.9
Noto Area*	Large-Scale Set Nets	Ishikawa Prefecture of Fisheries Cooperative Associations (Ishikawa Prefecture)	Hokumo	15 ～ 17	223.2 → 239.5	10.5 → 68.9
Nobeoka Area	Large-Scale Set Nets	Miyazaki Fisheries Co-operative Associations (Miyazaki Prefecture)	Hokumo	15 ～ 19	88.3 → 129.6	2.3 → 37.6
Goto Set Net Area	Large-Scale Set Nets	Goto Fisheries Cooperative (Nagasaki Prefecture)	Nitto-Kasutani Fishing Net Mfg	16 ～ 20	151.2 → 153.0	29.1 → 34.0
Yamaguchi Outer Sea Area*	Large-Scale Set Nets	Yamaguchi Prefecture Fisheries Cooperative (Yamaguchi Prefecture)	Hokumo	16 ～ 21	89.3 → 100.2	4.4 → 30.4
Fukui Prefecture Area	Large-Scale Set Nets	Fukui Prefectural Federation of Fisheries Cooperative Association (Fukui Prefecture)	Hokumo	16 ～ 20	112.9 → 120.8	19.3 → 32.3
Taiji-cho Area	Large-Scale/Small-Scale	Taiji Fisheries Association (Wakayama Prefecture)	Hokumo	17 ～ 22	139.0 → 145.1	22.1 → 35.7
Aomori Prefecture Fishing Area	Small-Scale Set Nets	Aomori Prefectural Federation of Fisheries Cooperative Association (Aomori Prefecture)	Nitto Seimo	16 ～ 21	87.5 → 94.1	14.7 → 21.8
Toyama City Area	Large-Scale Set Nets	Toyama City Fisheries Cooperative (Toyama Prefecture)	Nitto Seimo	16 ～ 20	113.2 → 166.0	1.7 → 45.6
Owase Area	Large-Scale Set Nets	Owase Fisheries Cooperative (Mie Prefecture)	Nitto Seimo	17 ～ 22	138.9 → 153.0	22.3 → 45.3
None Area	Large-Scale Set Nets	None Fisheries Cooperative (Kochi Prefecture)	Nitto Seimo	17 ～ 22	105.8 → 142.4	－4.5 → 26.9
Aomori Prefecture Fishing Area	Large-Scale Set Nets	Aomori Prefectural Federation of Fisheries Cooperative Association (Aomori Prefecture)	Nitto Seimo	18 ～ 23	91.9 → 103.6	26.5 → 37.2
Chiba Prefecture Fishing Vessels Fisheries Reform Promotion Concentration	Large-Scale Set Nets	Chiba Fisheries Promotion Public Corporation, Public Interest Incorporated Foundation (Chiba Prefecture)	Hokumo	19 ～ 23	268.8 → 323.8	－56.4 → 38.9
Shakotan Area	Large-Scale Set Nets	Higashi-shakotan Fisheries Cooperative (Hokkaido)	Nitto Seimo	19 ～ 23	110.7 → 121.8	1.8 → 25.3

Source: Information prepared based on restructuring plan for set net fisheries on the website of The Fishing Industry/Communities Promotion Organization

Note *: Due to the switch from a 1-fleet to a 2-fleet set net fishery, the figures for the current period are estimates.

the various challenges faced at fishing grounds through the introduction of new technologies.

National support measures for the Profitable Fisheries Program consist of a charterage subsidy and operating expenses subsidy. The charterage subsidy covers ship charter fees and are calculated by multiplying charter expenses consisting of fixed costs such as depreciation expenses for fishing vessels, repair expenses, and depreciation expenses for fishing gear by the subsidy rate (one third). The operating expenses subsidy cover total operating expenses such as labor cost, fuel cost, bait cost, and ice cost. At the end of a project period, the entire amount of the subsidy is to be returned to the government from the proceeds of sales of the fish caught during the project period (Note41) (Nata (2018)).

As described above, since the 1990s, fishing net companies have expanded proposal-based projects for rebuilding fishing grounds, as problems that cannot be solved by daily improvements by fishers, such as falling fish prices and fluctuations in stocks, have been increasing. These projects are involved in the rigging, laying and design of fishing nets across the country, and at the same time, they utilize the strengths of fishing net companies achieved through the accumulation and analysis of fishing ground information across regions. Fishing ground rebuilding is done under the initiative of a fishing net company with local consent. Fishing net companies too have been participating from the planning stage in the Profitable Fisheries Program, by contributing their accumulated experience. In this way, the presence of fishing net companies in set net fishing has been increasing.

(Note 31) Management impasses are considered to have been a frequent occurrence at fishing grounds managed by voluntary partnerships owing to the difficulty of maintaining internal reserves, especially due to the priority given to dividend payouts as a way to deal with catch fluctuations (Matsuura, Tamaki, Shimizu (2018)).

(Note 32) Since 2004, HOKUMO has been using GPS to collect 3D data on fishing grounds and analyzing this data to determine how to best use them (Fishing Development Department, Hokumo Co., Ltd. (2008)). NITTO SEIMO has been using NaLA-System, a network simulator jointly developed with researchers from universities to make business proposals including the use of fishing grounds (Suzuki, Takagi (2014)).

(Note 33) For example, HOKUMO formed “the Hokumo Mariners”, a group of set net fishers, in 2007, to focus on fishing ground assessment, maintenance, and rehabilitation of fishing grounds (Hokumo Fishing Development Department (2008)).

(Note 34) In recent years, the provision of such information has led to the entry of Seiyo Suisan K.K. in Mie Prefecture and the entry of Ajiro Gyogyo K.K. in Shizuoka Prefecture (UEDA 2020)).

(Note 35) The aim is to stabilize business management by the fishing net company informing fishers about the value of highly fresh catches, advising them on the procedure for pre-freezing fish on the open sea, and enabling them to grasp market trends.

(Note 36) NITTO SEIMO formed Nekton LLP in collaboration with Ajiro Gyogyo K.K. as a company focused on distribution, including original off-market distribution.

(Note 37) At the same time, Idoinkyomaru LLC, which operates at the Kamakura Fishing Ground, improved nets and introduced fishing vessels to save labor in order to switch employees from migrant workers from Tohoku to locals. Even in the case of the Kamakura Fishing Ground, the emphasis is on operation with a small number of workers and making stable profits (Kayama (1995)).

(Note 38) According to an interview conducted at HOKUMO, rebuilding of the fishing ground was embarked on based on the judgment of the company's CEO at the time.
(Note 39) According to the technical staff dispatched from the fishing net company at the time, the fishing grounds were rebuilt with an emphasis on building relationships with local fishers, for example by eating and drinking with them.
(Note 40) Fisheries Agency website
http://www.jfa.maff.go.jp/j/budget/23_hosei/pdf/111226_kouzou.pdf
(Note 41) Website of The Fishing Industry/Communities Promotion Organization
http://www.fpo.jf-net.ne.jp/gyoumu/hojyojigyo/01kozo/kozo_kenshokekkahoukoku.html
The actual result of four projects, namely the Maizuru City Area, Ajiro Port Area, Hagi Area, and Kanagawa Prefecture Area, have been published, and the result of one of these projects exceeds the planned targets. Other projects are also producing improvements, although less than planned due to fluctuations in fishery resources and rising labor costs.

4. Results of business expansion of fishing net companies in the set net fishery industry and future challenges

Fishing net companies are promoting labor saving in set net fisheries while undertaking also work heretofore done by fishers, such as the rigging, laying, and design of nets, and participating in the rebuilding of fishing grounds that have become difficult to exploit profitably by applying their accumulated information and expertise.

By expanding the services that they offer, fishing net companies have built a defense against inexpensive imported fishing nets. On the other hand, it is speculated that fishers' autonomy in the set net fishing sector has become weaker compared with other sectors.

Labor saving efforts, led by fishing net companies, have changed the management of set net fisheries to a high-cost structure that requires catch amounts appropriate for the incurred costs. Further, a side effect of management that reduces the labor force required for marine work by using labor-saving equipment is the tendency for shortages of onshore workers to occur after fishing vessels return to port or on days when there is no fishing, which can interfere with daily tasks such as fishing net repair work. Moreover, since the rebuilding and regeneration of fishing grounds are done for fishing grounds that are determined by fishing net companies to bring in fishing net business for a long time, this opens the possibility that the selection of fishing grounds will depend to an exceeding degree on this consideration.

4.1 Increasing cost of set net fishery management

The introduction of labor-saving equipment promoted by fishing net companies and their undertaking of fishing net design, laying, and rigging have reduced the labor force of marine and onshore workers in the set net fishing industry. The fact that set net fishing can now be carried out with a smaller labor force is considered to allow the allocation of workers to other coastal fisheries fields.

On the other hand, the cost involved in the mechanization and upsizing of set net fisheries means that catches must keep up with investments, and this creates a cycle of new equipment introduction to achieve that goal. In addition to fishery machine manufacturers, fishing net companies work with shipbuilders and maintenance companies that modify fishing net carts to develop materials and equipment that are labor saving, efficient, and compatible with year-round operation. A set net costing 200 million yen and a set-net fishing vessel 100 million yen, the total investment is expected

to reach 300 million yen. This increase in cost means greater outlays for fishers as the price for further efficiency and labor-saving improvements (Note42).

(Note 42) Dedicated set-net fishing vessels have good sway control that enables them to operate even in stormy weather, and the larger work space on board makes work more efficient and offers a better work environment (Yonezawa (2003)). HOKUMO manufactures fishing vessels for set nets in cooperation with shipyards in each region according to the needs of its customers.

4.2 Securing of labor force

Although labor saving is steadily progressing (Note43), some fishing grounds are unable to secure sufficient workers for onshore work (Note44). If a fishing net company's rigging company is nearby, the fishing net company can take care of daily repair work, but even fishing net companies are having difficulty securing sufficient manpower to take care of everything that needs to be done.

Going forward, as the population of coastal areas further declines, there may be fishing grounds where the management of fishing nets falls short and fishing grounds whose continued exploitation becomes difficult. While the number of U-turn and I-turn workers is rising, this increase is not sufficient to offset the decline in the number of fishermen/women. Fishers need to secure personnel so that a certain amount of work can be done at each fishing ground while introducing machinery to save labor in marine work. In the future, it may be necessary to take measures such as expanding the repair business of fishing net companies and having fishers from multiple set net fishing grounds perform repairs collaboratively.

(Note 43) NITTO SEIMO has developed a ubiquitous fish finder using ICT to visualize fish schools, and the company is developing technologies for further labor saving, such as technologies for adjusting the timing of net hauling and the amount of material to load on fishing vessels (Hosokawa (2018)).

(Note 44) By using the purse seine and ringnet method, the marine labor requirement can be reduced to about 8 people. On the other hand, the use of the ring-tightening method type has also issues, namely the risk that it may not be possible to secure sufficient personnel for onshore work, high cost, and the fact that this method subjects nets to heavy loads that promote net damage. Fishers select one of two types of net haulers according to the conditions at the site.

4.3 Relationship between set net fisheries and regional fisheries

Fishing net companies make effective use of set net fishing grounds to assist in raising the maximum amount of catches, while in set net fisheries, local fishers are incorporated into regional fishing bodies, and some fishing grounds are operated only at specific times by local fishers mainly. In the case of such fishing grounds, the optimal use of fishing grounds for set net fishery operation and the optimal use of fishing grounds for fishers plying their trade as a combination of multiple types of fisheries in the region may not necessarily coincide (Note 45).

In addition, as set net fisheries grow costly, their management may experience instability as fishery resources fluctuate.

If this becomes the case, management of fishing grounds not judged by fishing net companies judge to be profitable is expected to become increasingly difficult. Thus

local fishers will need to change their mindset and run set net fisheries with greater cost awareness.

(Note 45) For example, at Nomozaki-sanwa Fisheries Cooperative in Nagasaki Prefecture, joint management of set net fisheries is carried out by fishermen/women of small trawl fisheries. The set net fishing is done during the off-season for trawl fishing, which is done from summer to autumn (Fishing Communities Promotion and Disaster Prevention Division, Fisheries Infrastructure Department, Fisheries Agency (2012)).

■Afterword

This paper has clarified recent trends in the fishing net industry, mainly in the field of set net fishing. As the structure of Japanese fisheries changes, fishing net companies specializing in set net fisheries have expanded their business areas by undertaking work traditionally done by fishers, such as the rigging, laying, and design of fishing nets.

Conversely, fishers engaged in set net fishing have delegated part of their work to fishing net companies, which allows them to maintain operations in the face of major environmental changes such as the decrease of fishery workers, resource fluctuations, and fish price declines.

Set net fishery, which until some time ago has been called a fading sector, has become a key fishery in coastal fisheries where stable catches are on the rise, a change that was brought about by changing the division of labor between fishing net companies and fishers.

While labor saving promoted by fishing net companies for set net fisheries has made it possible for these fisheries to operate while the population of fishing communities is decreasing, the weight of capital investment in fishery management has further increased. Moreover, labor saving for marine work are creating a new problem—the shortfall of onshore workers. This intertwining of factors can make it difficult to manage set net fisheries in the same way as before. How fishing net companies face up to new challenges will be the subject of further study.

Enterprises engaged in set net fisheries include local entities such as fishery cooperatives, voluntary partnerships, and set net fishery companies that operate across regions. In this paper, relationships with fishing net companies could not be classified according to differences in the characteristics of individual management entities. The number of companies entering from outside the region is increasing as the number of local management bodies is decreasing. Further research will be done, taking into account differences in the characteristics of fishers.

Another task that remains to be done is to gain a detailed perspective of fishing net companies' business relative to fishers in the field. Light will be shed on these matters through further research.

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