THE SPINY KING CRAB FISHERY IN THE WATER AROUND NEMURO PENINSULA: HISTORY, MANAGEMENT AND FISHING EFFICIENCY

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Fig. – 8, ref. – 2.

1. HISTORY AND CURRENT STATUS OF THE SPINY KING CRAB FISHING IN NEMURO WATERS

Nemuro city is located at the east end of Hokkaido. Its administrative district is the Nemuro Peninsula, which is surrounded by the Sea of Okhotsk and the Pacific Ocean, and the city has been prosperous with the key industry of fishing based on the abundant aquatic resources. Crab fishing in Nemuro began with the first operation by Mr. Shozo Izumi and Mr. Katsusaburo Usui on the Kunashir coast in 1905. One of the characteristics of crab fishing is that it became affordable as an independent industry because crabs, which had been used only for private consumption, became directly linked to canned products. Also, the packing techniques of Nemuro are excellent and its canned shrimp and other products received the bronze prize at the World Exposition held in Paris in 1902. A technique in which crabmeat is wrapped in parchment to preserve the color was invented by Mr. Usui and has become a world standard. A number of people sang songs as they worked in the canneries. These songs are handed down as folksongs even today. It was an industry that has contributed not only in economical side but also culturally.

The development of the king crab canneries had reached maximum in 1930's, and Hokkaido had decided to deliver no more permissions for establishment of King crab canneries. Thus, in 1934, the traders who abandoned king crab cannery had applied permission for spiny king crab cannery, and approved in 1935. The 11 spiny king crab canneries that started operation in 1936 produced 15,200 cases (1 case contains 96 cans of 1/22-pound). Subsequently, both the number of canneries and their production volume increased, and the production (of the 17 canneries) hit the maximum record of 30,600 cases in 1938. However, the Pacific War started in 1941,

and after cans come to be under wartime distribution control, operating canneries had been decreased. When the War ended in 1945, the spiny king crab fishing was gradually reestablished. 4,370 cases (a catch of 850 tons) were produced in 1950, but production decreased after 1952 because the catch of spiny king crab was poorer than that of other crabs such as the red king crab, and it came to be treated as an unimportant material for canned food.

In recent years, the demand for boiled spiny king crab has increased in popularity as a special feature of tourism and a representative of the dainties of Nemuro due to its rich taste. This is reflected in the fact that the crab was named "Hanasaki" after the former name of the Nemuro Peninsula, Hanasaki County. The spiny king crab is loved, and the Nemuro Crab Festival, held in the crab season of the beginning of September, attracts 50,000 tourists from all over the country.

Based on the prewar production volume of canned crab between 1936 and 1938 the estimated catch is 3,000 to 6,000 tons a year throughout Hokkaido. After 1965, the catch in Nemuro was the highest in 1968, at 2,666 tons, but since then, it has been fluctuating in the 1,000–2,000 ton (**fig. 1**). In 1977, the fishing in the so-called triangular water area was banned and the catch decreased to 423 tons. It decreased even further to 39 tons in1980. A three-year fishing ban in Nemuro waters began in 1981, and, in the same year, 6 fishery associations in Nemuro region, Nemuro city, Bekkai Town etc. established the liaison council for measure on sustaining/ increasing spiny king crab stock in the Nemuro water (presently, the council for measures on spiny king crab stock in the Nemuro water). This council was a center in setting the allowable catch and the exploitable size of spiny king crabs, and further, reviewed fishing system, such as fishing season etc., up to present. As a result, the stock shows a rebounding tendency, and the catch became 443 tons in 1993, but the stock has remained at a low level of around 100 tons as present status.

Though the catch of spiny king crab does not currently dominate in the catches of other species in Nemuro in terms of both amount and sales, the spiny king crab is representative of the city's dainties and has a great significance in historical and cultural aspects. We expect the joint results of Hanasaki Program can become the basis of future collaboration for sustaining and increase of the spiny king crab stock.

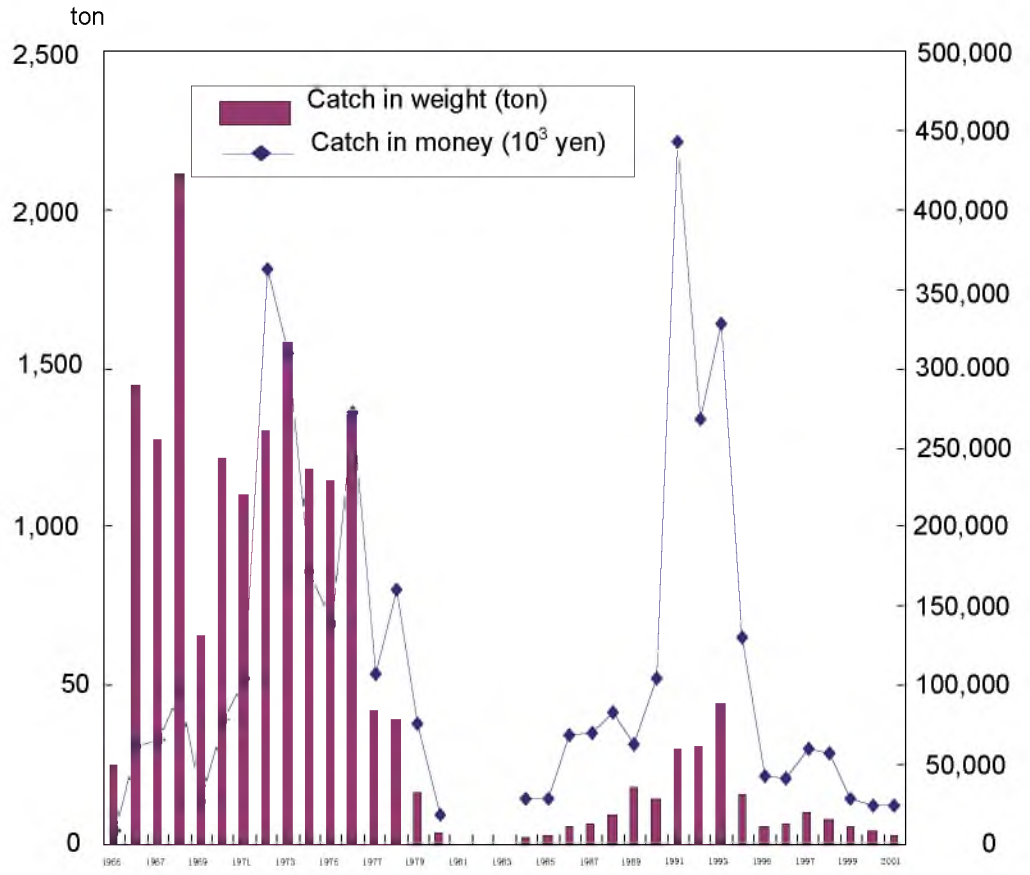

Fig. 1. *Historical catch (in weight and in money) of spiny king crab by crab fishery in Nemuro, fro 1965 to 2001*

2. MANAGEMENT OF SPINY KING CRAB FISHERY IN THE WATER AROUND NEMURO PENINSULA

2.1. License

As for the fishery license, the spiny king crab fishery in Nemuro city was operating under the common fishery right of Nemuro Sea Common No. 33, and, since autumn of 1993 up to now, it was moved to fishery licensed by governor of Hokkaido. The fishery is operation based on three licenses.

2.2. Operating period

Operating period of the spiny king crab fishery in Nemuro can be divided into spring season and autumn season with annual variation (**fig. 2**). For the spring season, the fishery is operated by three fishing boat belonging to Ochi-ishi Fisheries Cooperative in the water west from Cape Ochi-ishi mostly from March to June. For the autumn season, the fishery operates mostly from July to September, with annual variability.

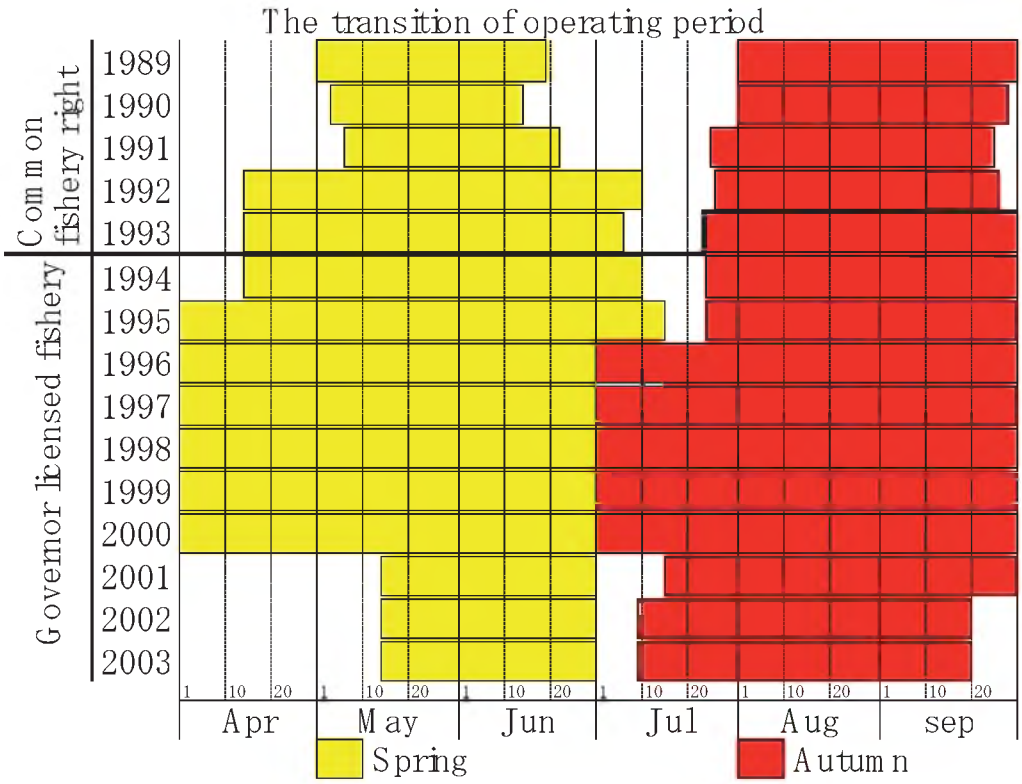

Fig. 2. *Historical transition of operating period of the spiny king crab fishery in Nemuro*

2.3. Operating Area

The spring operation area is the part of the fishing ground area of the common fishery right of Nemuro Sea Common No. 33, west from the Cape Ochi-ishi (**fig. 3**). The summer operation is "Pacific Area" : the part of the fishing area of the common fishery right of Nemuro Sea Common No.33, that is north from the line 70 deg. 30min. from the tip of the Cape Nosappu, and "Okhotsk Area": the fishing area of the common fishery right of Nemuro Sea Common No. 23, excluding the area east of lines, sequentially connecting Points 1 to 22, defined by Attached Table 2-2 of Article 32-2 of Hokkaido Ocean Fisheries Coordination Rule, and the line 160 degree true bearing from Point 22. And, by the operation guide line based on the line for license handling of the Common Ownership &Management, Committee of the common fishery right of Nemuro Sea Common No. 33, the operation is prohibited in the shore area of Habomai within 1,000m from land (from Cape of Nosappu to Cape Tomoshiri).

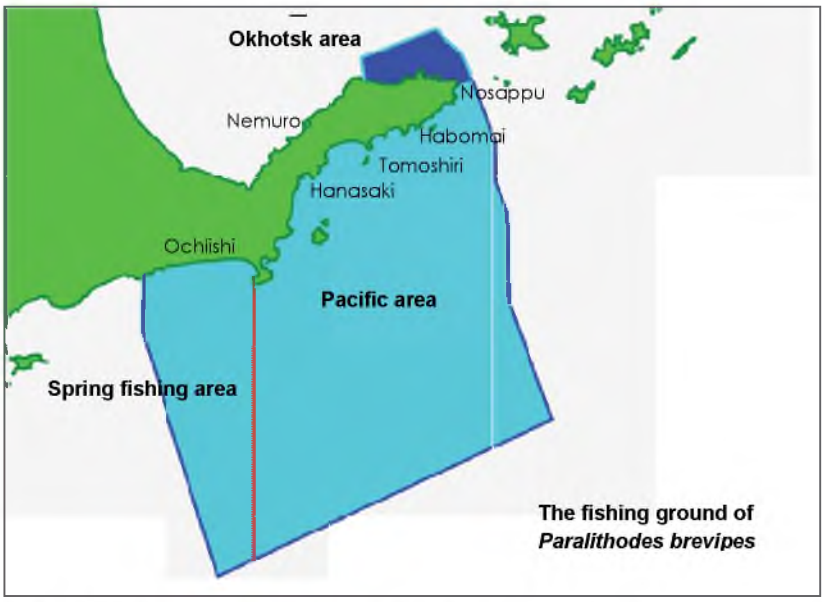

Fig. 3. *The fishing ground of spiny king crab in the water around Nemuro Peninsula*

2.4. Number of Licensed Boats

The number of licensed boats is, in the case of spring fishing, 3 that belong to Ochi-ishi Fishery Cooperative, and in the case of 2003, the number of boats actually operated was also 3 (**fig. 4**). In the case of autumn operation, it is up to 35 boats those belong to the six Cooperatives within Nemuro Branch. In the case of 2003, the number of boats operated in each area was, 16 in Pacific Area and 12 in Okhotsk Area. However, there exist overlapping boats between Pacific Area and Okhotsk Area, the number of actual operating boats was 13.

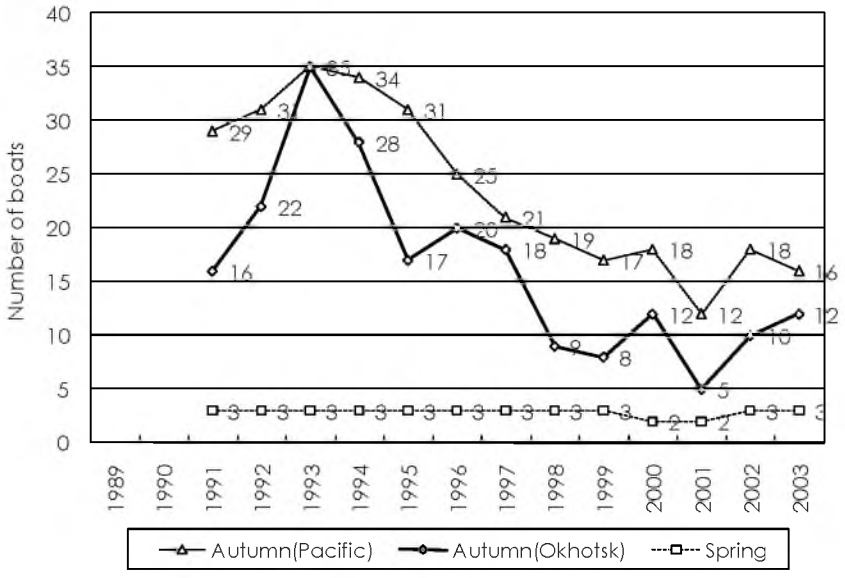

Fig. 4. *The transition of number of operating boats on spiny king crab fishery in the water around Nemuro Peninsula*

2.5. Fishing Gear in Operation

The fishing gear permitted to use is of the maximum of each of width, depth and height not exceeding 90cm, and number of up to 300 pots per boat. The dimensions of actual crab pot generally used by fishermen in Nemuro City are about 90cm in diameter of bottom, about 40cm in height, about 47cm in diameter of upper frame with net of 60mm mesh size, and as for the pit part, about 32cm in diameter of top of pit funnel, about 26cm in diameter of lower mouth of pit funnel and height of about 15cm (**fig. 5**).

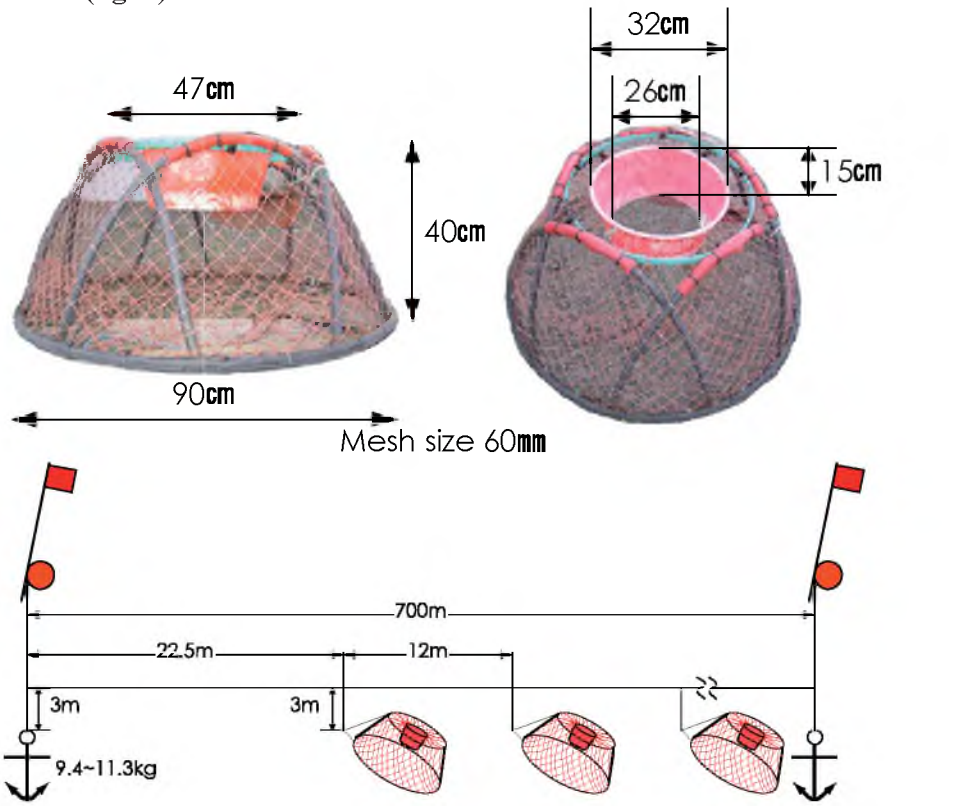

Fig. 5. *The permitted crab pot for spiny king crab fishery in the water around Nemuro Peninsula*

For setting these pots as in the form of longline, a set of gear, which fisherman call it as "One Extension" (in Japanese "Hito-Noshi"), is compose from pots main line, branch line buoy rope, anchor rope, anchor, buoy etc. A basic set of gear used by fisherman in Nemuro City is composed from, one main line, 50 branch lines, 2 buoy ropes, 2 anchor ropes, 2 anchors, 2 buoys and 50 pots. The number of gear sets permitted for operation in Pacific Area is up to 6 sets of length not exceed 800m per boat. The generally used gear is about 700m in length of main line with 50 pots. For the Okhotsk Area, each of number of pots and number of gear sets has own limitation. As the limitation by license by governor of Hokkaido, among total permitted 300 pots, the use of 80 pots is allowed to use in the Okhotsk Area, and by the operation guide line based on the line for license handling of the Common Ownership &Management Committee of the common fishery right of Nemuro Sea Common No. 33, the number of pot per gear set is within 40 and only one set of gear is allowed for one boat.

2.6. Limitation of Catch by Carapace Width

A crab allowed to catch is a male of carapace width exceeding 8cm. By the special permission of catch, a female of carapace size exceeding 11.5cm can be caught. And catch of a crab just after molting is not permitted.

2.7. Amount of Catch in Weight and in Yen

In the period since 1989, the total catch of Spiny king crab, including Pacific Area and Okhotsk Area, reached its peak of 441.257 ton (0.46% of total fisheries landing of Nemuro City) in 1993, then decreased rapidly since 1994, and, in 2003, became 87.075 ton, about 1/5 of its peak (**fig. 6**).

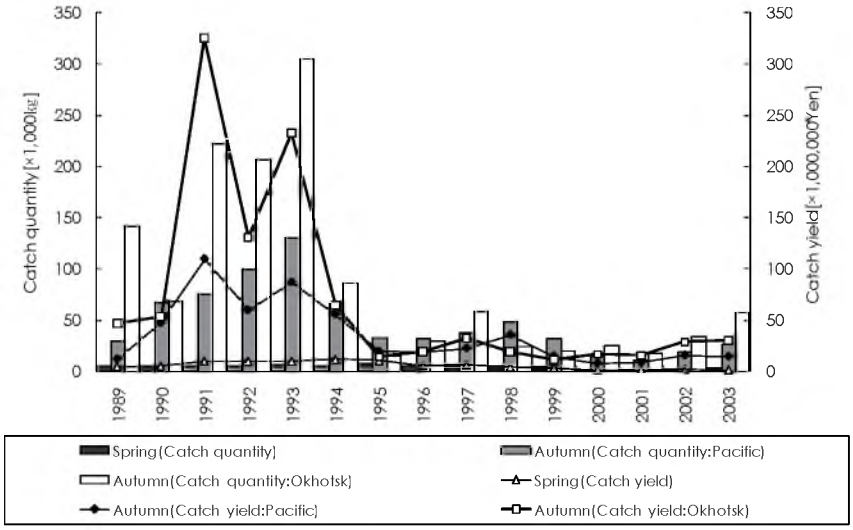

Fig. 6. *The transition of annual catch of spiny king crab in the water around Nemuro Peninsula, in weight and in money*

In the period since 1989, the amount of catch in yen, including Pacific Area and Okhotsk Area, shows its peak of 443,229,437 (1.36% of total fisheries landing of Nemuro in yen) in 1991, then decreased rapidly since 1994, and, in 2003, became 45,218,568, about 1/l0 of its peak.

3. FISHING EFFICIENCY OF CRAB POT FOR SPINY KING CRAB

Here, we would like to introduce the results of survey on the crab pot executed jointly by Kushiro Fisheries Experimental Station and the Conference for promotion of Spiny king Crab Stock Survey (present: Communication Conference for Measure of Sustaining & Increasing of Spiny king Crab Stock) in 1981 to 1983.

3.1. Survey on the difference in catch selectivity by mesh sizes of pot cover net

The survey on the existence of catch selectivity by mesh size of pot cover net was executed by random allocation of crab pots using 2 kinds of cover nets of 40mm and 75mm mesh sizes, among 1 set (40 pots) of gear, deployed day and night at survey points A and B in the Hatta-ushi Coast of Nemuro City, from May 28 to June 6, 1981. The catch tests ware made by deploying one set of crab pot gear that have two kinds of cover nets of 40mm and 75mm mesh size, once at Station A and twice for day and night at Station B, total three times. The variance analysis was done on the results of catch number by instars per pot for each mesh size in each test.

As the results, there are;

A) Differences of catch number per pot between three tests;

B) Differences in catch number by instars;

C) No differences in catch number between used mesh sizes of 40mm and 75mm; and

D) No differences in catch number by instars between different mesh size.

It become clear that the catchability of pot for any instar does not change between covers nets of different mesh sizes of 40mm and 75mm. The aim of this survey was C) and D), and the results indicated that, there are no difference in the individual number of catch and in the instar composition of catch, between pots of different cover net of 40mm and 75mm mesh size, and the results of test, catch using these two kinds of pots can be considered equal.

3.2. Survey on the Attracting Area of Crab Pot

The two kinds of test were made during May 31 to June 10 and September 23 to October 10, 1982; the one was by the method to estimate from difference in catchability between pots allocated by different spacing, and the other is to examine the distance of crab entering pot by releasing tagged crabs around the pot.

A) Using total four sets of gear, each have pots attached in spacing of 6, 9, 12 and 18m, seven times of catch experiments were made in almost same place by changing points, and recorded number of individuals caught by each pots in catch operations of principally one night immersion. The crabs caught was tagged and released, after examining and recording necessary items. The total numbers of pots were 635.

B) The entering distant test were made by immersing three pots in 2m spacing, and releasing total 200 individuals of tagged crab by diver at the eight points 15m and 30m apart from pots in each four directions, i. e. 25 individuals per points, and picking up the pots after one night immersion.

Results were;

A) The test operation of crab pot gear of different spacing was made total seven times, but one was daytime immersion and another two were two or three nights immersion. Thus, to analyze on the case of same condition, the data only for remaining four cases of one night immersion were analyzed. The catch efficiency is best in the case of pots with 6m spacing, and efficiency lowered for the cases of smaller or larger spacing. From this result, it can be considered that the attracting area of pots are overlapping in the case of 6m spacing and causing lower catch efficiency, and, in the case of 9m spacing, overlapping is less. The lowering of catch efficiency in the case of 12m spacing seems to be caused by the effect of interaction between neighboring pots in the case of 9m spacing. Therefore, the attracting area of crab pot of one night immersion can be estimated between 9m and 12m.

B) As the results of test operations for examining entering of tagged crab release around the pots, total of 8 individuals were caught by 3 pots of one night immersion, but tagged crab is none, and thus the attracting area of crab pots cannot be estimated from this tests.

3.3. Survey on entering/escaping of spiny king crab with length of immersion

In order to elucidate the entering and escaping procedure with the days elapsing after immersion, a survey was made from June 5 to 10, 1882, using following four types of crab pots:

i. Pot without bait;
ii. Pot with bait in bait container can;
iii. Pot with naked bait on metal wire;
iv. Same as above, but bait renewed after one day immersion.

Putting in each pot with tagged crab of 15, 10, 5 and zero individuals and entering and escaping individuals were checked after 1 day and 5 days immersion.

There are no characteristic differences among the methods of attaching bait, excepting the fact that the number of crab in the pots without bait showed case of decrease but never increase (**fig. 7**). Thus, by taking average of these four kinds of test crab pots, it is identified that, though the pots having initially 5 individuals of crab show almost no change, the pots initially no crab show increase of crabs in the pots and the pots having initial individuals of 10 to 15 indicate decreasing trend converging around 5 individuals. Considering together with the results of catch survey that, until 5 to 6 individuals, the number of individual caught per pot increase proportional to the inhabiting density, but when density increase more than that the number of individual caught per pot does not increase, we can estimate that the saturation density of crab in a pot is around 5 individual. We must note that this saturation density can naturally depend on the size of crab, and thus we need to examine in detail in future studies.

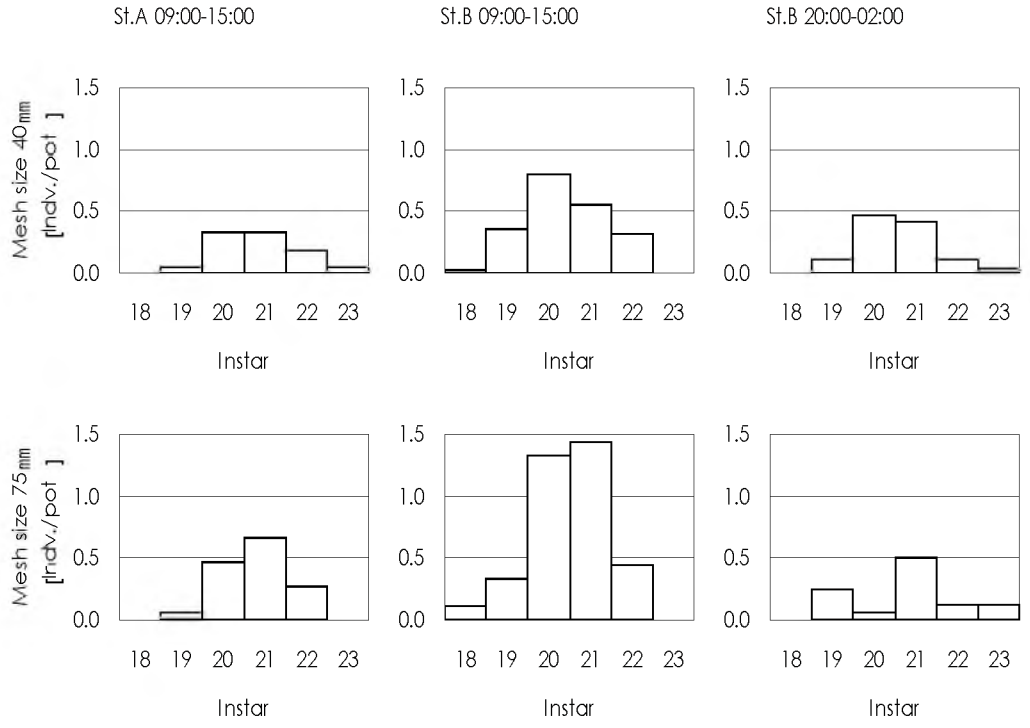

Fig. 7. *Catch in number per pot by instar-class and mesh size*

Above examinations are only on the total number of individuals in the pots. When inspecting entering one and escaping one separately, for example, in the case of 2 pots having initial individuals of 5 and bait in bait can, the number of individuals in the pot for the case of one day immersion and 5 days immersion, was 5 and 9 individuals respectively. In the case of 5 individuals, one was escaped between day

1 and day 5, and new one enter the pot, and in the case of 9 individual, 2 had escaped and 2 had newly entered into the pot, and as the results, the number of individuals in the pot shows no changes. On the other hand ,examining the remaining rate by sex and carapace size, the remaining rate after 5 days immersion decrease as increase of carapace length both for male and female. This may because, when carapace length becomes large, the chance of escaping by reaching legs to the funnel part can increase.

3.4. Survey on the relation between length of immersion and catch (fig. 8)

The relation between length of immersion days and catch was investigated using 6 sets of gear having 20 pots per set, by changing immersion days from 1 to 4 days, during May 26 to June 17 and November 24 to December 9, 1982. The largest individuals per pot were caught in case of 3 days immersion, and it showed decreasing trend again in case of 4 days immersion. However, as the number of data for 4 days immersion is not enough, it cannot be decisively determined but it can be confirmed that catch of crab pots can change with changes of immersion days.

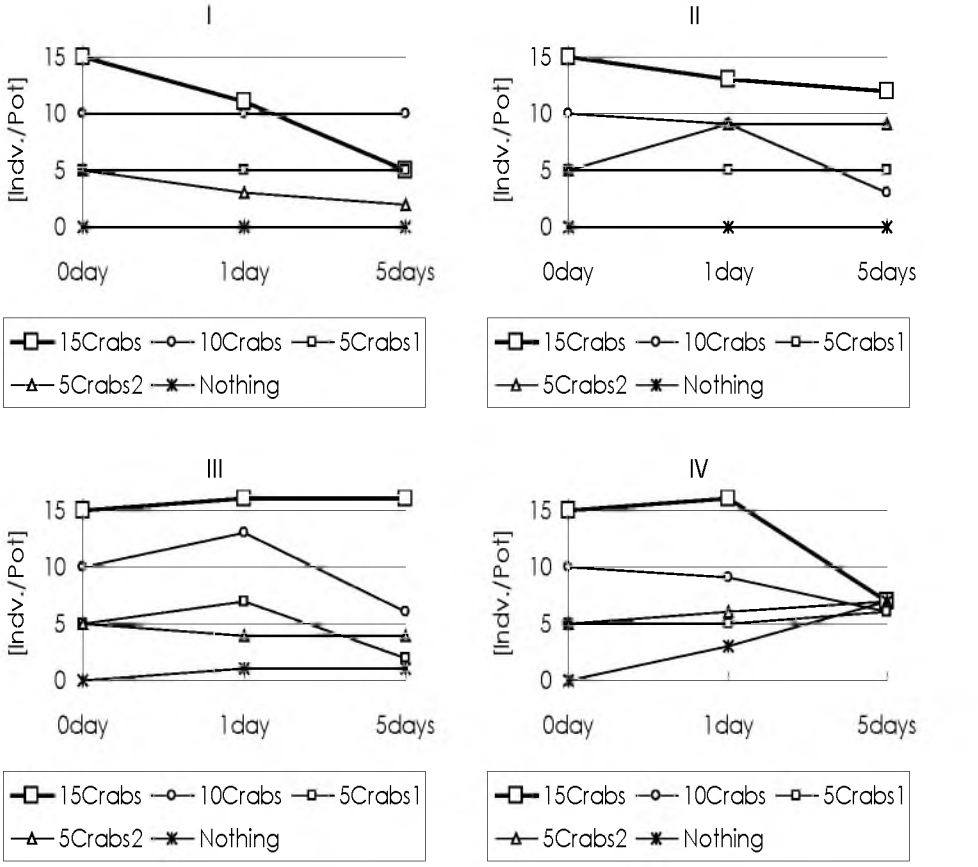

Fig. 8. *Changes in number of crab in pot according to soaking passage of pot*

3.5. Survey on comparison of type of pot

The survey on comparison of number of individuals caught and its instar composition of 1-hour immersion of flat pot and 24-hours immersion of ordinary pot, in the water off Goyo-mai, in 1982 and 1983. As the results, it was estimated that the catch of ordinary pot can be expected to be 3.71 times of flat pot catch in spring period and is 2.47times of flat pot in autumn.

4. SUBJECT TO BE CONSIDERED

In order to obtain quantitative estimates of fishing efforts, the past survey data must be examined closely and analyzed on following items, and then the contents of future survey must be considered.

i. Consideration the difference of catch in weight and in yen among boats with relation to the gear used;

ii. Consideration the plan of complementary survey to obtain mesh selectivity curve preliminary and the in higher precision;

iii. Trial calculation of the fishing efficiency (exploitation rate) of a pot and a set of gear.

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