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Descriptions of Offshore Squid Angling in the Sea of Japan, with Special Reference to the Distribution of Common Squid (*Todarodes pacificus* STEENSTRUP); and on the Techniques for Forecasting Fishing Conditions[1]

SHOGO KASAHARA

Abstract

Exploration of the fishing ground for squid angling in the Japan Sea has been conducted since 1961. Up to 1963, this fishing ground proved to be commercially feasible and prospective for squid angling fishery. Since 1967 when fishing activities became regular size, the number of vessels as well as the catch amount have been increasing two-fold each year. In recent years around three thousand vessels were engaged in this fishery and the catch amounted to two hundred thousand tons. As the result, this fishery has attracted much public attention.

At the first stage of development, fishing ground for squid angling fishery was limited mainly from thn offshore frontal zone to Yamatotai Bank located in the middle part of the Japan Sea. As the fishery developed, the fishing ground extended every year, chasing seasonal distribution and migration of the squid, all over the Japan Sea until 1971, and there remained no more unexploited fishing grounds for this fishery.

These common squid caught in offshore areas consist mainly of fall-born squid. There is no indication which positively shows aggravation of reproduction caused by fishing. However undue competition caused by the concentration of fishing vessels, decline of inshore catch caused by the interception of offshore fishing and levelling-off of the total annual catch are remarkable features in this fishery in recent years. As this fishery has already passed the stage of development and there would be no expectation of further increase of the catch, the most important object is to use the stock rationally and efficiently, and to put this fishery under steady conditions.

The history and present situation of the offshore squid angling fishery, as well as seasonal distribution, migration and fishing ground formation of the fall-born squid stock, which is the main fishing stock, and also the fishery forecasting activities are introduced here as follows.

I History of the common squid angling fishery in the offshore area

1. Development of the fishing ground of common squid

It has been well-known for many years that common squid is distributed not only in the coastal area of the Japan Sea but also in Yamatotai Bank which is situated

[1] Expert consultation on "Fishing for Squid and other Cephalopods" was held at Tokyo, Japan in September, 1975, under the sponsorship of FAO. This paper is a translation from the Japanese of the original copy included in the proceedings published by the Consultation (Fisheries Agency (1975): Exploitation and Utilization of the Cephalopod Resources in tha World).

in the middle of the Japan Sea.

During the survey on the Tsushima Current, which was conducted from 1953 through 1957, common squid was chosen together with pink salmon, Alaska pollack and saury etc. as one of the main offshore resources to be surveyed. Some knowledge on the distribution of offshore common squid was collected in this survey.

In addition to the above survey, fishery development investigation in the northern cold water zone of the Japan Sea was conducted in 1961 and 1962, by Japan Sea Regional Fisheries Research Laboratory (JSRFRL) jointly with some prefectural fisheries experimental stations concerned.

Then a knowledge about the offshore distribution of common squid in a fairly wide area and biological information were obtained. As the result, the feasibility of the squid angling fishery in the offshore area, mainly in Yamatotai Bank began to be considered.

Consequently, JSRFRL conducted experimental fishing of squid angling using a mothership, jointly with the Taiyo Fishing Company.

As the result of all these experimental operations, it became clear that common squid is distributed in high density around the offshore frontal zone of the central Japan Sea and around cold and warm waters in offshore area. Around this time, commercial fishermen found this fishery profitable and some of the large scale fishing vessels went out to Yamatotai Bank and proved the feasibility of the fishing on a commercial basis in summer, that is, from June through August. However, the fact that the catch declined sharply after mid-September revealed it was difficult to realize all-year round fishery on a commercial basis. For the purpose of solving this problem, JSRFRL investigated the area west of Yamatotai Bank in September, 1963, entrusted by Northern Japan Sea Fisheries Association consisting of six prefectures. In 1965, southward migration mechanism of the offshore common squid was investigated by experimental stations of the six prefectures ranging from Fukui to Yamaguchi. In 1966 and 1967, a large-scale tagging program was undertaken in a wide area by JSRFRL and the further information concerning the distribution and migration of squid after September was obtained. Furthermore, in 1968 and 1969, simultaneous research on fishing grounds south of 42° N was conducted by JSRFRL jointly with twelve prefectural experimental stations. On the other hand, as for the area north of 42 N, Hokkaido Regional Fisheries Research Laboratory, Hokkaido Hakodate and Wakkanai Fisheries Experimental Stations had conducted a joint survey since 1969. As a result, the general picture of the distribution, local stock and migration of squid has been disclosed. It might be appropriate to conclude that the sequence of the inten siveresearch activities has contributed greatly to the promo tion of the offshore squid angling fishery in the Japan Sea.

In other words the research activities acted as a pioneering role in the development of the squid angling fishery of today.

2. Development of the offshore squid angling fishery

As the result of a series of research activities, the squid angling fishery around Yamatotai Bank in summer proved to be fairly promising. However, it was a long time till the full-scale operation was realized. The reason was that the size of the fishing vessels was too small to carry out offshore fishing in the northern Japan Sea area, from Ishikawa to Aomori prefecture, where squid angling fishery was very important. Another reason was their special operational pattern. At that time they used to fish squid in the area within twenty to thirty miles off the coast in summer season, then moved to the fishing ground in the Pacific off the east coast of Hokkaido.

However, introduction of the automatic squid angling gear in 1964, made this fishery manageable with very few people. At the same time, development of the processing techniques encouraged the demand of squid as a material for "CHINMI", that is a kind of smoked squid.

Encouraged with all these facts, some portion of the medium type offshore trawlers from Hyogo and Tottri prefectures ranging from 40 to 60 tons, went out for fishing to Yamatotai Bank in the trawling off-season and had good success in 1967.

This successful result encouraged trawl fishermen to find their way to squid angling fishery. In 1968, the number of vessels reached 170 and this became one of the established fisheries. In 1969, the number of specialized squid angling vessels ranging from 60 to 90 tons, increased remarkably to over four hundred, converted mainly from offshore trawlers as well as from Danish seiners and salmon vessels.

The fishing grounds extended to the southwestern area of the Japan Sea thas year, according to the southward migration of common squid stocks, from the central Yamatotai Bank, and the operation lasted seven months from May through November and the catch was more than forty thousand tons which highly exceeded the total squid catch of twenty thousand tons in the coastal Japan Sea area.

Furthermore, newly constructed vessels of 99 and 100 tons equipped with deep freezers found their way to this fishery in 1970.

A lot of fishing vessels which had been operating in the eastern Hokkaido and Sanriku areas which were the main squid fishing grounds around Japan, moved into the Japan Sea because of the decline of catch in those areas. Consequently, the number of vessels reached some twelve hundred and the fishing ground extended to the northern area near Maritime Province and the catch exceeded seventy thousand tons. In 1971, the number of vessels increased up to two thousand and the catch of common squid increased up to one hundred and twenty thousand tons. The fishing ground, in thas year, extended up to the western Sakhalin by the vessels with freezing facilities. This fact indicates that there was no unexploited fishing ground for this fish in the Japan Sea, and this became one of the newly established fisheries attracting the attention of many people.

It is the specific characteristic that it took a long time to make this fishery a full-scale fishery after the fair prospect of the amount of the resource became clear

by much research. The main causes of this fact, as mentioned above, can be found in technical, sociological and economic conditions.

3. Contemporary situation of the offshore squid angling fishery

Until 1971, the squid angling fishery was under free operation without any legal restrictions except for the fishing vessels ranging from 100 up to 500 tons, which were subject to approval of the Minister of Agriculture and Forestry. However because of the high concentration of vessels in this fishing ground as a result of the rapid development of the fishery as well as the stagnation of catch in the Pacific Ocean, some difficult problems on resource conditions and safety operations arose. Therefore, the approval system by the Minister of Agriculture and Forestry was also applied to the squid angling vessels of medium size ranging from 30 tons to 100 tons in September, 1972.

Along with this, the prohibition of fishing in March and April and the restriction of fishing ground as well as landing port limitations were imposed.

Total number of approved medium size squid angling vessels exceeded 3,000 in 1972 and 1973. In 1974 the number decreased to 2,870 (Table 1). Almost all of these approved vessels are allowed to operate in the Japan Sea, and if we include some

Table 1. Number of approved vessels for medium type (30–100 tons) squid angling fishery by area by year.

Year		Number of vessels		
		1972	1973	1974
Total		3049	3127	2870
Pacific Ocean	(A)	91	180	115
Japan Sea	(B)	915	851	717
Both	(C)	2043	2096	2038
B+C		2958	2947	2755

Source: Fishery Agency

Table 2. Number of approved vessels for medium type (30–100 tons) squid angling fishery by size by state of facilities.

Tonnage Class	Total	With Quick Freezing	Without Quick Freezing	Unknown
Total	2, 870	1, 010	1, 796	64
30. 0–39. 9	439	34	387	18
40. 0–49. 9	522	104	409	9
50. 0–59. 9	367	122	243	2
60. 0–69. 9	221	157	61	3
70. 0–79. 9	144	32	110	2
80. 0–89. 9	353	40	301	12
90. 0–99. 9	824	521	285	18

Source: Fishery Agency

portion of the large size vessels over 100 tons which are also operating in the Japan Sea, the total number of squid angling vessels operating in the offshore area of the Japan Sea can be estimated at near 3,000. The average duration of a trip of the vessels of 90 tons extended to twenty or thirty days because of the quick freezing facilities (Table 2).

From 1951 to 1966 the squid catch did not increase with fluctuating from fifty thousand to one hundred thousand tons. Since 1967, however, the catch has increased sharply along witn the appearance of full scale offshore fishery, and reached two hundred thousand tons in 1970. In 1972 the catch marked the highest record of two hundred and ninty thousand tons, then decreased a little bit in 1973 and 1974, but it is still three and half or four times as much as that of the pre-developed stage of the offshore fishing ground (Fig. 1).

Now, this fishery is facing a difficult problem of undue competition. Because of the sharp increase of the number of the fishing vessels together with the end of the expansion of the fishing ground, they began to compete each other in the same fishing ground. As a result, catch per fishing vessel began to decline and the difference of catch between fishing vessels increased. Furthermore, some fishing vessels

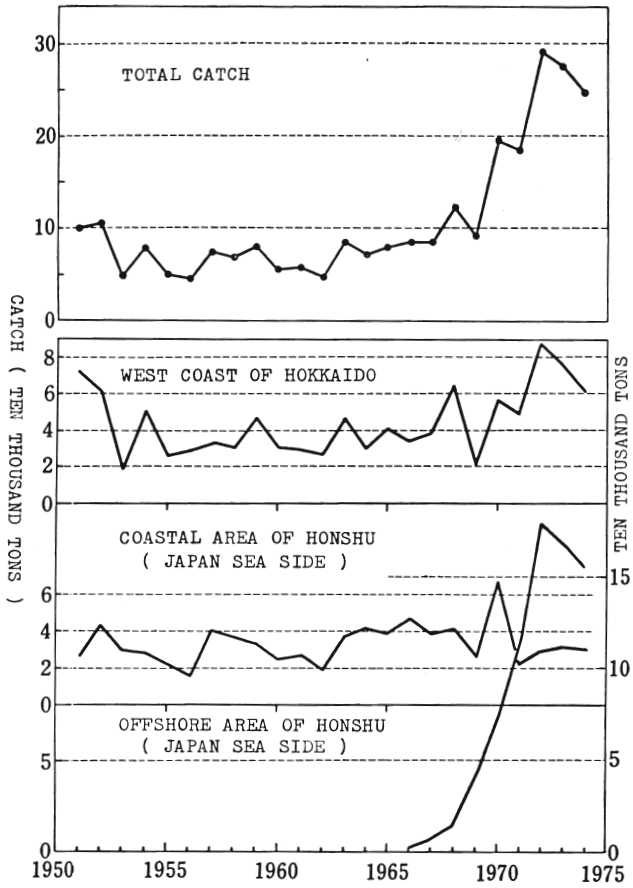

Fig. 1. Annual catch of common squid in the Japan Sea (1951–1974).

began to have economical losses. It is especially difficult for the medium size (30–100 tons) vessels with only ice storage whose area and period of operation are limited because of the lack of good facilities and efficiency. It should also be noted that the catch in the last half of the season decreased sharply from that of the first half, and the total annual catch in the offshore area was levelling-off or decreasing. On the other hand, the sharp increase of the offshore catch of fall-born squid reduced the catch in the coastal area of the western Japan Sea and Tsushima Island. This is interception of the offshore fishery. At any rate, no further increase of catch is expected, because this fishery has passed the stage of development. Therefore, the most important problem is to use this stock efficiently and make this fishery a steady one.

II Distribution, migration, fishing ground and fishing season of the fall-born squid stock

1. Distribution and migration

There are three stocks of common squid in the Japan Sea. They are winter-born, summer-born and fall-born squid. Almost all common squid which are caught in the offshore area are fall-born.

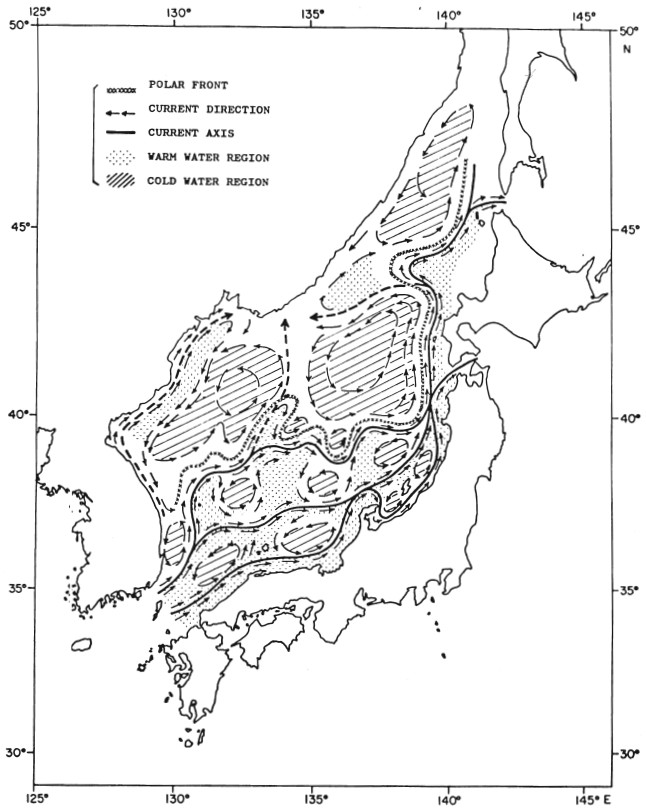

Fig. 2. Typical current movement and dispostion of weter masses in the Japan Sea in summer (NAGANUMA, unpublished).

Main spawning grounds of fall-born squid probably lie from the southwest Japan Sea to the northern East China Sea. Larvae of squid which are born in these areas appear in the coastal areas of the Japan Sea south of 39° N from September through November. As for the areas south of Tsushima strait, they appear from the west coast of Kyushu to the outer edge of the continental margin in the northern East China Sea. Juvenile squid which are around 20–120 mm in mantle length are caught in great amount by set net and beach seine which are set from western Kyushu to middle Honshu from December through April mainly from March through April.

No detailed information about the distribution of larvae and juveniles near the Korean Peninsula are available. They appear from the southern Yellow Sea to the coastal area of the East China Sea all year round, and juveniles of 25–50 mm in mantle length are caught from October through December.

Juveniles are distributed in the depth of 25–50 m, and appear specifically in warm water. Juveniles less than 70 mm in mantle length, have hardly any swimming ability because of their shape. They seem to grow drifting in the Tsushima Current.

In May, adult of 15–18 cm in mantle length are caught near Takeshima Island situated in the western Japan Sea between Okinoshima Island and western Honshu, and in the area of offshore branches of the Tsushima Current especially off Noto

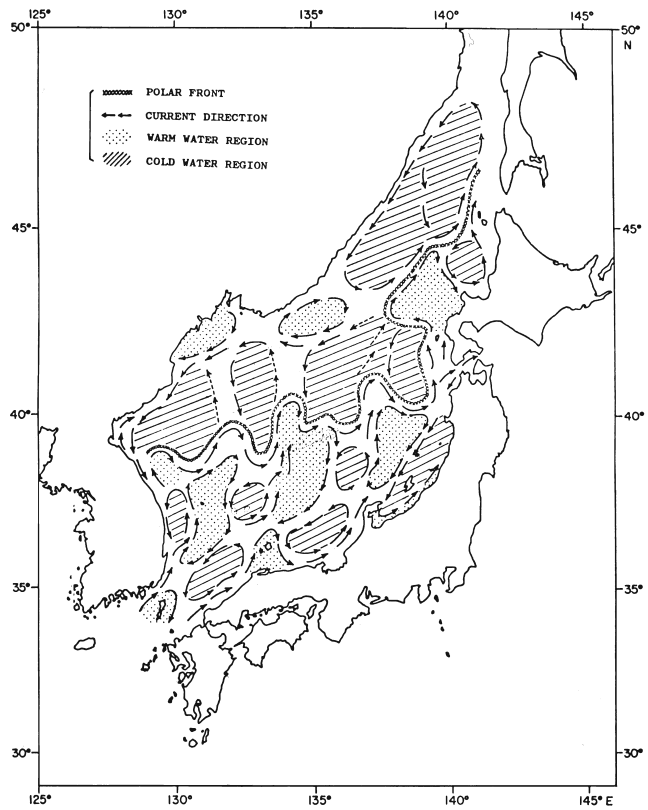

Fig. 3. Typical current movement and dispostion of water masses in the Japan Sea in autumn (NAGANUMA, unpublished).

Peninsula and near Sadn Island.

At the same time, fairly large squid are canght also in the offshore frontal zone of the Japan Sea which is the main fishing ground of pink salmon. Squid which belong to this stock also arrive at the coastal area of the northern Korean Peninsula from the end of April to early May and fishing activities start at this time.

From all these facts, it can be assumed that the squid which have been distributed in the coastal area would migrate northward quickly as far as the central Japan Sea with the strong movement of the Tsushima Current in early May.

It is quite certain that, in June, they are distributed all over the offshore Japan Sea south of 42° N, judging from the results of research activities and catch data. Especially, they are highly concentrated in the southern rim of the winding zone of the offshorefront, the outskirts of the northern cold whirling waters and coast of the southern Maritime Province. These areas are very good fishing grounds for squid.

Although some stock living around the offshore frontal zone migrate to the coast of northern Honshu (north of Noto Peninsula) and southern Hokkaido and also some stock distributed north of the offshore frontal zone migrate to the east of the Korean Gulf and the Korean Peninsula, we are quite sure that almost all squid do not migrate extensively but stay around the same area judging from the tag recovery.

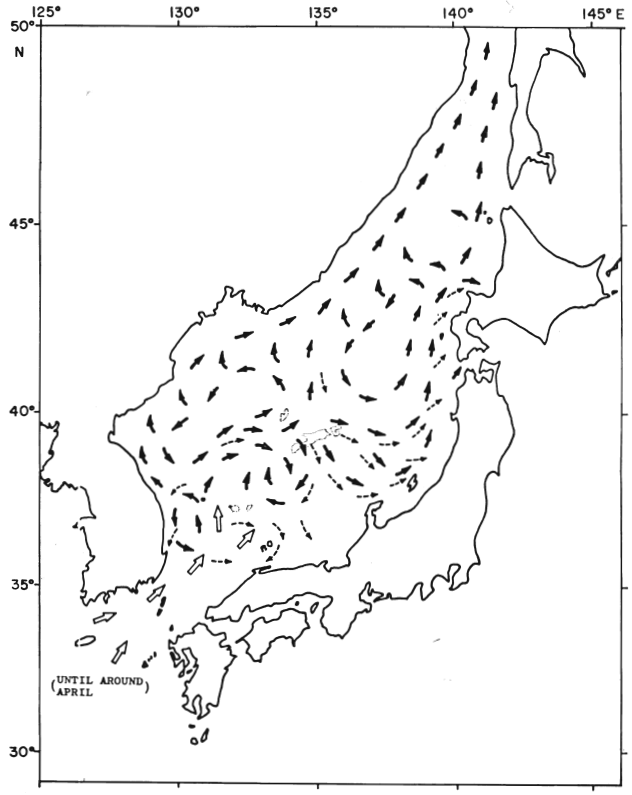

Fig. 4. Typical distribution and migration of northward migrating common squid stocks in the Japan Sea in spring-summer term (KASAHARA and ITO, 1972).

Fall-born squid in the offshore area of the northern Japan Sea north of 42° N come out in July. However the main area of distribution is up to 45°–46° N and very few stocks are distributed north of this area.

In the case of the common squid, the male matures first. In early August the maturation rate of the male exceeds 50 percent and copulation begins from this time. After copulation, they begin to move southward. In the first and the middle term of September, the maturation rate of male reachs 90 percent and copulation rate of the female reaches 70–80 percent.

In the middle of September, almost all of them begin to move southward. In late September, fall-born squid disappear from off western Hokkaido and, from September through October, they arrive mainly in the east coast of the Korean Peninsula and the coast of the Tsushima Islands.

The course of this migration is closely related to the pattern of the current at this time.

Stock which is formed at this time as distributed south of the offshore front, moves southward to the coast of the Tsushima Islands along with the southward current which is situated at the east rim of the large warm water masses near Utsuryo Island, north of Okinoshima and Sadogashima Islands. They rarely migrate

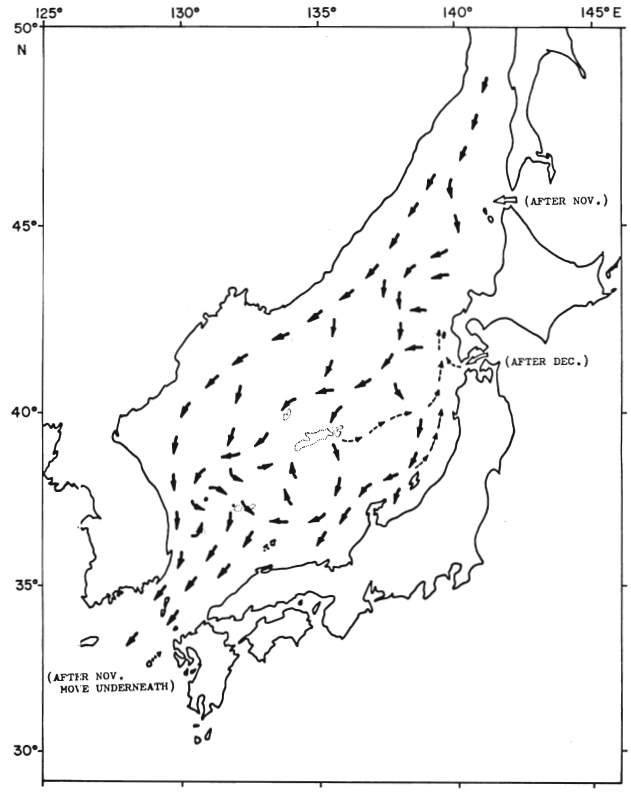

Fig. 5. Typical distribution and migration of southward migrating common squid stocks in the Japan Sea in fall term (KASAHARA and ITO, 1972).

northwestward across the frontal zone. On the other hand, stock which is distributed north of the offshore frontal zone, rarely migrates southward to the coastal area of Honshu across the offshore frontal zone and it is recognized that the main stock gathers in the east coast of the Korean Peninsula after moving from the southern Maritime Province along with the westward current near the coastal area of the northern Korean Peninsula. Afterward, they migrate along the east coast of the Korean Peninsula.

As stated above, after their birth fall-born squid in the offshore Japan Sea are moved northward by the offshore branches of the Tsushima Current up to the offshore frontal zone until May.

In summer (from June through August), they continue to grow mainly in the offshore frontal zone and the outer rim of the whirling cold water zone. They migrate southward in fall (after September).

It is apparent that their distribution and migration are closely related to the pattern of the oceanographical conditions of the Japan Sea, especially to the movement of the current and the location of the water masses (Fig. 2 and 3). Figures of the usual year are summarized in Figure 4 and 5.

2. Fishing ground and fishing season

Fishing season of the squid angling fishery in the offshore area of the Japan Sea, is from May through December with the peak from June to October (Fig. 6).

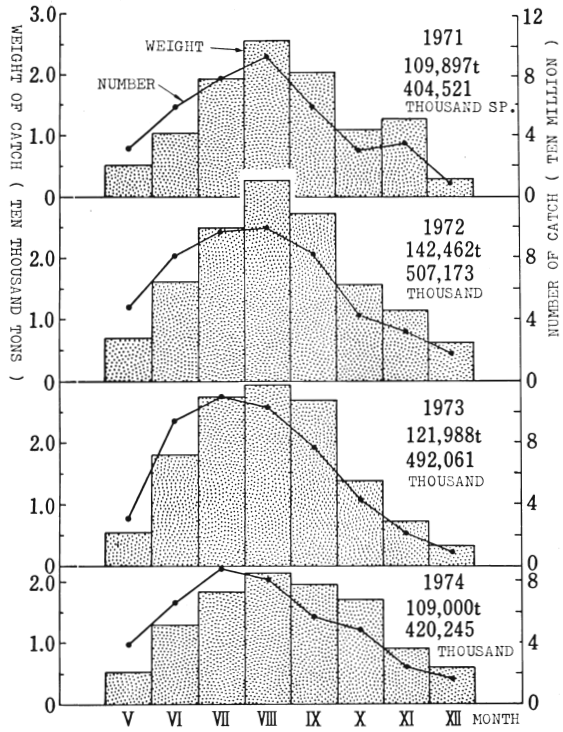

Fig. 6. Catch of common squid in the offshore Japan Sea by year by month (landing of honshu only).

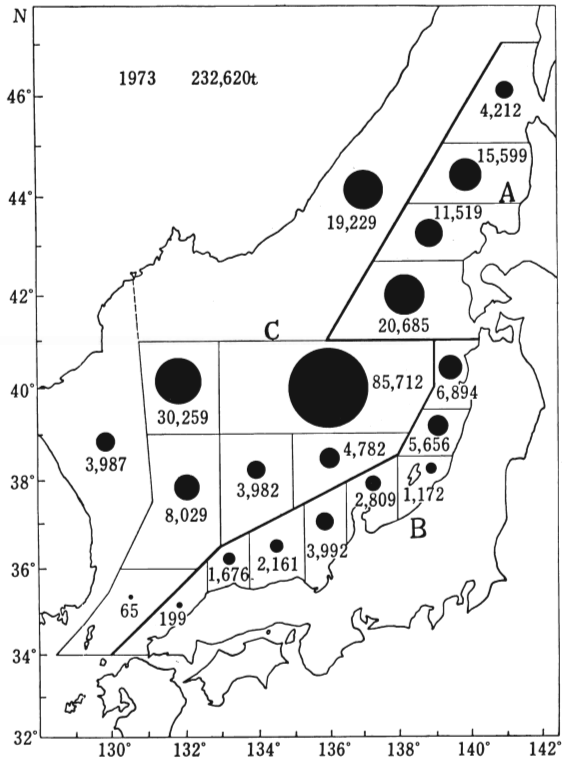

Fig. 7. Catch of common squid in the Japan Sea by area in 1973.
A—coastal area west Hokkaido
B—coastal area off the Mainland in the Japan Sea
C—offshore area off the Mainland in the Japan Sea

Catch data by area shows that the offshore fishing grounds of squid are formed in the central Japan Sea between 39° N and 41° N (Fig. 7).

In May, they are formed near the coast of Honshu and they move northward after that. From June through October, which is the peak season, they are formed near the frontal zone (Fig. 8).

The distribution of offshore squid is closely related to the conditions of the sea.

High density stocks, in summer, are found in the southern rim of the meandering zone of the offshore front whose temperature is within the range of 5°–10° C in 50 m depth.

They are also found near the cold waters in the area north of the frontal zone.

In September, high density stocks are found in the northern rim of the meandering zone of the front as well as in the outskirts of the offshore cold waters north of it. Different from summer, there might be no high density stocks in the warm water of the southern rim. From these facts, it can be concluded that the location of high density stocks which form the fishing grounds, fluctuates according to the annual pattern of sea conditions such as the location of the offshore frontal zone and offshore cold waters, as well as the seasonal (summer to autumn) changes.

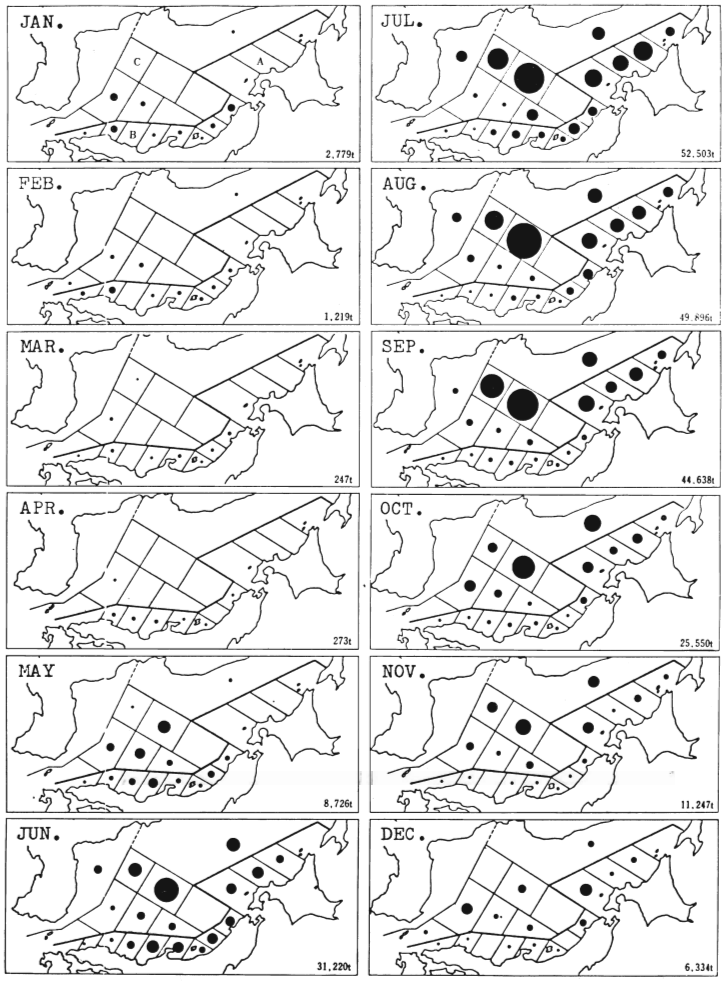

Fig. 8. Catch of common squid in the Japan Sea by area by month in 1973.

Location of the offshore frontal zone in early June, when the fall-born stocks begin to move northward, and the location of it in early September, when they begin to migrate southward, are shown in Figure 9. Compared to normal years, it was located further north in the area west of 135° E in 1972 and 1973. On the contrary, it was located in the south in 1974. With the change of the frontal zone, the center of distribution of high density stock moves. In 1972 and 1973, it was located near the coast of the northern Korean Peninsula and very good fishing grounds were formed in the northwest part of the Japan Sea from June through August. In early June in, 1974 high density stocks were found in the central Japan Sea near 38°–39° 30′ N, and the fishing grounds were formed further south than usual.

Good fishing grounds are located where the current changes from convergence to divergence.

As for the wave-shaped frontal zone, areas around the valley correspond to it. In the middle of the warm waters and cold waters, there seems to be no high density

stocks and there are no good fishing grounds.

As stated above, fall-born squid stocks begin to mature around August, and begin to migrate southward. Owing to this migration, the location of fishing grounds changes. After October, the main fishing grounds are usually formed around the tip of the tongue-shaped cold waters extended from the north, and also around the boundary zone between warm warters and cold waters.

From June through October, fall-born stocks eat a lot of food, mostly *Parathemisto* (*Parathemisto*) *japonica*. The abundance of these food species makes them stay there and it is the main reason of the formation of the good fishing grounds.

The ranges of temperature which show the distribution of relatively high density stocks from June through September are 13°–28° C in 0 m deep, 5°–25° C in 20 m deep, 1°–19° C in 50 m deep and the main scopes are 20°–24° C in 0 m deep, 17°–22° C in 20 m deep, 5°–13° C in 50 m deep. However, in the area north of the offshore frontal zone, especially near the coast of the South Maritime Province, they are caught in great amounts where the temperature is lower than 5° C in 40–50 m deep.

It is known that they move vertically in a very short time in the waters where there is a marked difference of temperature. Therefore they seem to be a very adaptable to temperature.

Accordingly, it may not be efficient to search for the fishing ground only by means of temperature.

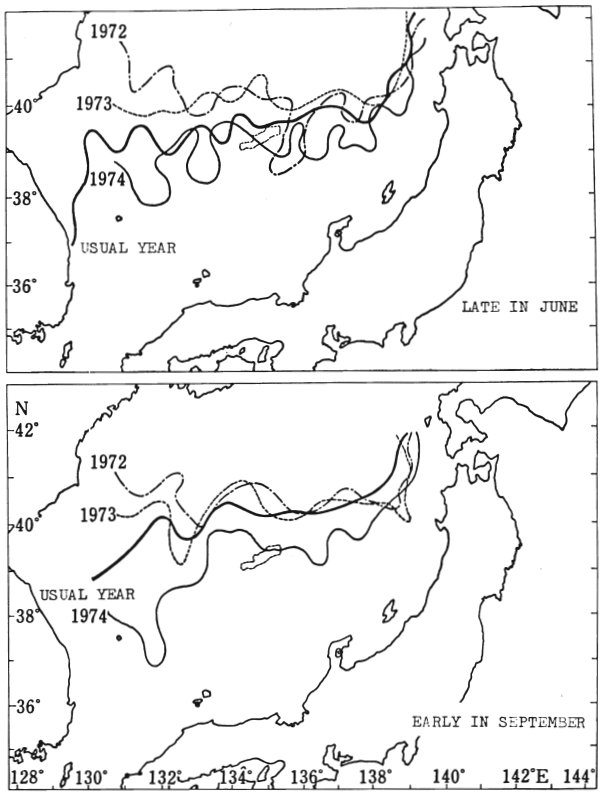

Fig. 9. Locations of offshore front (7° C in 50 m deep).

Locations of water masses and developed current boundaries would be the important indices for locating fishing grounds.

III Current situation of fisheries forcast

1. Outline of the forecasting activities

Fishing vessels which are engaged in the squid angling fishery range from vessels less than 30 tons to those larger than 400 tons, including 3,000 medium size vessels (30–100 tons), which are the most popular ones. Total catch by all these vessels amounts to 250.3 thousand tons. Fisheries conditions have changed extremely because of the expansion of fishing grounds, complication of stock structure and fluctuation of stock size and fishing grounds.

Because of these backgrounds, squid angling fishery became one of the objectives of the fisheries forecast.

Accuracy of the forecast might be somewhat low because of the limitation of knowledge, budget and personnel. Outlines of the forecasting activities are described as follows.

The most important basic data used for the forecast is that obtained by the research for all fishing grounds conducted by research vessels twice a year, that is, in spring and fall.

The research in the spring is conducted in early June when the recruitment of squid into the Japan Sea is supposed to be completed.

This is the time when they begin to migrate to the north. On the other hand, the fall research is conducted in early September when they begin to migrate to the

Table 3. Population size index and density index of common squd in the Japan Sea.

Year	Early in June†		Aug.–Early in Sep.††	
	P.S.I.††† (thousand)	D.I.††††	P.S.I. (thousand)	D.I.
1971	100. 9	58. 0	67. 2	28. 6
1972	61. 6	36. 7	66. 6	28. 4
1973	38. 7	22. 2	71. 9	30. 6
1974	32. 7	23. 6	57. 3	24. 4

† At the beginning of northward migration
†† At the beginning of southward migration
††† Population size index
†††† Density index
Source: Calculated by the following formula;

$$P = \Sigma A_i \phi_i$$

where P = Population size index
A = Area index
ϕ = Density index
Calculated areas
At the beginning of northward migration: South of 42° N
At the beginning of southward migration: South of 45° 30′ N

south. This research mainly consists of experimental fishing and oceanographic survey. Observation points are fixed, in grid shape, to cover the important offshore areas. Many research vessels (6–10 vessels belonging to the prefectural experimental stations) are arranged to survey cooperatively all fixed points in one week. Therefore, data obtained by research vessels, reflects the conditions of the sea at a certain time.

From this data, we can know the location of high density stocks and the sea conditions. This information is important. Besides, it is essential for the estimation of the stock density index and population index (Table 3).

It is also important for study of the relation between fishery activities and oceanic conditions.

Furthermore, biological information such as body length, maturity aad copulation are also obtained and are utilized to identify and to understand the migration of stock. Research data on fishing grounds, obtained by the vessels of the prefectural experimental stations and the fisheries high schools, are utilized together with landing information obtained in main fishing ports, in order to supplement the data obtained by the simultaneous research.

As for oceanic conditions, "Prompt report on fishing grounds and oceanic conditions in the Japan Sea" which contains the monthly data on the oceanic conditions at the fixed observation points, published by the JSRFRL, is the most important source of information.

After the simultaneous research, which is conducted twice every year, is completed, a meeting of experts on the forecast of the fisheries and oceanic conditions is hosted by the JSRFRL. Here, long term forecast concerning the fisheries and oceanic conditions for the coming three months, is discussed and published for fishermen.

An example from the 1974 forecast for offshore squid fishing together with relevant data which was the main source of the forecast, is shown as follows;

(1) Fisheries forecast in June–September term (published on June 21, 1974)

Spuid which will come to the offshore Japan Sea consist of stock which was born last fall (fall-born squid). The abundance of this stock which will be the objective stock from June through September, may be on the same level or a little bit better than that of last year.

In early June, high density stock was found exclusively in the area one hundred miles west of Nyudo-zaki Peninsula. Areas of rather high density stocks were located east of Utsuryo Island –south of Yamatotai Bank –west of Nyudo-zaki Peninsula and were extended northeast-ward in the shape of belt which was 30–50 miles wide (Fig. 10).

Main fishing grounds will be divided into two parts by a line 135° E (Yamatotai Bank) for the July–September term. In the area east of this line, main fishing grounds will be formed northeast of the Yamatotai Bank. In the area west of this line, the main fishing grounds will be formed much more south than usual that is,

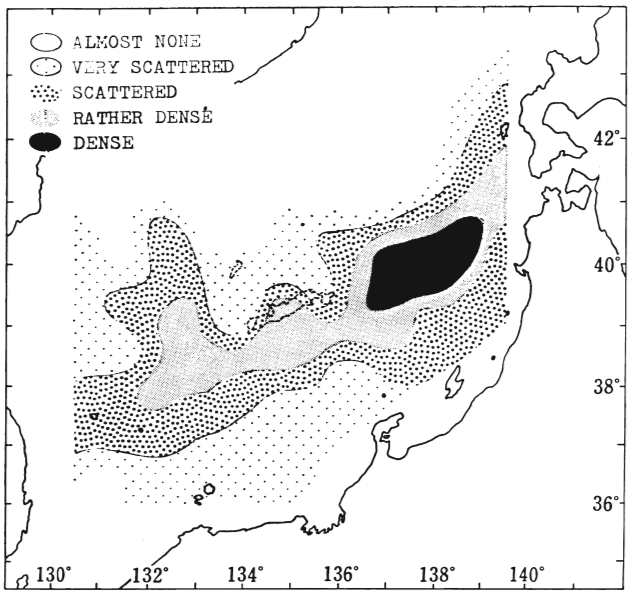

Fig. 10. Distribution of common squid from late in May through early in June in 1974 (by simultaneous research).

from the areas north of Utsuryo Island to the west of the Yamatotai Bank.

These main fishing grounds will move gradually to the north, but it will begin later than usual.

Good fishing grounds might not be expected near the coast of the northern part of the Korean Peninsula.

Considering stock size, distribution pattern and oceanic conditions, the catch amount per vessel may be the same or slightly better than that of last year.

Catch in the area west of Yamatotai Bank would be relatively steady but catch east of the Yamatotai Bank will fluctuate daily and from vessel to vessel. Location of fishing grounds will also move around inconstantly.

The number of vessels which has been increasing rapidly up until 1972 reached the ceiling in 1973. This year, it is expected to be a little bit less than last year. Therefore, the total catch will be at the same level as last year (In the Japan Sea off Honshu, 84,000 tons in Jaly–September in 1973).

(2) Fisheries forecast in the October–December term (Published on Sep. 27, 1974)

Squid which will come to the offshore Japan Sea consist of stock which was born last fall (fall-born sqhid).

The abundance of this stock which will be the objactive stock from October through November will be at the lowest level since 1971 and a little bit lower than that of last year (1972 brood fall-born squid).

High density stock was found near the continent mainly in the southern Maritime Province and the coast of northern part of the Korean Peninsula. It was also found in the central Japan Sea near Yamatotai Bank and west of Tsugaru Strait (Fig. 11).

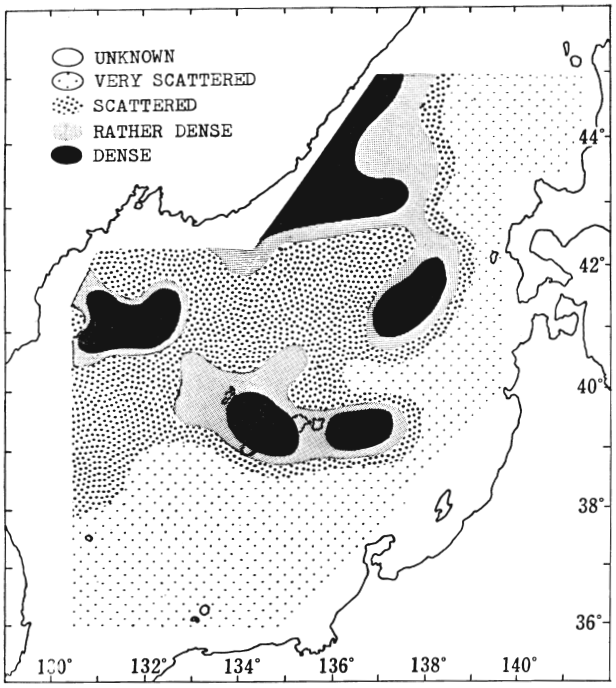

Fig. 11. Distribution of common squid in late in August in 1974 (by simultaneous research).

Fall-born stock mature rapidly and copulates extensively around August.

In September they begin to migrate southward. As the copulation rate of the female and the maturation rate of the male have exceeded those of last year and reached the same level since August as in normal years, southward migration will begin at the same time as usual.

Main fishing grounds will be formed from east of the Korean Gulf to Utsuryo Island, in the area west of 133° E. In the area east of 133° E, they will be formed from Yamatotai Bank to the north of Okinoshima Island.

Recruiting stock size is estimated slightly smaller than that of last year. Therefore, even though the number of vessels is expected to decrease a little bit, the competition of vessels will be as severe as last year and catch per vessel as well as total catch in the October–December term will be slightly less than that of last year (In the Japan Sea off Honshu, 35,000 tons in October–December in 1973).

2. Problems of forcasting activities

There are a lot of problems about the contents, precision and time period of the forecast of fisheries conditions of squid in the Japan Sea.

One of the difficulties is to get the information of recruit in the early stages, because their life span is only one year.

Now, we publish the first estimate of the recruit utilizing the data obtained by the total research activities conducted at the beginning of June, when their recruit

is estimated to be completed. Fishermen have a desire to get this information much earlier. In order to comply with their request, eggs and larvae of the fall-born squid are systematically collected. As it is in progress, results are not yet known. But if it goes well, more exact estimation of the recruitment can be expected in the near future.

It should also be noted that the fixed observation points of the total research do not completely cover important areas, especially, the coast of the Korean Peninsula where high density stock is found every year. This fact might have been the cause of a mistaken estimate of the stock size.

For example, stock size was underestimated at the beginning of June in 1973, 1974 possibly because of this reason.

At the meeting on fisheries forecast, the difference between the estimate of recruit and the actual catch in July–September term was discussed. As a result it was judged finally that the main reason for this difference was the lack of information in the coastal area of the Korean Peninsula.

There is a strong desire from fishermen for the short term prompt report in addition to the long term forecast which is now published twice a year. This is not too much to ask because fisheries conditions very continuously. Therefore, we are planning to publish a prompt report of a short term, say, on weekly basis.

If this plan is realized, a combination of long term and short term reports would make the forecast very speedy while it would improve the contents and precision of the forecast. Then, the forecasting system will be substantially improved.

Anyway, in order to improve the contents of the forecast, much more cooperation is necessary with fishermen who are the main source of information. Now, fishermen are not well organized to provide us assistance, but systematization is gradually under way.

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日本海沖合のいか釣漁業の動態とスルメイカ分布性状および漁況予報の方法

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要　　旨

沖合スルメイカ釣漁業の動態

日本海沖合のスルメイカについては，1961年から組織的な漁業開発調査が進められ，1963年に至つて漁業成立の見通しが得られた．その後，1967年から漁業として本格化し，以降は着業船，漁獲量とも毎年倍増の傾向を辿り，1972～1974年の着業船は約3,000隻，これらの漁船による沖合水域からの漁獲量は20万トン前後に達し，一大新興漁業に発展した．

開発当初の漁場は日本海中央部の大和堆を中心とした沖合前線帯付近に限られていたが，漁業の発展に伴つて年々拡大され，1971年にはスルメイカ群の季節的分布・移動に対応して日本海沖合のほぼ全域へ展開し，事実上，未利用漁場を残さないまでに開発が進められた．

新漁場の開発が終了した1971年以降は漁場内での多数漁船の集中による過当競争，沖合水域での“先取り”による沿岸水域での漁獲減少傾向及び年間漁獲量の頭打ちがめだつている．漁場開発の段階をすでに通り越し，この面からの大幅な漁獲増加を望めない現状においては，この資源をいかに有効に利用し，漁業の維持と安定を計るかが大きな課題である．

秋生まれ群の分布・移動，漁場・漁期

日本海沖合いか釣漁業の主要な漁獲対象群である秋生まれ群は，発生してから後の5月頃までの春季には対馬暖流の沖合分枝流によつて沖合前線帯付近まで北上し，6～8月の夏季には沖合前線帯及び渦流冷水域外縁部を中心とした各水域で滞泳しながら成長をつづけ，性成熟が進んだ9月以降の秋季には南下移動するが，その分布・移動は日本海の海況パターン，とくに流動や水塊配置と密接な関連がある．

沖合いか釣漁業は主として5月から12月にかけて行われるが，盛漁期は6～10月である．漁場は，巨視的には39°～41°N間の沖合中央部に形成されるとみてよい．漁期当初の5月には本州沿岸寄り水域に形成され，その後月が進むにつれて北上し，盛漁期の6～10月は中央部の沖合前線帯付近を中心に形成される．その後の南下移動期における主漁場は秋型海況において北の方から舌状に延びる冷水域の先端部付近

及び大規模暖水域と冷水域とが接する潮境付近に形成される．

漁況予報の方法

日本海のスルメイカは，国の漁況海況予報事業の一環の中で重要な予報対象種のひとつにとりあげられている．予報に使用されている基礎資料の中で最も枢要な地位を占めているのは，春季（6月上旬，スルメイカ群の動きからみると北上初期）と秋季（9月上旬，南下移動の初期）の2回にわたつて実施される漁場一斉調査資料である．調査は漁獲試験と海洋観測が主体で，沖合水域に重点をおいて，重要分布域をできるだけカバーするよう網目状に調査定点を設定し，多数の調査船が共同して1週間程度で全定点の調査を消化するように行動する．したがつて，漁場一斉調査によつて得られるデータはある時間断面の状態を反映するもので，これらのデータに基づいて，各調査時点における魚群の濃密分布の位置や拡がり及び海況などが把握される．これらの情報自身重要な予報内容であると同時に，魚群密度指数，魚群量指数の推定及び漁況と海況との関連の追求に関する重要な資料源となる．

現在，年2回にわたつて行われる漁場一斉調査終了後に，日本海区水産研究所を中心とする漁況海況予報会議が開催され，各種資料，情報に基づいて3か月先までのスルメイカ漁海況に関する長期予報文が作成され理由と資料のあらましを添えて公表されている．