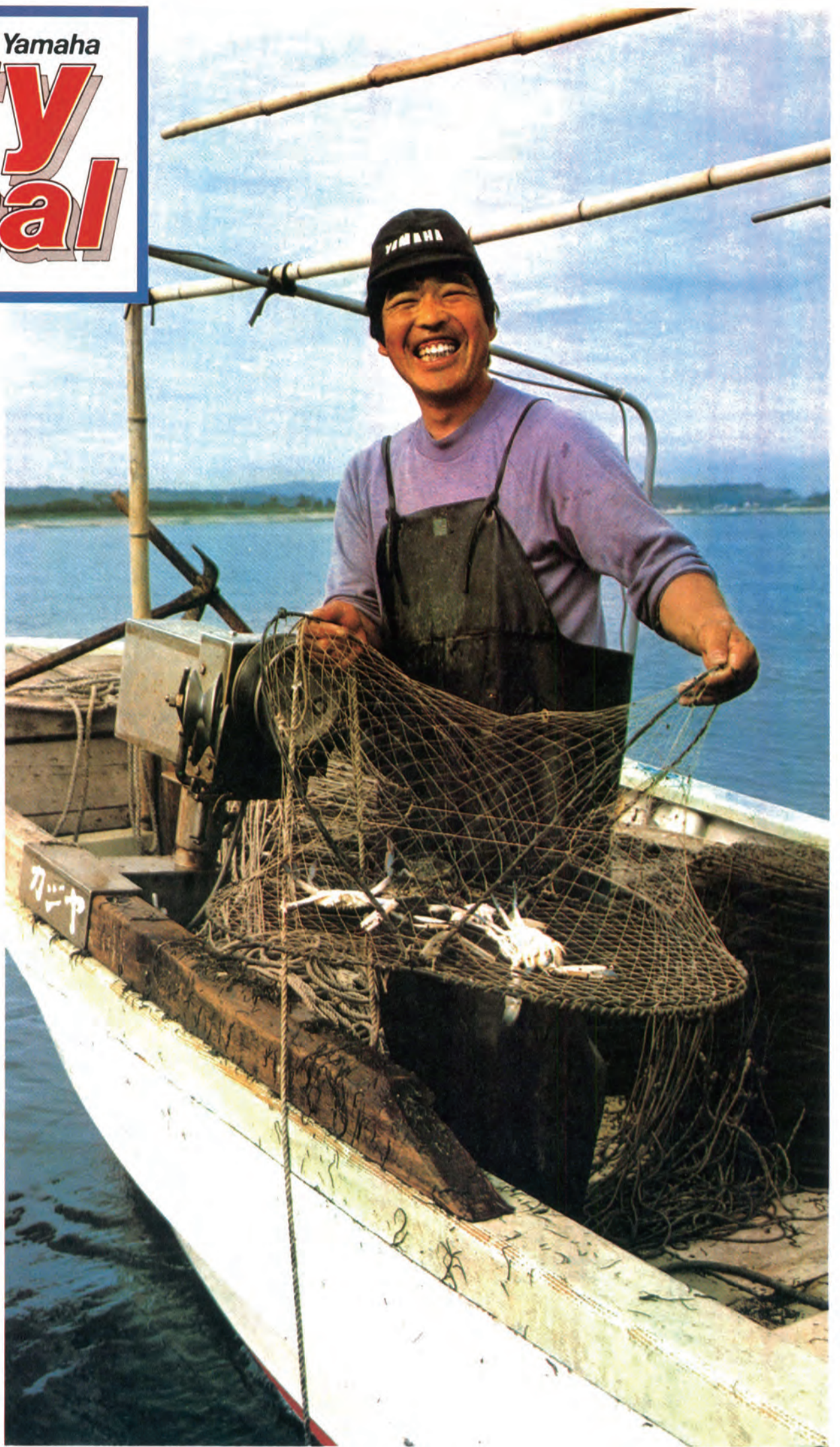


Selection in Crab Fishery

Production of international commodities or development of home industries?



With the "practical" beginning of the 200 mile era, coastal countries began to have jurisdiction over their own coastal fishing grounds. This has forced both coastal countries and those engaging in pelagic fishery to cope with new situations. Within the fisheries industry complicated international relations, such as the interdependence between the developed nations and the developing nations have begun to appear.

Hereafter, a marked tendency for marine products to be produced as international commodities is expected. Also, many countries will be striving to promote fisheries as a major means of national development. Countries that are thinking of starting fisheries and making good use of the unused aquatic resources for their economic development, must choose between one of the courses of development; either to obtain foreign currency by export or to improve the fishing village economy by supplying sea foods to the people.

Needless to say, it is impossible to put these two courses into practice separate-

ly. One of the two must be chosen as the primary objective, based on conditions such as the biological characteristics of the resources intended for development catching method and funds that will be involved, and international commodity value of the fish caught.

In order to illustrate this problem, we will discuss the case of crab fishery in this issue. Japan was once the largest crab fishing country in the world, but now Japan is the largest crab importing country. Moreover, in the coastal waters throughout Japan, many small fishing boats are engaged in commercial crab fishing. These phenomena seem to have aroused the interest of crab producing countries around the world, because in Japan there exist both cold sea crabs in comparatively large quantities and warm sea crabs which are not so abundant but which are omnipresent over a large area; and both types of crabs have been utilized in highly refined forms, establishing their value as a priority catch. There are all kinds of methods for crab fishery, and it is interesting to note that the various

methods which have been developed over the years vary greatly according to type of crab being caught.

Entre Artículo de Exportación y Desarrollo de Industrias Nacionales

Los países que estén pensando en comenzar la explotación de la pesca y usar adecuadamente los recursos acuáticos para su desarrollo económico, deben escoger entre dos caminos: obtener divisas extranjeras con la exportación, o mejorar la economía de las aldeas pesqueras suministrando al pueblo alimentos marinos.

Sobra decir que no se puede separar prácticamente estos caminos; pero la selección de uno u otro como objetivo primario, debe hacerse de acuerdo con varias condiciones, tales como las características biológicas de los recursos que se intentan desarrollar, los fondos y métodos necesarios para la pesca, y el valor internacional del pescado.

Para considerar estos problemas, en esta edición presentaremos la pesca de cangrejos.

Denrées pour l'exportation ou produits pour la consommation intérieure.

Maintenant, les pays qui envisagent de développer leurs industries de pêche et exploiter au mieux leurs ressources aquatiques inutilisées en vue de leur développement économique, doivent choisir entre méthodes: soit obtenir des devises étrangères avec les exportations ou améliorer l'économie de pêche du village en approvisionnant la population avec des denrées à base de produits maritimes.

Il est évident qu'il s'avère impossible de mettre en œuvre ces deux méthodes séparément, mais la priorité de l'une des deux méthodes doit se faire en fonction des conditions variées telles que les caractéristiques biologiques des ressources sélectionnées pour l'exploitation, les moyens requis pour la prise des produits de mer et les fonds pécuniers nécessaires ainsi que la valeur des denrées sur le plan international.

Afin d'envisager ce problème sous le meilleur angle, on traitera de la pêche aux crabes dans ce numéro.

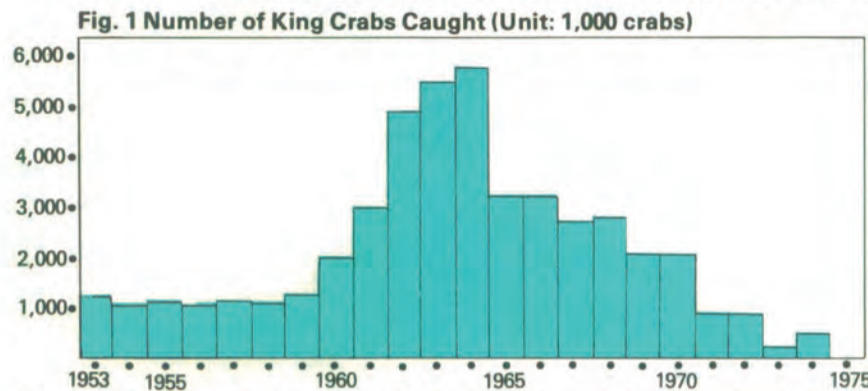
The Rise and Fall of Mother

Japanese Crab Fishery in the North Pacific Ocean

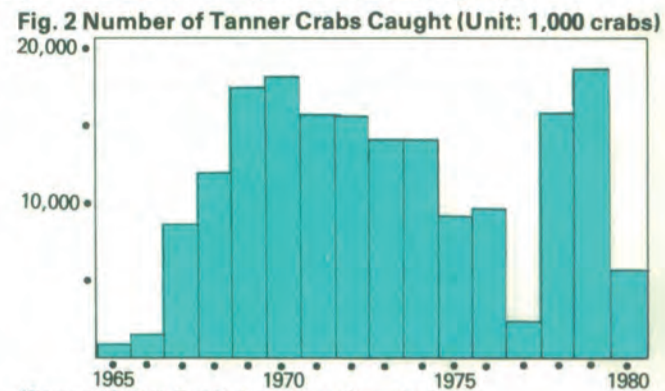
Change in catch by Japanese mothership-type crab fishery in the eastern region of the Bering Sea

Fig. 1 and 2 show the changes in catch of crabs by mothership-type fishery in the fishing grounds of the North Pacific Ocean.

Traditionally, king crabs have been the main crab caught in northern waters. But, as a result of fishing control of king crabs by the Japan-Soviet Fisheries Treaty and the Japan-U.S.-Canada Fisheries Treaty, fishing in recent years has changed to catching mainly tanner crabs.



[Remark 1] Both king crabs (*P. camtschaticus*) and blue king crabs (*P. platypus*) are included.
[Remark 2] Since 1975, the quota of catch of king crabs has been reduced to zero.



[Remark 1] Both *C. bairdi* and *C. opilio* are included.
[Remark 2] This indicates only the catch by mothership-type fishery, and no catch by landbased fishery is included.

Ecology of Crabs

Although the market price of crabs varies with the species, generally they are distributed as "prime fish". Along with tiger shrimp, salmon, tuna, squid and others, crabs are one of the "international goods".

Because crabs live mainly in fishing grounds rich in bottom prey animals in the continental shelf environment, it is possible to get a comparatively stable catch efficiently. Their habitats are limited and the growth period of crabs, especially those living in cold currents is very long. Therefore, the reproduction potential of crabs is rather limited. For the successful development of crab fisheries, management of resources is one of the measures which must be given top priority.

[Classification]

Crabs belong to the class Crustacea of the phylum Arthropoda, and they are classified as shown in Fig. 3. The Arthropoda contain many species and aquatic arthropods are mostly crustaceans. Among these, crabs as well as spiny lobster and tiger shrimp are numbered among the important aquatic resources.

Most species of crabs live in the sea; however, a small number of species also live in fresh water, in the brackish water of estuaries, and on the coastal land. Crabs are widely distributed from the tropical to frigid zones, and they show great variety in terms of morphology and ecology.

Reproduction, Development and Morphology

Crabs are dioecious, and the sex can be easily determined by the external shape. As to reproduction, ectosomatic fertilization takes place by copulation and the female carries eggs in the abdomen for protection. Crabs grow through various larval stages with body shapes quite different from those of the mature adult. The first larval stage, i.e., nauplius stage, occurs within the egg, and hatching occurs at the zoea stage. During the planktonic life stage, the zoea metamorphoses into the megalopa, a more advanced stage of larva. The megalopa grows further into the adult crab.

The body and appendages of arthropods are covered with the exoskeleton containing a chitinous substance. Ecdysis occurs several times during growth, because the exoskeleton does not grow at the same rate as the inner body. Shrimp, prawn and crab are the most evolved species among the crustaceans. The body consisting of 20 segments is divided into the head, thorax and abdomen. Each body segment has paired appendages, and of these, five

pairs function as walking legs. Other appendages are transformed into antennas, mouth parts and a part of the copulatory organ. Out of the five pairs of walking legs, the most anterior pair is transformed into the cheliped, and for the species which have a swimming capacity, the last pair is transformed into the pleopod.

[Ecology and Life History]

Because the ecology and life cycles of crabs vary greatly with latitude and living environment, we have chosen three representative species of marine crabs living in the North and Central Pacific Ocean to be discussed here.

•King crab (*Paralithodes camtschaticus*)

This species is a large crab living in the North Pacific Ocean. It is characterized by the fact that the fifth pair of appendages are atrophied and concealed under the body, and there are many spines on the surface of the body and appendages. It inhabits the continental shelf at depths up to 250m, and its optimum water temperature is $-1^{\circ} \sim 12^{\circ}\text{C}$.

The female reaches sexual maturity at 5 to 6 years of age. Both male and female become fertile when they reach a size of about 90mm in carapace length. The breeding season of this species is during the spring, and these crabs come to shallow coastal waters in groups to copulate and spawn. Fertilized eggs are brooded by the female until the next spring and hatch from March to June enter-

ing into the planktonic stage of their life cycle. The planktonic life stage is about two months, and after that benthic life begins. Young crabs live gregariously in shallow waters between 20 ~ 60m, but with growth they gradually migrate to the deeper bottom in what becomes a seasonal depth migration.

In the waters around the northern districts of the Japanese Islands, they generally live in the sandy mud zone between 30 ~ 300m in depth. The life span is over 15 years. The growth is slow and the reproduction rate is low.

•Tanner crab (*Chionoecetes opilio*)

This species lives on the continental shelf from Alaska and Kamchatka to the Japanese Islands. There are many small protuberances on the dorsal surface of the carapace. The legs are slender, and all leg segments are flat. The body color is pale testaceous. The male is larger than the female, and it has a carapace of more than 140mm. The female's carapace is 75 ~ 85mm long.

They live in the sandy mud bottom 200 ~ 400m deep, but they move to comparatively shallow waters in winter.

It is believed that tanner crabs reach the adult stage after the 9th instar*, and they obtain complete copulatory ability after the 10th instar. They reach this stage about eight years after hatching. Another species (*bairdi* type) similar to and larger than the *opilio* type lives in almost the same water area.

[Remarks] For crabs like other crustaceans, there are no traits by which their age can be determined easily. (The age of fishes can be determined by several characteristics such as the scales, otolith and

the centrum of vertebra). Therefore, studies of the age of crabs have been carried out using the characteristics of the growth by ecdysis. The young crab which has just finished its first metamorphosis and has begun benthic life is called the 1st instar. After that, ecdysis occurs at regular intervals and one instar is added for each ecdysis that the crab passes through.

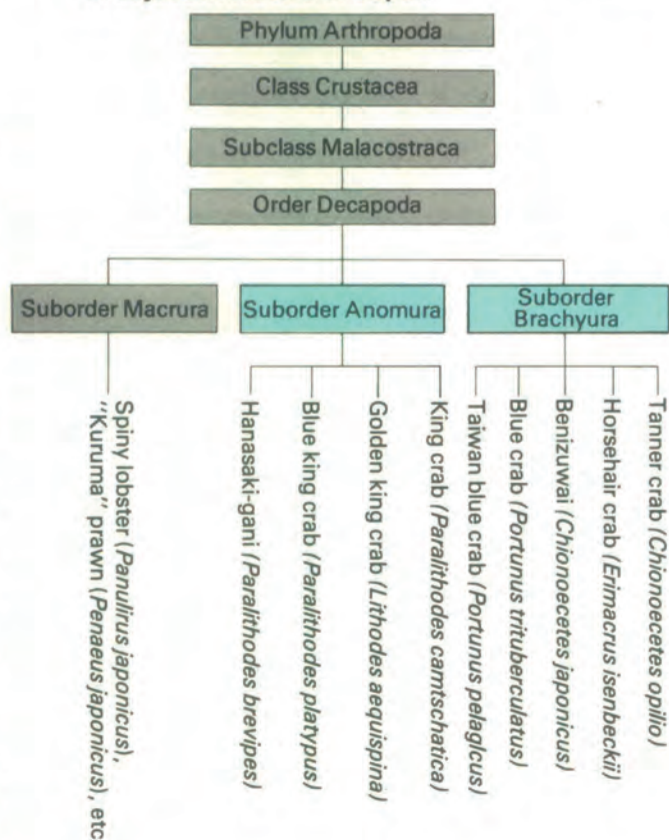
•Blue crab (*Portunus trituberculatus*)

The carapace of the cephalothorax of this crab is elongated from right to left, and both edges project like a spine. This species lives in the sandy mud zone in shallow waters. This crab stays in the mud in the daytime, and it moves about seeking food at night. The end segment of the fifth leg is shaped like a flat plate, being adapted for active swimming. Spawning season is from April to October (spring-summer-autumn), and the same crab spawns several times in one season. The spawning ground is in the submarine forest of shallow waters.

Blue crabs have strong swimming ability, and migrate over a large area. In winter they move to the deeper bottom or into the open sea, and when the temperature drops to $14 \sim 15^{\circ}\text{C}$ and below, they burrow into the sandy mud and enter a period of hibernation.

In spring when the temperature rises over 17°C , they begin to move about, migrate to shallow waters or bays, and gather in shallow places. After 12 ~ 13 ecdysis, young crabs reach the adult stage (the carapace is about 130mm in width). The larvae hatch from May to August and grow into adult crabs which have a carapace of about 130 ~ 170mm in width by September or October, and even for the crabs with slow growth, maturity is reached by October or November.

Fig. 3 Classification of crabs and main edible species in adjacent waters of Japan



Ecología de los Cangrejos

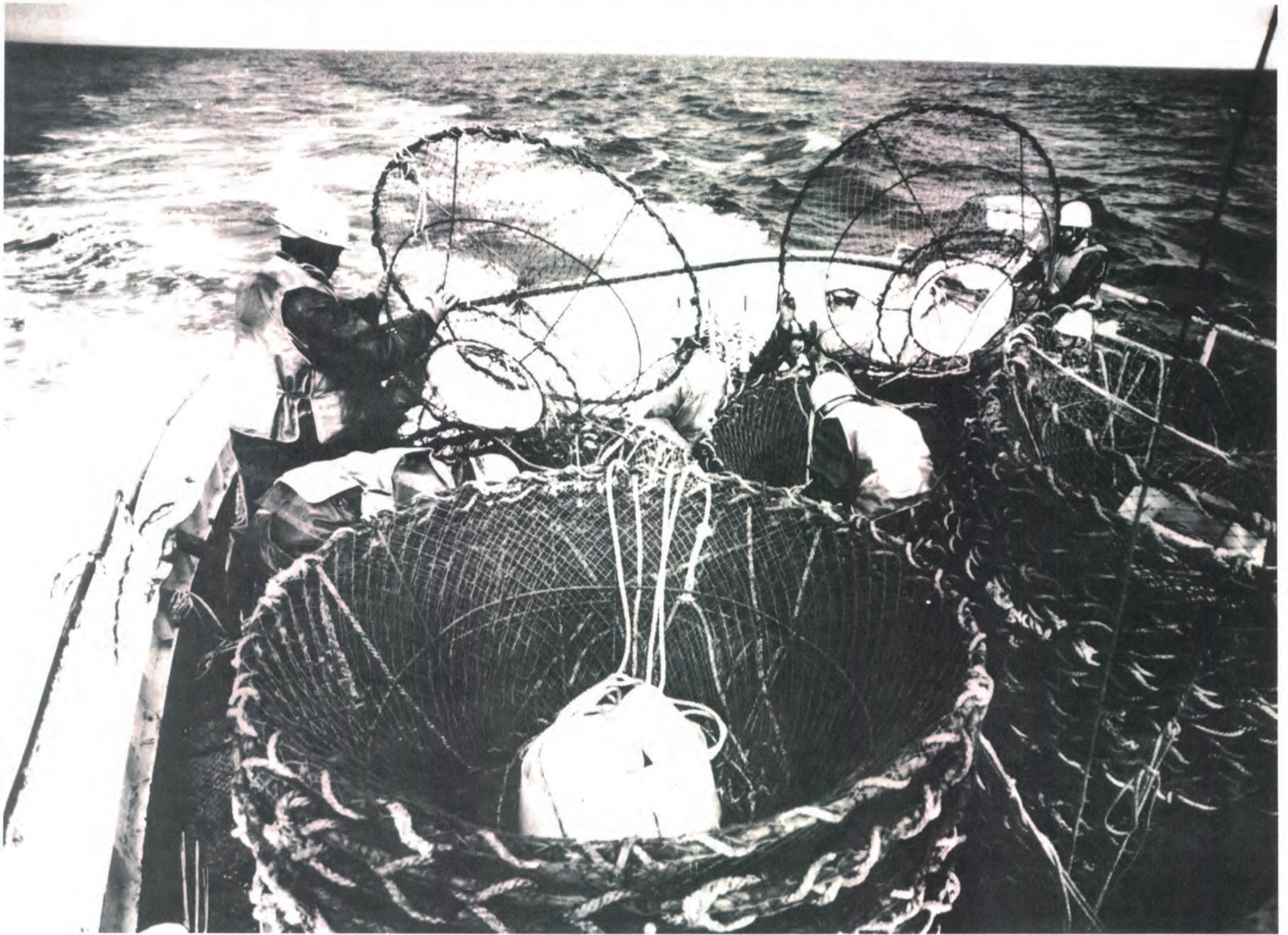
Como los cangrejos viven principalmente en campos de pesca ricos en animales de presa sobre roca subyacente continental, es posible lograr con eficiencia pesca comparativamente estable. Sus hábitats son limitados, y el período de crecimiento de los cangrejos, especialmente de los que viven en corrientes frías, es muy largo.

Por todo ello no es tan grande la reproducción potencial de estos recursos. Para el desarrollo de la pesca de cangrejos, el manejo de los recursos constituye una de las medidas prioritarias que han de tomarse.

Ecologie des crabes

Du fait que les crabes demeurent principalement dans les zones de pêches au fond et riches en animaux de proie sur un plateau continental, il est possible d'obtenir de façon efficace une prise relativement stable. Leurs habitats sont limités et la période de croissance des crabes, en particulier ceux qui vivent dans les courants froids, est très longue. Par conséquent, le potentiel de reproduction de ces ressources n'est pas très conséquent. Pour le développement des pêches aux crabes, la gestion adéquate des ressources est l'une des mesures prioritaires à prendre.

ship-type Crab Fishery



In the coastal waters of Japan's northern island Hokkaido, crab fishing has been carried on for many generations. But, it was done only as a side job, for the fisherman's private consumption, and the fishing method used was primitive long-lining. Since the beginning of this century, crab fishery has rapidly developed as a commercial industry. This development was caused by two important facts. One was the development of a "crab factory ship" on which the crabs caught could be canned (1914) and the other was the success in using sea water for washing crab meat (1920). In 1900 the first crab cannery was established on Rishiri Island of Hokkaido, and since around 1905 crab canneries were gradually constructed in Nemuro district of Hokkaido and on the coast of the Sea of Okhotsk. Owing to these two successive technical innovations, the Japanese crab industry came to include a canning industry by means of which it developed into a commercial capital initiative type industry which extended its market overseas where the United States was the main buyer.

This development in the crab-industry soon led to the over-crowding of Japan's coastal fishing grounds, and led to the search for offshore or pelagic grounds. In 1921, two crab factory ships (of 300 and 385 tons) belonging to a private company went out fishing in the Sea of Okhotsk. In 1923, large factory ships of the 2,000 ~ 3,000 ton class emerged. In 1927, two fleets went out fishing in the offshore waters along the east coast of Kamchatka. Furthermore, in 1930 a fleet went out fishing in the Bering Sea with fishing mainly conducted in Bristol Bay off Alaska. In this way, full-scale mothership-

type crab fishery conducted by a fleet consisting of ten-odd boats, i.e., a mothership, self-navigating boats and Kawasaki-bune [fishing boats carried on the mothership] appeared in 1) the waters off the west coast of Kamchatka, 2) eastern waters of Bering Sea, and 3) waters off Cape Olyutorskiy, as the major fishing grounds. This type of fishing reached its peak in the years 1927 ~ 30. In 1927, 17 motherships (of about 4,000 tons in total) caught 21,870,000 crabs, and 330,000 cans were produced. In 1930, an unprecedented 580,000 cans were produced.

After that, because of the decrease in resources and depression in the foreign markets, the necessity for rationalization of enterprise arose and administrative measures to restrict output and to combine enterprises were taken. Under the pretext of the "national policy", fishing industries were reorganized. With this as a turning-point, a monopolistic system of crab fishery by fishing companies with large capital was set up during the period of 1934 ~ 1940.

* * * * *

Japanese fisheries were destroyed by the Second World War, but in 1951 a peace treaty was concluded with the Allied Nations and the reconstruction of fishery was begun. What became different from the prewar days was that the pelagic fisheries in the North Pacific Ocean were now conducted based on diplomatic negotiation with the coastal nations of the United States, Canada, and the Soviet Union. Firstly in 1951, Japan, the United States, and Canada concluded the "Japan-U.S.-Canada Fisheries Treaty" [International Convention for the High Seas Fisheries of the Northern Pacific

Ocean]. In the case of crab fishery, mothership-type fleets started to go out fishing in the Bristol Bay of Alaska based upon this treaty after 1953. Also the "Japan-Soviet Joint Declaration" was signed with the Soviet Union in October 1956, and diplomatic relations were once again normalized. At the same time, the "Japan-Soviet Fisheries Treaty" came into effect. Since 1957, the areas of operation and amount of catch allowed for each kind of catch by Japanese fisheries in the Japan Sea, the Sea of Okhotsk, waters along the east coast of the Kamchatka Peninsula, and Bering Sea, have been controlled by the "Japan-Soviet Fisheries Committee" which meets every year.

In 1977, the fisheries conservation and management law of the United States (the so-called law of the 200 mile zone) came into effect, and the decree on the establishment of a 200 mile fishing zone was issued by the Soviet Presidium. As a result of these decrees, Japanese fisheries in the North Pacific Ocean have changed drastically and the mothership-type crab fishery has disappeared almost completely under international regulations.

At present, crabs in the Sea of Okhotsk off the Kamchatka Peninsula and the Bering Sea along the Olyutorskiy Islands and along the coast of Alaska are under the jurisdiction of the United States and Soviet Union as it is with other bottom fishes. Catches by Japanese pelagic fisheries have decreased, and in their place imports from the State of Alaska of the United States has increased.

Since 1979, "Japan-Soviet Joint Fisheries Operations" have begun, and

this joint operation is being carried out in some water areas for shrimps and crabs (tanner crab and blue king crab); however, the operations have just gotten under way.

Pesca de Cangrejos por Buque Madre

Las figuras 1 y 2 muestran los cambios en la pesca de cangrejos por sistema de buque madre en los campos pesqueros del Océano Pacífico septentrional.

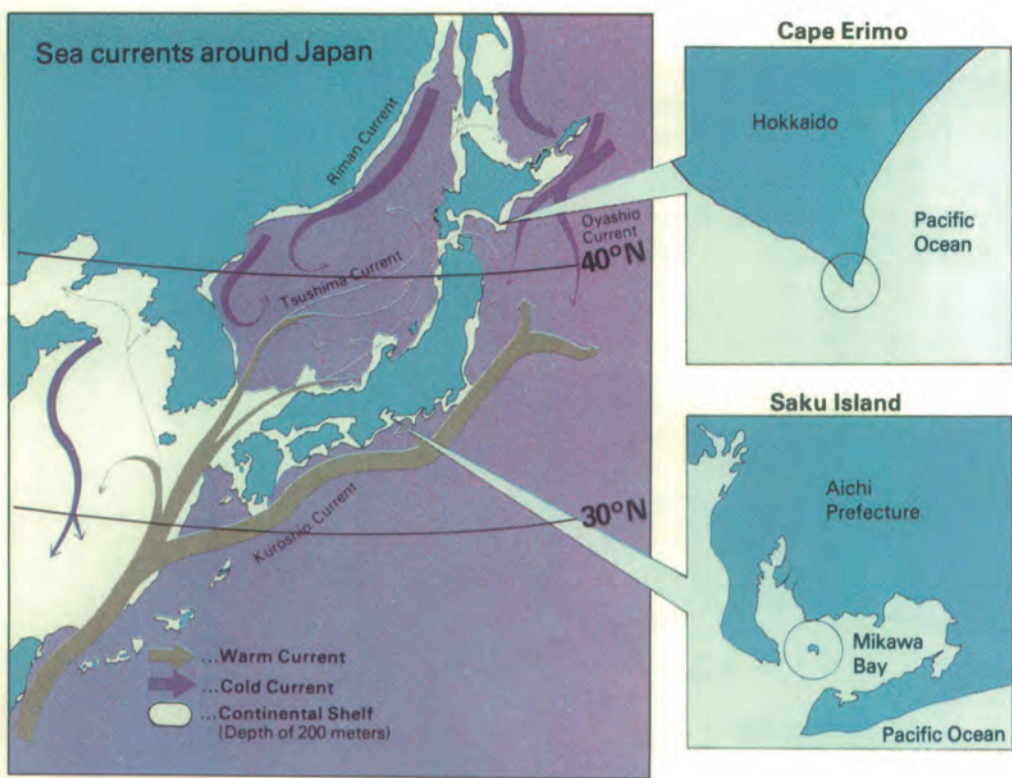
Tradicionalmente en la pesca de cangrejos del mar del norte, los cangrejos bayonetas han sido objeto de las principales faenas. Pero como resultado del control de pesca de cangrejos bayonetas según el Tratado de Pesca Japonés-Soviético y el Tratado de Pesca entre Japón, EE.UU. y Canadá, en años recientes se ha pasado principalmente a la pesca de cangrejos curtidores.

Pêcherie au crabe du type à navire gigogne

Les figures 1 et 2 montrent les transferts de prises de crabes dans la pêche du type à navire gigogne sur les lieux de pêches de l'océan Pacifique nord.

Quant à la pêche au crabe dans la mer du nord, les limules ou crabes des Moluques constituent la prise principale de manière habituelle. Mais, par suite des contingentements de pêches concernant les crabes de limules dans le cadre du traité des pêches japonais-soviétique ainsi que le traité des pêches japonais-USA-canada, la pêche au crabe dans les années récentes est surtout orientée vers la prise des crabes tannés.

Coastal Cr

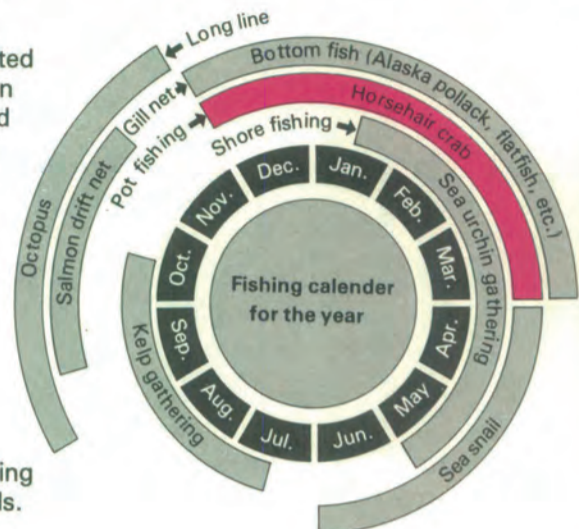


Horsehair Crab Fishery around Cape Erimo (in Hokkaido)

The Boat Type and Methods of Fishing

The size of fishing boat used is limited to under 5 tons in gross tonnage when in operation in the coastal waters, and thus fishing boats of the 4.9 ton type are mainly used.

The main methods of fishing are (1) gill net fishing, (2) pot fishing, and (3) shellfish and seaweed gatherings on rocky beaches. Fishing operations by these methods are planned on a yearly basis. Of these methods, the shore fishing is done by means of a open-deck type boat fitted with an outboard motor, but 4.9 ton type fishing boats are used in all the other methods.



Among the crabs caught in coastal waters, the ones which give comparatively large and stable catches are horsehair crab and blue crab. The subject of coastal crab fishery will be discussed with regards to these two species. Horsehair crab (*Erimacrus isenbeckii*) lives in cold waters, and blue crab (*Portunus trituberculatus*) lives in warm waters. The habitat of these two species is separated, with horsehair crab living mostly in the northern half of the Japanese Islands and blue crab in the southern half.

Horsehair crab

This species lives on the sandy mud bottom at 30 ~ 60m depth along Hokkaido and the northern coast of the Japan Sea. After the Second World War, the commodity value of this species was recognized, and commercial fishing became very active. At present, the main producing areas are coastal waters in the Pacific Ocean and the Sea of Okhotsk around Hokkaido, and several thousand tons a year are caught with baskets or bottom gill nets.

In the districts of Kitami, Monbetsu and Sarufutsu on the coast of the Sea of Okhotsk around Hokkaido, each fishing cooperative regulates the total catch for the sake of resource conservation. Furthermore the fisherman often make use of joint operations and pooling of catches.

Blue crab

For many generations blue crabs have been caught by various fishing methods

such as trawl, gill net and pots in the inland seas such as Tokyo Bay, Mikawa Bay, Ise Bay, Ariake Sea and the Seto Inland Sea.

Stocking waters with young blue crab was attempted for the first time in the Seto Inland Sea in 1971. Propagation by stocking was attempted because of the blue crab's (1) rapid growth, (2) high commercial value, and (3) comparatively concentrated habitation. Stocking proved to be economically effective, and thus thereafter stocking became widespread in many districts.

Efforts at crab culturing have been thwarted by the fact that crabs in a closed environment resort to cannibalism, and although attempts to prevent this habit have been made by extracting the molting hormone and by trying to synchronize the time of ecdysis, so far these attempts have proved unsuccessful.

Fishing Gear and Fishing Techniques

Each fisherman has several hundred crab pots, and uses them alternately. Because the fishing ground is small, the fisheries cooperative of each district limits the number of pots which can be set in the fishing ground, with 700 as the maximum.

The fishing grounds for horsehair crab are flat places in the sandy mud zone or peripheral areas of a reef. Each fisherman fishes his own specified ground, and they all observe the unwritten rule that they must not invade the fishing grounds of other fishermen.

Fishing gear varies slightly with each fisherman as to the thickness of line, the size of pot and other characteristics. After the fishing ground is selected with due regard to the depth and the strength of tidal current, the long line with many pots is laid perpendicular to the coastal current.

Selling

The crabs that have been caught are landed at the markets of the producing area run by the local fisheries cooperative, where they are bought by middlemen,

and shipped to the consuming areas. In this system, a clear difference in price is placed on live crabs and dead crabs. Moreover the crabs are divided into the following market sizes ... (1) large size: over 9cm in carapace length, (2) small size: over 7cm and less than 9cm in carapace length, and (3) offgrade: less than 7cm in carapace length. Fishing and selling small offgrade crabs are actually prohibited.

In districts that have a large catch, crabs are transported by refrigerated container cars prepared by the cooperative, to a large city and they are sold at a central wholesale market in that city. But, usually crabs are collected by middlemen in each district who bid for the catches at auctions held by the association.

Middlemen preserve live crabs in water tanks for a while, and ship them live when they consider the market conditions to be good. Dead crabs are immediately boiled and shipped.



An opening for taking out the catch is made at the bottom of the pot, and it is closed by tightening the string.



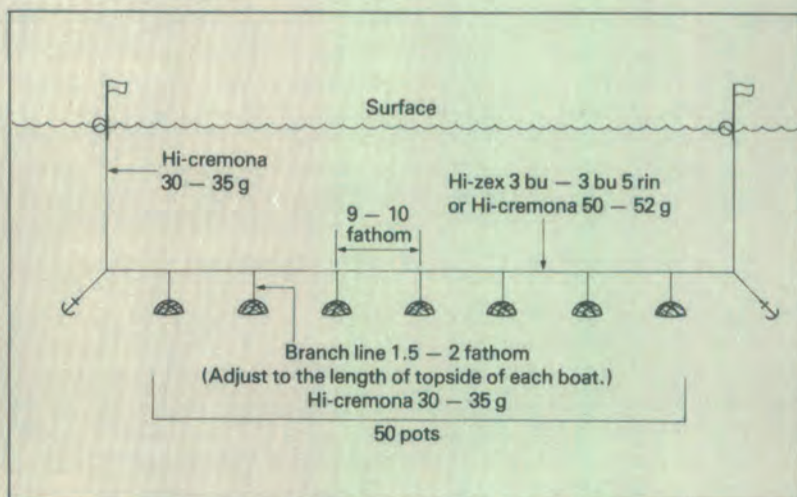
As bait, squid or Alaska pollack is used.



It is cut in slices with a cutter, and the slices are packed in plastic cases which have many small pores.



Fishing boat of the 4.9 ton type is operated by three persons. The shipowner operates the boat, and two crewmen work at hauling and setting the nets and long lines.



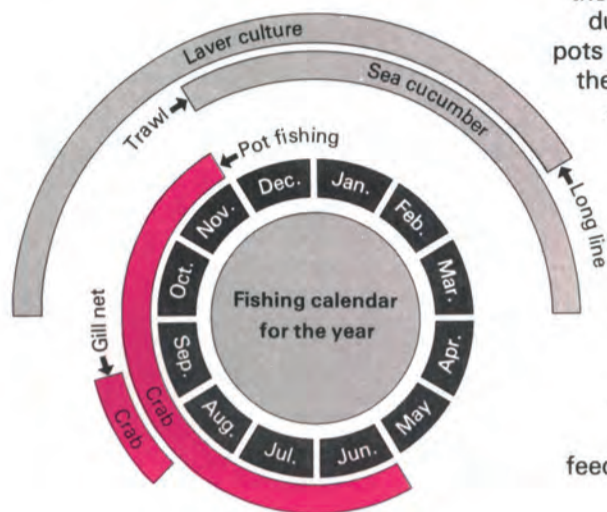
Shipping of live crabs. packed in a box made of plastic foam. After this, also packed in the



Boiled crabs. After the legs are bound rubber band, the crabs are packed in a cardboard box and transported in a chilled

Crab Fishery

Blue Crab Fishery on Saku Island (in Mikawa Bay)



the fishing ground. Because crabs feed during the night, the boat from which pots are cast into the water will go out to the sea before sunset, and 1 or 2 hours after laying the pots they are hauled up again. This process is repeated until after midnight. In order to guarantee a large catch the pots must have good stability on the bottom and be baited with fresh bait. In the summer, there is sometimes a period when crabs do not take the bait. In that case, pot fishing should be halted and fishing with gill nets should be tried instead. It is said that the crabs feeding activity is related to the cycle of ecdysis.

The Boat Type and Methods of Fishing

Because Mikawa Bay is an inland sea, the boat type is limited to a maximum of 4.9 tons. A fishing boats over 5 tons must operate in the open sea. Furthermore, by the fisheries system, fishing boats less than 5 tons are divided into (1) those of over 3 tons and less than 5 tons, and (2) those less than 3 tons. The former operates trawl nets in the central area of the bay, and the latter engages in various methods such as gill net, pot, long line and angling in the waters near the coast. On Saku Island where we did our research, only fishing boats less than 3 tons were in operation. These small fishing boats are used for catching "Kuruma" prawns (with drift gill nets) and blue crabs (with pots) as the main resources in the bay.

Fishing Gear and Fishing Techniques

The fishing gear used for blue crabs is a kind of trap, which is made by fixing 60 ~ 70 pots to a single line. A fisherman lays several of these lines in

Selling

All the crabs that have been caught are shipped alive as they are. To avoid cannibalism, the anterior half of the unmovable claw of each chela is cut off soon after being captured.

In Europe and the United States, crabs that have just completed ecdysis are sold by the name "soft crab" or "peeler", and these crabs are customarily eaten broiled. This custom differs greatly from that in Japan.

In Japan crabs just after ecdysis are called "Mizugani" (crab with high water content), and these crabs are not liked because of their small amount of meat. On Saku Island, soft crabs just after ecdysis are sold at a low price, about one fourth that of hard crabs.

Pesca de Cangrejo Costanera

Entre los cangrejos capturados en aguas costaneras, los que comparativamente ofrecen mayor y más estable rendimiento son el cangrejo de pelo de caballo y el cangrejo azul. El tópico de pesca costanera de cangre-

jos se centrará en estas dos especies.

El cangrejo de pelo de caballo (*Erimacrus isenbeckii*) vive en aguas frías, y el cangrejo azul (*Portunus trituberculatus*) vive en aguas templadas.

El hábitat de estas dos especies es separada: el cangrejo de pelo de caballo habita principalmente en la mitad septentrional del Archipiélago Japonés, mientras que el cangrejo azul vive en la mitad meridional.

Pêcherie de crabe côtière

Parmi les crabes attrapés dans les eaux côtières, ceux qui donnent relativement des prises importantes et stables sont le crabe à crinière et le crabe bleu. Le sujet de la pêche du crabe en eau côtière fera l'objet d'une discussion en considérant ces deux espèces.

Le crabe à crinière (*Erimacrus isenbeckii*) vit dans les eaux froides, et le crabe bleu (*Portunus trituberculatus*) vit dans les eaux chaudes.

L'habitat de ces deux espèces est séparé, tandis que le crabe à crinière vit principalement dans la moitié nord des îles japonaises et le crabe bleu dans la moitié sud.

Offshore Tanner Crab Fishery in the Japan Sea

It has been estimated that about 800 ~ 1,500 tons of tanner crabs were caught from the entire area of the Japan Sea early in the Showa era (in the 1920's). Although fishing of tanner crabs was interrupted during World War II, after the war in many prefectures from Akita to Shimane Prefecture on the coast of the Japan Sea, crab fishery using a trawl net sprang up and has become more active year after year.

The crab fishing grounds are on the slope of the continental shelf at a depth of 200 ~ 300m. As regards fishing methods, hoop net, bottom gill net and bottom long line are used in addition to trawl nets; however, the greatest part of the catch is caught with trawl nets. The size of trawlers varies with the district. Trawlers of 14.9 ton and 34 ton types are in operation in the prefectures of Akita, Yamagata and Niigata; those of 15 ton and 30 ~ 50 tons types in the prefectures of Toyama, Ishikawa and Fukui; and those of 50 ton and 58 ~ 65 ton types in the prefectures of Hyogo, Tottori and Shimane.

In all of these districts, there are two types of medium-sized trawlers operating mostly in the coastal waters and large-sized trawlers operating in the offshore waters. But, on the whole, the larger types tend to be used more in the southwestern districts than in the northern districts of Japan. This indicates

that there is a difference in the amount of catch, i.e., abundance in the fishing grounds.

From the latter half of the 1950's to the 1960's, the catch continued to increase in all the districts. During several years from 1960 to 1964 the catch reached a peak in all prefectures one after another, and since then the catch has started decreasing. It is feared that the rapid increase in fishing intensity has depleted the resources.

Because the catch of tanner crab (*Chionoecetes opilio*) has become poor, fishermen have begun to look for new resources. They have turned to be "Benizuwai" (*Chionoecetes japonicus*) which is a species very similar to tanner crab. These crabs live on a deeper bottom than tanner crabs, at the depth of 800 ~ 1,000m. Because they are bathybic, it is difficult to catch them by trawl nets and they are caught exclusively by lines with many pots. The size of fishing boat used for this type of fishing is larger, and in some districts boats of over 100 tons are in operation.

The market price of "Benizuwai" is lower than that of tanner crab, but the amount of catch in all districts has become twice or several times that of tanner crab. The supply of crabs is still stable.



for live crabs (middleman).



A day's fishing gear prepared on the front deck.



Gizzard shad and small mackerel are used as bait. Although the use of fresh fish as the bait is desirable, because of the recent high fish prices, frozen fish has to be used.



Crabs are packed in boxes of insulating sawdust in a box.

with a corrugated state.

Here, fishing is done by a husband and wife. Because the fishing work is conducted on the front deck, a simple apparatus made of a bamboo pole is devised to operate the throttle lever and the tiller from the anterior side.



Whole fishes are used for bait, and they are pierced with bamboo.



The pot is collapsible, and it is set up and fastened with a hasp just before line setting.



The anterior half of the unmovable claw of each chela is cut off soon after being captured.

Pot Fishery

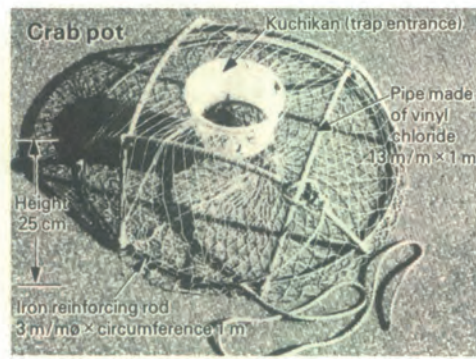
A fishing method suited to coastal fishery with high species selectivity

Pots are a small fishing gear, simple in structure and easily handled even by a small fishing boat. Pots have been used as fishing gears for generations in coastal fishing grounds of various parts of the world for catching crustaceans such as prawn, lobster, crab, shellfishes such as welks of genus *Neptunea* and horned turban shell, and some bottom fishes such as sablefish (*Anoplopoma fimbria*) and *Tilapia*. Pots might easily be regarded as antiquated and inefficient fishing gear, but in fact that is not the case. If pots are used correctly by selecting the species being caught, they can be considered as fairly efficient fishing gear. Let's take a closer look at crab fishery.

Fig. 1 shows the catch statistics of crabs by fishing method. The fishing methods used for catching crabs are trawl net, bottom gill net and pot line, and at present, pot fishing is at the top. The statistics for Tanner crabs by gill net shown in the figure represent catches from the North Pacific Ocean (Bering Sea). Among the crabs caught by pot fishing, "Benizuwai" from offshore waters of the Japan Sea (about 30,000 tons) and horsehair crabs from the coast of Hokkaido (about 5,000 tons) are overwhelmingly abundant.

Some of the special characteristics of pot fishing are as follows:

- (1) Fishing gear is of simple structure, and compared with gill net and trawl, the operation is labor efficient.
- (2) Arrangement and repair of the fishing gear are easy.
- (3) On the fishing boat, a line hauler is used. It is simple in structure and is easy to handle. Thus, compared with gill net and trawl net, it is comparatively easy to operate in the deep sea.
- (4) It is possible to catch live crabs which have a higher market price, and because the fish body is not injured during fishing fishes brought to market stay very fresh. Moreover, young or female crabs can be set free at sea immediately after capture.
- (5) It is a passive and waiting-type fishing method, but it is possible to lure aquatic animals by the use of bait.



Among the advantages of pot fishing gear, we would like to place special emphasis on the fact that they have high "fishing selectivity".

There are two factors that are used in evaluating the value of a fishing gear, these are "fishing efficiency" and "selectivity efficiency". "Selectivity efficiency" means the ability of the fisherman to select and catch only the species and size of fish that he desires. Generally, fishing gear that has a high "fishing efficiency" (for example, trawl net) has low "selectivity efficiency", and fishing gear having high "selectivity efficiency" has low "fishing efficiency".

Crabs are not gregarious animals, and they are scattered over a wide area. Pot fishery, which is a process of setting up pots in an area which seems to be the home range of crabs and catching them by luring with bait is easier and offers better selectivity than methods which involve towing nets around over a wide area.

By varying the mesh size and mouth size of the pot, it is possible to control the size of fish being caught. In order to conserve the reproductive capacity of the crab population, the body length of catchable crabs is restricted (in the case of tanner crabs in the Japan Sea, the capture of small crabs less than 90mm in carapace width is prohibited) and the capture of female crabs is also prohibited. These restrictions can be strictly maintained by determining the minimum mesh size of the pot and the minimum diameter of the mouth of the pot. Even when crabs beyond these regulations are caught in the pots, it is possible to return them to the sea alive.

Crabs are distributed as perishables (mainly blue crabs), boiled or boiled and frozen crabs (mainly tanner crabs and king crabs) and canned crabs (mainly tanner crabs). As to the import and export of canned crabs, export has declined and at present only several hundred tons a year are exported. Import is on the increase, and presently total 20 ~ 40 thousand tons a year. From the United States and Republic of Korea, crabs are imported fresh, chilled or frozen. Some of these imported crabs are used in the canning industry.



Distribución y Procesamiento de Cangrejos

Los cangrejos se distribuyen así: perezaderos (principalmente cangrejos azules), hervidos o hervidos y congelados (principalmente cangrejos curtidores y cangrejos bayonetas), y cangrejos enlatados (principalmente cangrejos curtidores). En cuanto a exportación e importación de cangrejos enlatados, la primera ha disminuido, de modo que de presente sólo se exportan varios centenares anuales de toneladas; la importación está aumentando, y llega a de 20 a 40 mil toneladas al año. De los Estados Unidos y de la República de Corea, se importan cangrejos frescos, enfriados o congelados. Parte de de estos cangrejos importados se destina a la industria del enlatado.

Distribution et traitement des crabes

Les crabes sont distribués comme denrées périssables (surtout le crabe bleu), les crabes bouillis ou bouillis et congelés (surtout le crabe tanné et le crabe limule) et les crabes en conserve (surtout le crabe tanné). Quant aux importations et exportations de crabes en conserve, les exportations ont diminué et à présent l'on compte seulement quelques centaines de tonnes exportées annuellement. Les importations sont en progression et comptent pour 20 à 40 milles tonnes par an. Les crabes sont importés des Etats-Unis et de la République de Corée sous forme de denrées fraîches, gelées ou congelées. Une partie des crabes importés est utilisée pour l'industrie des conserves alimentaires.

The Dilemma of the

Saku Island is a small island as seen on the map, and the present population is about 600. Two villages stand on the east and west plains of the island. Visitors who come to this island for the first time may be surprised by what they find. We get to this island by a small ferryboat. There is a tasteful hotel near the port, and many "Minshuku", (simple Japanese-style private lodging houses which are managed by fishing households as a side-job) stand side by side. But, when we went deeper inside the village, we saw that there were very few souls around. Afterwards, when we were told that about a half of the houses were empty, we were very surprised. Formerly the population of this island had been over 1,000, but a half of the inhabitants had abandoned fishing and had moved to cities to look for new jobs.



Mr. Kazuhiro Matsumoto, the president of the Fisheries of the Cooperative.

We visited the fisheries cooperative of Saku Island located in the central part of the island. There, we interviewed Mr. Kazuhiro Matsumoto, the president of the cooperative, on the present conditions and his views on the development of fisheries on this island.

(The editor is responsible for the wording).

The island has only a few flat areas, therefore agriculture is limited only to home consumption. From the past inhabitants made their living on only one industry, fishery. This island is located only ten-odd kilometers by sea from Nagoya City, which is one of the largest cities in Japan and from its surrounding urban areas, and thus the island has been able to exist economically by supplying fresh fish to the large cities.

However, changes in the industrial structure induced by the "drastic" growth of the Japanese economy since the 1960's have indeed exerted an influence upon the fisheries of Saku Island.

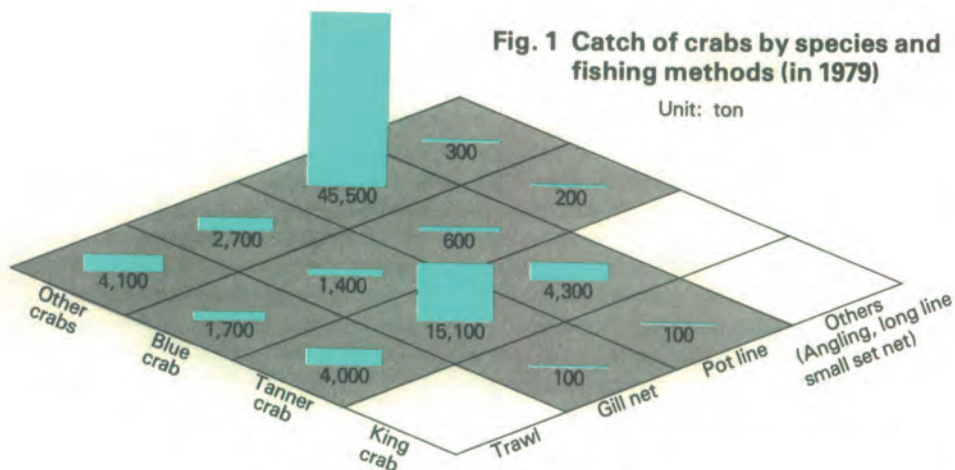
(1) With the expansion of the industrial area around Nagoya City, the biological environment of the fishing grounds has been aggravated by

reclamation of foreshore areas and by the industrial waste water.

(2) Because of the difference in income level between the urban workers and fishermen on the island, the labor force has been drained out of the island causing "underpopulation" in the community.

(3) Conversely, because the island is near a large city, the possibility for development as a sightseeing resort for the city workers was considered.

The "transformation into a sightseeing resort" was completed, and since the 1960's tourists from cities began to visit this island, and the fishermen opened "Minshukus" to welcome these tourists. As a result, the conventional distribution methods of aquatic products of this island have changed. Up to that time, the catches had been sold every day by public tender held by the fisheries cooperative in two ports. But, as a result of the development of "Minshukus", the demand for medium and prime fishes and shellfishes such as Kuruma prawns and blue crabs by the "Minshukus" increased during the summer season. Therefore, in 1970, the fisheries cooperative had to discontinue the tender system within the island. Since that time the fishermen have simply sold their catches as they pleased. At present, about 40% of the catch on Saku Island



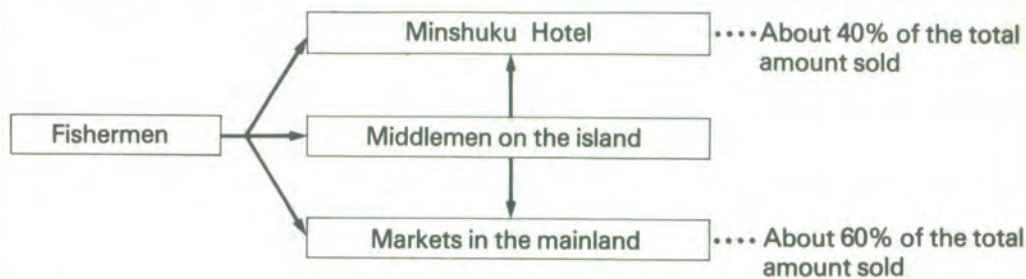
Pêche aux casiers

Les casiers sont des petits appareils de pêche de structure simple et se manipulent facilement même avec un petit bateau de pêche. Depuis les temps anciens dans les terrains de pêche côtiers variés dans de nombreuses parties du monde, les casiers ont servi comme principaux appareils de pêche pour attraper les crustacés tels que les crevettes, les homards et crabes, les mollusques comme les ocydromes de genre *Neptunea* et les coquilles à turban corné puis quelques poissons de fond tels que poissons de sable (*Anoplopoma fimbria*) et *Tilapia*. Les casiers sont susceptibles d'être considérés comme des appareils de pêche désuets et inefficaces, mais ce n'est pas le cas. Si on applique les casiers judicieusement là où il conviennent, ils deviennent vraiment des auxiliaires de pêche efficaces.

Pesca de Pote

Los potes son pequeños equipos de pesca de estructura sencilla, que se pueden manejar fácilmente aun desde un bote pequeño de pesca.

Desde muy antiguo en los campos costeros de pesca de diversas partes del mundo, se han usado potes como equipo de pesca para coger crustáceos, como camarón, langosta o cangrejo; mariscos, como géneros de *Neptunea* o conchas de turbante cornudo; y algunos peces de fondo, como pez sable (*Anoplopoma fimbria*) y *Tilapia*. Los potes no deben mirarse como equipo de pesca ineficiente o anticuado; usados apropiadamente escogiendo las especies de peces, son en realidad bastante eficientes.



Distribution and Processing of Crabs

Fig. 2 Flow chart of processing of king crab and tanner crab

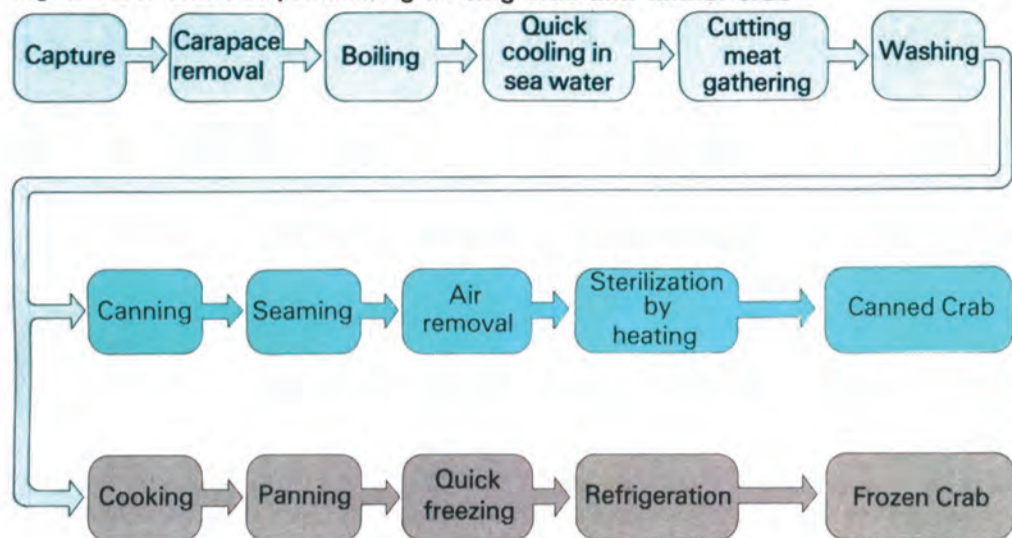
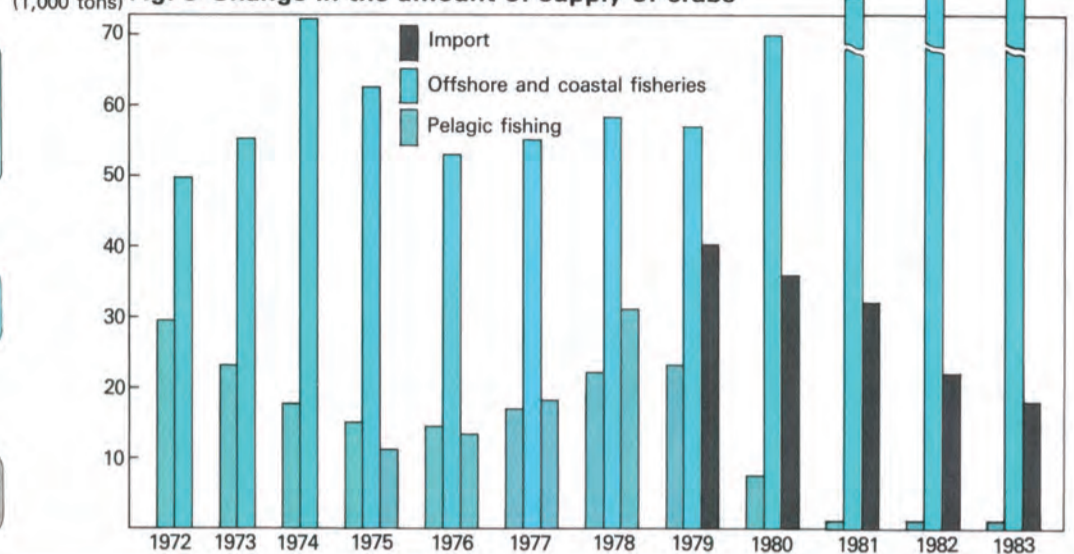


Table 1 Import of crabs in Japan

	Amount of money (1,000 \$)			Quantity (tons)		
	1981	1982	1983	1981	1982	1983
Total	149,786	139,220	90,078	31,039	23,394	17,722
U.S.A.	113,812	91,146	44,464	21,726	11,814	6,889
Canada	3,409	20,905	18,292	679	4,572	3,869
Korea	18,000	13,128	13,347	3,992	2,894	3,534
China	5,966	5,599	8,922	2,771	2,524	3,600

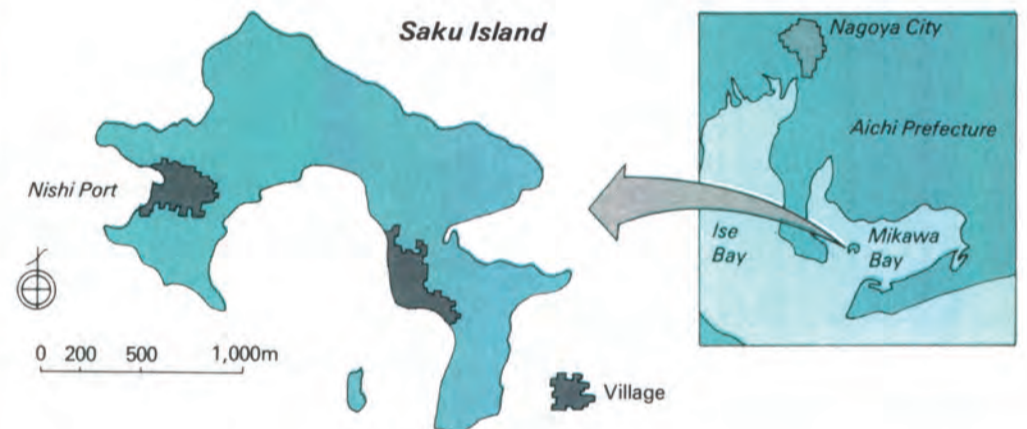
Source: Entry Statistics

Fig. 3 Change in the amount of supply of crabs



President of A Fisheries Cooperative

Creating a balance between "promotion of the primary industries (fisheries)" and "adapting to the urban economy"



is used by "Minshukus" within the island, and the remaining 60% is shipped to the markets on the mainland directly by the fishermen themselves.

Sales of aquatic products to tourists is very profitable during the summer vacation season from July to August. Because of the fact that except for the sightseeing season, catches must be landed at the markets on the mainland, fishermen are forced to bear extra expenses such as the fuel expense and working hours involved in the round trip to the mainland. Because of this the conditions necessary for a sound growth of both production and selling have been lost.

Now, Saku Island is subsidized by the "Coastal Fisheries Promotion Program" pushed forward by the government, and they are tackling a project to increase the fisheries resources. Since 1977 the fisheries cooperative, acting as a leading body of the project, has conducted "stocking" of larvae and juveniles of Kuruma prawn, intermediate breeding and "stocking" of abalone spat, construction of artificial reef for rearing abalone, and "stocking" of short-necked clam spat. Starting this year (1981), intermediate breeding and "stocking" of juvenile black sea bream will be tried. (As for blue crabs, because a sign of restoration of resources has been recognized recently, there is no plan for to try "stock-

ing" for the time being.

By the way, Mr. Matsumoto, the cooperative's president, who is a leader in these projects, has the following personal opinion. He believes that to develop a fisheries economy in the island, the present catch of about three hundred million yen by both fishing and culture must be increased at least to five hundred million yen; and moreover, it is necessary to increase the present fishing population from 600 to about 800 ~ 900 persons.

However, it requires a lot of time to increase the aquatic resources and catches. Then, in parallel with the propagation of resources, a program to introduce sport fishing on the island has been suggested. Just recently, the leading members of the cooperative have made an inspection tour of areas with successful sport fishing industries. They are hoping to attract anglers from cities to increase the income of the island, and at the same time to prepare easy working places for middle and older aged fishermen.

This plan, however, faces one problem. If large sightseeing capital begins to flow into the island, the leaders of the community are afraid it will cause a rise in immorality that usually accompanies rapid economic growth. Mr. Matsumoto and the leading members of the fisheries cooperative have been taking pains to find good concrete measures to balance fisheries with the present day economy.

Dilema entre Promoción de Pesca y Adaptación a la Economía Urbana

Saku es una pequeña isla situada en la bahía de Mikawa adyacente a la ciudad de Nagoya, la tercera ciudad del Japón en cuanto a número de habitantes. Durante los pasados diez años la pesca ha venido disminuyendo constantemente debido a la influencia del gran crecimiento de la economía japonesa. Pero en años recientes, con la ayuda de medidas gubernamentales para la promoción del desarrollo de la pesca costanera, los pescadores de la isla se esfuerzan por aumentar las fuentes de pesca alrededor de la isla y hacer revivir dicha industria. ¿Cuáles son los problemas y puntos de discusión del proyecto?

Dilemme entre la promotion des pêches et l'adaptation à l'économie urbaine.

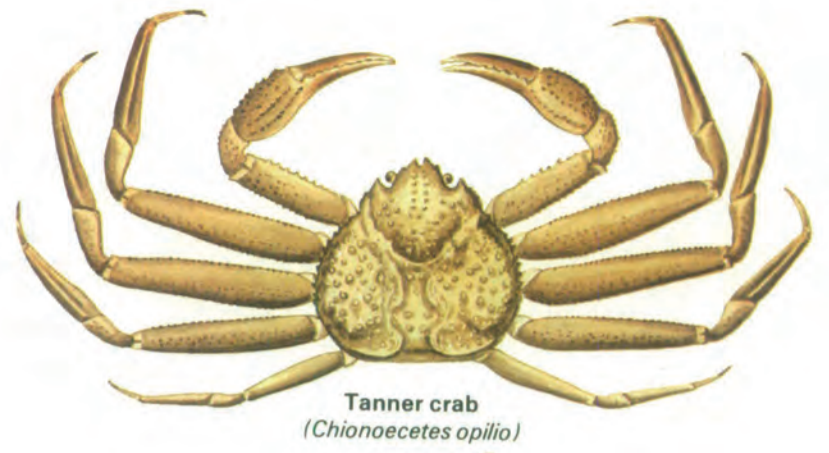
Saku-Island est une petite île située dans la baie de Mikawa près de la ville de Nagoya, la troisième grande ville au Japon. Durant les quelques dix années passées, les pêches dans cette île ont continué à décliner suite à la haute croissance de l'économie japonaise. Mais, dans les années récentes, grâce à l'application des mesures pour le développement des pêches côtières mises en place par le gouvernement, les pêcheurs de cette île sont assistés dans leurs efforts pour accroître les ressources des pêches autour de l'île et ainsi de raviver cette industrie. Quels sont les problèmes et points cruciaux en rapport avec ce projet?



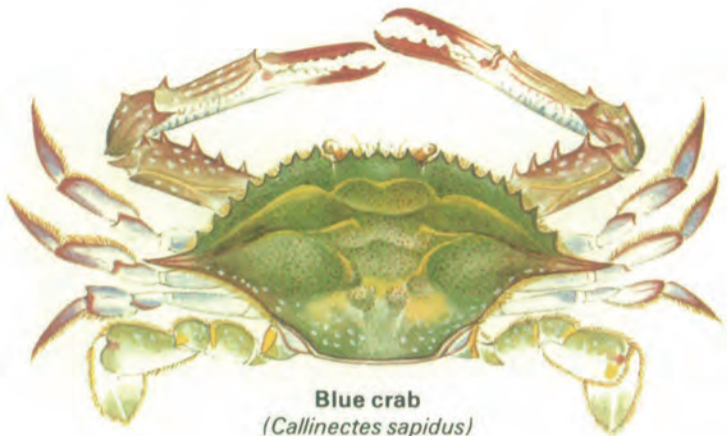
Mr. Matsumoto, the president of the fisheries cooperative, talks to school children about the history and present conditions of fisheries on the island. Sometimes, school children come to the cooperative for study tours headed by a teacher.



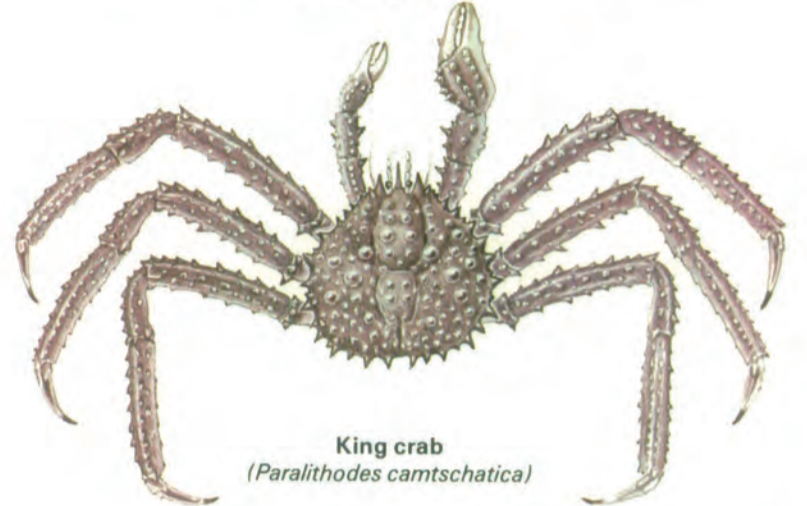
Horsehair crab
(*Erimacrus isenbeckii*)



Tanner crab
(*Chionoecetes opilio*)



Blue crab
(*Callinectes sapidus*)



King crab
(*Paralithodes camtschatica*)

Crab Resources around the World

Fig. 1 shows the distribution by region of crabs having high commercial value, and Table 1 shows the total catch of crabs by region. The high latitude zone in the northern hemisphere has vast resources, and accordingly the development of resources in the waters of this zone has been carried out most extensively. On the other hand, in the high latitude zone of the southern hemisphere, allied species corresponding to those of the northern hemisphere are also living; however, it is doubtful whether we can expect to find resources as abundant as those of the northern hemisphere. Although surveys on resources have been carried out in some regions, enough detailed information on crabs is still not available. The present low catching rate may be a reflection of limited resources, but in addition, the low rate is also due to the fact that crabs have not become a regular part of people's diets and good fishing methods have not been developed.

The low latitude zone is characterized by an uneven development, and the fact that many areas still remain unsurveyed. On the coasts of both the United States and Mexico in the Atlantic Ocean, blue crab fisheries are developed. In many

districts of Japan and Southeast Asia, various types of local fishery are carried out. In the coastal waters of the Indian Ocean and the northwest region of Africa, a small number of crabs are caught along with shrimps, but the catchable amount of crabs is still unknown.

Recursos de Cangrejos en el Mundo

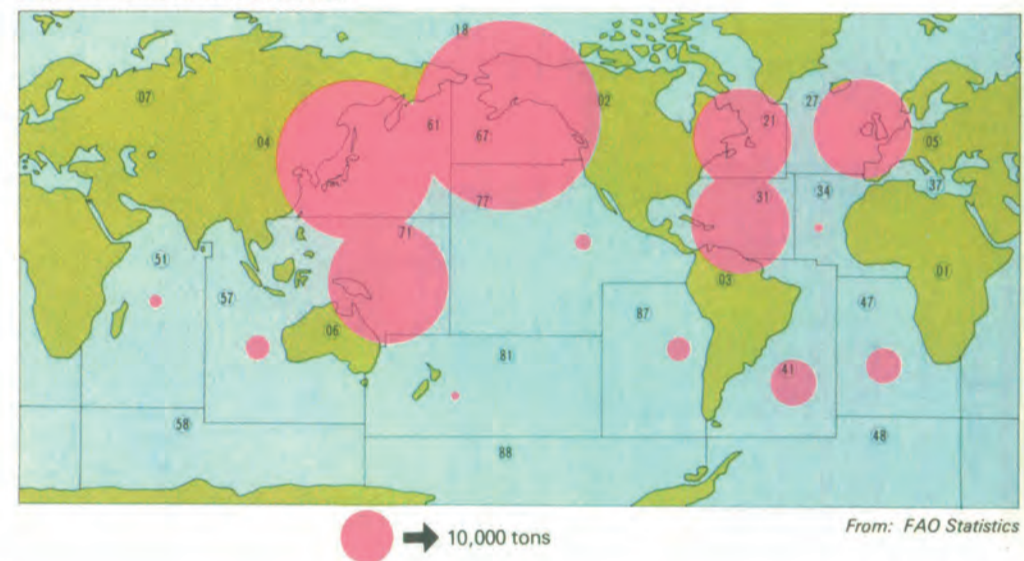
La zona de latitud alta en el hemisferio septentrional posee vastos recursos naturales, y en sus aguas se ha llevado a cabo de la manera más extensa el desarrollo de tales recursos. Por otra parte, también en la zona de latitud alta del hemisferio meridional viven especies correspondientes a las del hemisferio norte; sin embargo, es incierta la existencia de tantos recursos naturales como los del hemisferio septentrional.

La zona de latitud baja se caracteriza por la falta de uniformidad de desarrollo, y por la permanencia de áreas sin explorar o investigar.

Les ressources en crabes dans le monde

Les zones de haute latitude dans

Fig. 1 Catch of crabs (1978)



l'hémisphère nord comprennent des ressources de pêches énormes. Et le développement de ces ressources a été poursuivi de façon la plus intensive. D'autre part, dans les zones de haute latitude de l'hémisphère sud, on trouve des espèces marines parentées à celles de l'hémisphère nord. Mais il est à douter qu'on puisse espérer

exploiter un contingent de ressources de pêches aussi important que dans l'hémisphère nord.

Les zones à faible latitude se caractérisent par un degré de développement des ressources marines moins uniforme et il reste encore des régions qui n'ont pas fait l'objet d'étude.

Table 1 Distribution of representative species with high commercial value (See Fig. 1)

Division	English name	Japanese name	Scientific name	Northwestern Atlantic	Northeastern Atlantic	Western Central Atlantic	Eastern Central Atlantic	The Mediterranean	Southwestern Atlantic	Southeastern Atlantic	Western Indian Ocean	Eastern Indian Ocean	Northwestern Pacific	Northeastern Pacific	Western Central Pacific	Eastern Central Pacific	Southwestern Pacific	Southeastern Pacific
				(21)	(27)	(31)	(34)	(37)	(41)	(47)	(51)	(57)	(61)	(67)	(71)	(77)	(81)	(87)
Cold current dwellers	KING CRAB	Tarabagani Aburagani Hanasakigani Hokuyou-ibaragani	<i>Paralithodes camtschatica</i> <i>Paralithodes platypus</i> <i>Paralithodes brevipes</i> <i>Lithodes aequispina</i>										●	●				
	SOUTHERN KING CRAB		<i>Lithodes antarcticus</i>						●									●
	PACIFIC TANNER CRAB	Zuwaigani Zuwaigani Beni-zuwaigani	<i>Chionoecetes opilio</i> <i>Chionoecetes bairdi</i> <i>Chionoecetes japonicus</i>										●	●				
	TANNER CRAB	Zuwaigani	<i>Chionoecetes opilio</i>	●														
	SPINOUS SPIDER CRAB	Kumogani	<i>Maja squinado</i>		●			●										
		Takaashigani	<i>Macrochelia kaempferi</i>										●					
	SOUTHERN SPIDER CRAB		<i>Jacquinoia edwardsii</i>															●
	ATLANTIC ROCK CRAB		<i>Cancer irroratus</i>	●														
	DUNGENESS CRAB		<i>Cancer magister</i>												●			
	EDIBLE CRAB		<i>Cancer pagurus</i>			●												
	PACIFIC ROCK CRAB		<i>Cancer productus</i>														●	
	JONAH CRAB		<i>Cancer borealis</i>		●													
	RED CRAB		<i>Geryon quinque-dens</i>		●						●							
	HORSEHAIR CRAB	Kegani	<i>Erimacrus isenbeckii</i>											●				
Warm current dwellers	GAZAMI CRAB	Gazami	<i>Portunus trituberculatus</i>										●	●				
	SWIMMING CRAB	Taiwangazami	<i>Portunus pelagicus</i>			●						●	●		●			
	BLUE CRAB		<i>Callinectes sapidus</i>	●			●											
	DANA SWIMCRAB		<i>Callinectes danae</i>						●									
	MUD CRAB		<i>Scylla serrata</i>								●					●		
	BLACK STONE CRAB		<i>Menippe mercenaria</i>														●	
			Other species		●	●	●	●	●	●	●	●	●	●	●	●	●	●

● Catch, over 1,000 tons ● Catch, less than 1,000 tons