



Abalone catching. This man has just arrived at a boat, with an abalone caught. (Futomi, Boso Peninsula)

# Fishing Grounds Being Built in Shallow Coastal Waters

## More Wealth and Stability to Coastal Fishing Communities

The traditional concept of fishery has long been to "exploit fish resources given by nature". This concept has been based on the fact that fishing grounds largely depend on natural conditions such as the temperature and qualities of water, currents, sea bottom topography and qualities which are often changeable but not easily transformed by man.

However, studies have been made in Japan for sometime now with the idea of managing, protecting and propagating fishery resources as has already been the case in agriculture. These studies have now reached the stage where practical application is now being made of them in fishing communities.

Some of these activities are described below.

Creation of fishing grounds, which is a new human endeavour, is of particular significance in the shallow coastal waters of the world. This new attempt involves numerous fishing communities where hundreds of thousands fishermen and their families depend on marine fish resources. Building and development of coastal fishing grounds will no doubt increase the

catch of fish and raise the standard of living for these people. It will also greatly stimulate construction of fishing harbours, processing and marketing facilities in the fishing communities, which have so far often been impoverished, thus enabling the people to make a greater contribution to the national economy.

# Fishery Resources in Shallow Coastal Waters



Bay (top) Open sea (bottom) These air photographs were issued by the Geographical Survey Institute.

Shallow coastal waters are important habitats for fishes, shellfishes, seaweeds and crustacean. In this issue, our attention will be focussed on marine resources which are sedentary or only slightly migratory, i.e. shellfishes, seaweeds and crustaceans, rather than on fishes which are more migratory. The biota of shallow coastal waters is rather complex, as the waters are varied, ranging from brackish waters affected by the inflow of fresh land water to high-salinity waters open to the outer sea. Fishing grounds in shallow coastal waters may be classified broadly into "inner bay fish-

ing grounds or inshore fishing grounds" and "open sea fishing grounds". The air photographs on the left show a comparison of typical fishing grounds of these two different categories. The "Inner bay fishing grounds" normally have a sea bottom consisting mainly of sand or mud, while "open sea fishing grounds" consist usually of rocky sea bottoms. The different environments result in different types of dominant marine resources inhabiting their respective fishing grounds.

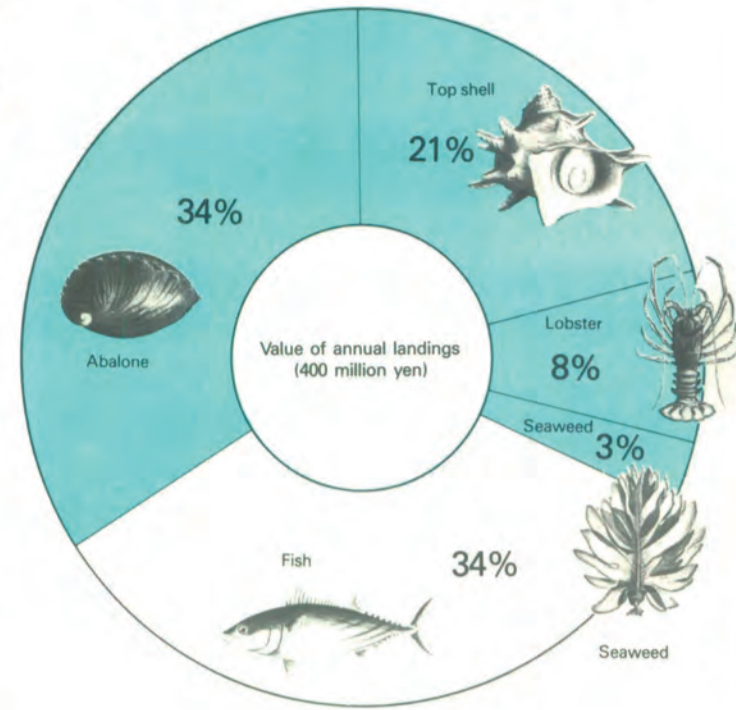
**Création de terrains de pêche côtiers en eau peu profonde.**  
 - De plus grands bénéfices et une meilleure stabilité pour les communautés de pêche côtière.  
 Comme il en a déjà été le cas pour l'agriculture, des études concernant la protection et la reproduction des ressources marines ont été entreprises depuis quelques temps au Japon. Maintenant, ces études ont atteint un stade où leur application pratique peut être entreprise au niveau des communautés de pêche.  
 Certaines de ces activités seront décrites plus loin. La création de terrains de pêche, qui est une nouvelle recherche de l'homme, est d'un intérêt particulier pour la pêche côtière en eau peu profonde du monde entier. Cette nouvelle tâche concerne de nombreuses communautés de pêche où des milliers et des milliers de pêcheurs et leur famille dépendent des ressources marines. Sans aucun doute, la construction et le développement des terrains de pêche côtiers vont augmenter la production et élever le niveau de vie de ces personnes. Cela stimulera aussi considérablement la construction de ports de pêche, d'usines de traitement et de bureaux d'études pour l'organisation des marchés au sein de ces communautés de pêche, lesquelles ont jusqu'à maintenant souvent vu leur équipement réduit à sa plus simple expression, ne leur permettant de donner aucune grande contribution à l'économie nationale.

**DESARROLLO DE REGIONES PARA LA PESCA EN LITORAL DE POCA PROFUNDIDAD. MAYOR PROVECHO Y ESTABILIDAD PARA LAS COMUNIDADES QUE SE DEDICAN A LA PESCA COSTERA.**  
 Por algún tiempo se han ido prosiguiendo en Japón estudios sobre la organización, protección y propagación de los recursos de la pesca como ha sido el caso para el desarrollo de la agricultura. Estos estudios han llegado actualmente a un punto en que la aplicación práctica de los resultados obtenidos han alcanzado un nivel de pesca comunitario de grupo.  
 Algunas de estas actividades vienen descritas mas abajo. La habilitación de regiones para la pesca, es un esfuerzo humano nuevo hasta la fecha y de particular significación para todas las costas del mundo. Este nuevo empeño concierne a numerosas comunidades de pesca en las que centenares de miles de pescadores y sus familias dependen de los recursos marinos de la pesca.  
 El hecho de formar y desarrollar las regiones de la pesca costera ayudará sin duda alguna a una mayor cogida de pescado elevando de paso el nivel de vida de esos pueblos que dependen de ella. Esto también contribuirá a dar un gran estímulo a la construcción de puertos de pesca, a la industria de la conserva, y facilidades mercantiles entre estas comunidades dedicadas a la pesca, tan empobrecidas muchas de ellas hasta la fecha. Dándoles también la oportunidad de tener una mayor contribución a la economía nacional.



A group of fisherman divers at Futomi are ready to go out fishing in the morning.

Fig. 1 Fishery in Futomi Area



### Example of Abalone Fishermen in Boso Peninsula

# Group Activities Promote Propagation of Fishery Resources in Shallow Coastal Waters

Fig. 2 Abalone production in Futomi Area

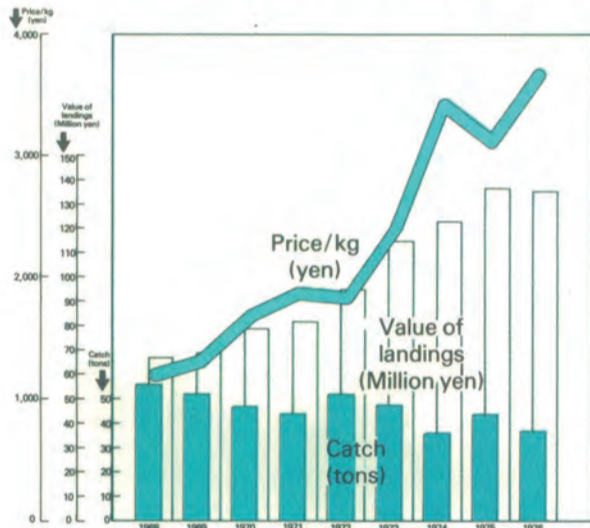
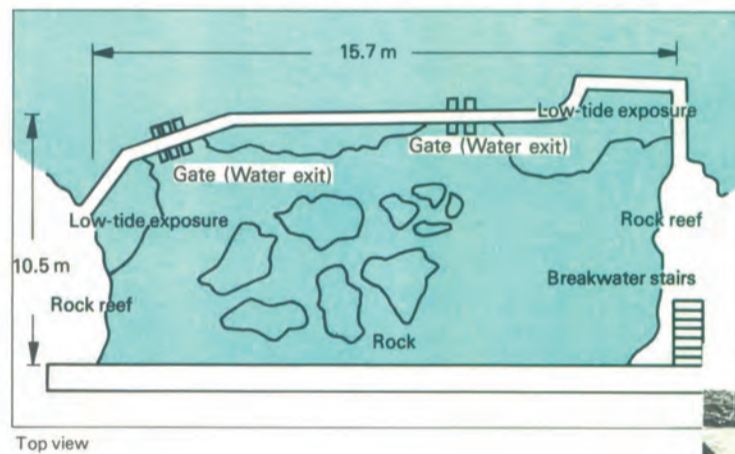
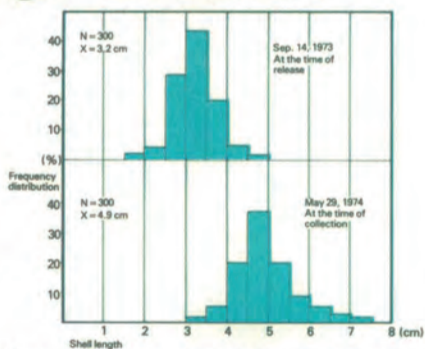


Fig. 3 Illustration of preservation pond



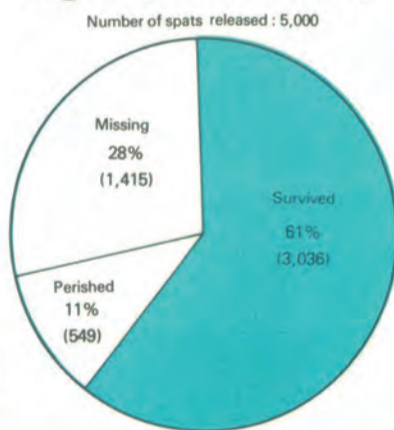
Top view

Fig. 4 Growth rate



• Above illustrations show the frequency distribution of shell lengths of spats at the time of release and collection, respectively. Average shell length ranged from 3.2 cm to 4.9 cm.

Fig. 5 Survival rate



The resources should not be depleted! These fishermen who dive and work everyday know what must be done. A study group of Futomi diving fishermen was thus formed to make a study of abalone resources and group activities were started: 1969~1970: Young abalones supplied by the Prefectural Research Laboratory were released to the fishing grounds (sanctuary area), but there were no noticeable effects.

1971: The group members visited advanced fishing areas and learned about "intermediate breeding". The intermediate breeding was tried using the concave parts of rock reefs, but proved unsuccessful because of the sands which drifted in it.

April 1972: A study group for abalone propagation was formed. The group consulted the Fishery Research Laboratory, collected useful information and also visited advanced fishing communities in the

Prefecture, in order to gain knowledge and learn necessary techniques. Since 1973: "Intermediate breeding of abalone" has been tried again seriously.

(1) Construction of abalone preservation pool (See Fig.3):

A concrete breakwater was built, making use of reefs. Inflow and outflow of the sea waters was ensured through 2 openings made in the breakwater.

(2) Breeding: 5,000 larvae were released in the preservation pool. Several subgroups of fishermen were formed to take turns feeding them and controlling the water quality of the pool.

(3) Measurement of the growth: After 8 months, all the young were collected and examined. Growth rate and survival rate were ascertained as shown in Fig.4. The young abalones were then marked and released to the fishing grounds. Fig.5 shows the result of the first release.

Intermediate breeding has been conducted every year since then, and the study group has been able to obtain better knowledge and understanding of environmental conditions necessary for growth, as well as methods of feeding. Some of the young abalones released in the first trial have already grown to marketing size. Although they are still only a very small part of the total harvest, the study group is now aware that they are able to contribute positively to the reproduction of their abalone resources. The next task of the study group will be a comparative study of the growth conditions in various fishing grounds where the young abalones have been released.

# Viabile fisheries

Dive fishing to collect shellfishes or to catch fish with a spear without the aid of special diving apparatuses is an old and primitive method, which is now very rarely practiced. It is practiced only in a few places in the world, and is confined mainly to the circum-pan-Pacific belt area, e.g. the Tuamotu Islands, Arafura Sea, the Bantan Islands of Bashi Strait, Japan, and Islands of Korea. The fishing diver is called an "Ama" in Japan. Nowadays we find "Ama" only in particular areas of Japan. They use simple fishing gear and gather seaweeds, shellfishes and other sedentary fish and marine animals in the shallow waters of reef areas. In many areas, they are mainly female divers, but in some areas male divers are engaged in this type of fishing. For example, on the Boso Peninsula, female divers are prevalent in some villages, while in others only male divers are found.

Mr. Kazuo Takahashi (pictured here) is an expert middle aged fisherman diver for abalone. His earnings from abalone dive-fishing account for as much as 70% of his total annual earnings. The fisherman divers group of the Nanaura Fishery Cooperative, of which Mr. Takahashi is a member, has made a study of the intermediate breeding method for abalone, like the Futomi group, and the work is highly appreciated. Mr. Takahashi earns his living as well by fishing with gillnet, a pattern of fishing which has been conducted in the last 10 years or so by the fishermen in this fishing village. Dive-fishing is possible only for 4 to 5 months during the summer. During the remaining seasons, most of the woman divers returned to household work, while fisherman divers were usually obliged to engage in farm work or to leave home to seek some other kind of work.

Under the circumstances, small-scale fishermen having no farmland wished to establish a viable pattern of fishery in which they could be engaged throughout the year, and efforts were made to introduce new fishing methods. The formation of the study group mentioned earlier was a part of their efforts.



Mr. Kazuo Takahashi

Activités d'un groupe pour l'encouragement à la reproduction des ressources piscicoles dans les eaux côtières peu profondes.

Nous vous présentons ici l'histoire d'un groupe de plongeurs qui, après avoir étudié l'haliotide (oreille de mer), est parvenu avec succès à aider la reproduction de ce coquillage. C'est après bien des échecs et des erreurs que ce

groupe a pu obtenir de bonnes connaissances sur les conditions environnantes pour la croissance du naissain de ce coquillage, ainsi que sur la façon de le nourrir. Après ce premier essai concluant, certains naissains sont arrivés à atteindre une taille commerciale. Bien que cela ne représente qu'une infime partie de la récolte totale, ce groupe d'étude est conscient qu'il peut contribuer positivement à la reproduction des haliotides.

GRUPOS ACTIVOS PROMUEVEN LA PROPAGACION DE LOS RECURSOS PESQUEROS EN LAS AGUAS DEL LITORAL

Aquí le introducimos con los resultados obtenidos de un método de cría intervenida, que ha tenido un éxito notable realizado por un grupo de pescadores buceadores, los cuales han hecho unos estudios sobre los recursos de moluscos (oreja marina) en sus respectivas regiones de pesca.

Los estudios realizados por este grupo de pescadores han dado como resultado un conocimiento mayor de las condiciones del medio ambiente en que se desarrollan los moluscos, así como diferentes maneras de criarlos, todo esto en medio de dificultades y errores inevitables. Algunos de estos moluscos conseguidos en la primera experiencia han crecido ya hasta un tamaño aceptable para ser puestos en el mercado. Aunque todavía no son mas que una parte pequeña de toda la cosecha, el grupo responsable tiene conciencia de que se encuentran capacitados para contribuir positivamente a la reproducción de estos moluscos favoreciendo así estos recursos marinos.

## Fishery systems and institutions in Japan

### Control of fishing grounds based on Fishery Laws

Legally, Japanese fisheries are classified into 3 categories:

1. Free fisheries (including sport fishing)
2. Fishing right fisheries
3. Licenced fisheries.

Many fishermen engage in several different types of fisheries, e.g. free fishery and fishing right fishery or licenced fishery. Fishery Laws are the basic laws controlling marine as well as fresh water fisheries. The Laws provide a fundamental institutional framework for fishery activities and aim at a coordinated utilization of marine and inland waters for the improvement of fishery productivity.

#### I Fishing right fisheries:

Numerous rights are granted in coastal waters as well as in rivers and lakes throughout the country. There are several different kinds of fishing rights. First comes the common fishing right which includes various categories. The main ones are as follows:

- **Common fishing right category No. 1:** The right is granted to the fishermen in a given coastal area to collect shellfishes, seaweeds, sea urchin, sea cucumber, etc.
- **Common fishing right category No. 2:** The right is granted for the operation of small set-nets.
- **Common fishing right category No. 3:** (Details omitted)
- **Common fishing right category No. 4:** (Details omitted)
- **Common fishing right category No. 5:** The right is granted for river or lake fisheries.

A fishery system somewhat similar to these common fishing rights already existed in the Tokugawa feudal era (17th ~ 19th century), when coastal fishermen were allowed to fish commonly in their own coastal area. After the feudal era ended, the practice was legalized in 1901 by the government. The common fishing rights is now granted only to fishery cooperative

associations by the prefectural governor regarding the coastal waters where the cooperative has been set up. Therefore, the cooperative administers the right and the member fishermen can engage in the fisheries concerned according to rules established by the cooperative. While the cooperative, for its own fisherman members, is given the exclusive right for fishing in the coastal area concerned, fishermen in other areas may be given access to the fishing grounds according to certain rules. This is also a legalization of traditional practices. Besides the common fishing right, there are 2 other kinds of fishing rights provided for in the Fishery Laws.

#### (1) Demarcated fishing right:

This right is granted for the purpose of culturing fishes, shellfishes or seaweeds.

#### (2) Set net fishing right:

This right is granted for the purpose of operating large set-nets.

Both of these fishing rights are granted by the prefectural governor to the local fishery cooperative association or the individual fisherman, upon application by them, to operate these fisheries.

#### II Licenced fisheries granted by Prefectural Governor or the Minister of Agriculture, Forestry and Fishery

Licences are given to fishermen or fishing enterprises, taking into consideration the following factors for the purpose of protecting fish resources:

- a. Total number of fishing vessels and total fishing efforts.
- b. To avoid too heavy a concentration of fishing vessels in a given fishing ground or fishing season.
- c. To prevent over-competition in the field of fishing vessel construction and equipment.

The Minister or prefectural governors issue licences to an adequate number of fishing vessels regarding respective fisheries, also placing various conditions on fishing operations.

Fishery licences can be classified into 3 categories according to the type of fishery and size of fishing vessels:

#### 1. Local coastal fisheries for which prefectural governors issue licences:

Most of the fisheries which employ efficient fishing methods have been brought under licence restriction by the prefectural governor, as there is a need for coordination and adjustment of operation among fishermen. Examples are certain types of small-scale purse seine fishing, gill netting, set-net

fishing, angling, long-lining, etc.

2. Those fisheries for which the Minister of Agriculture, Forestry and Fishery fixes a maximum number of fishing vessels and their maximum total tonnage with respect to each prefecture, with licences being given by each prefectural governor within the set limitations.

Examples include middle-size purse seine fishing, small-size trawling, small-size salmon gill-net fishing.

3. Those fisheries for which the Minister of Agriculture, Forestry and Fishery issues licences directly: Examples include middle-size purse seine fishing, purse seine fishing, tuna or skipjack fishing, salmon fishing, crab fishing and whaling.

### Mechanism of fishery control and system of coordination

In Japan, fishery coordination committees have been established for the purpose of regulating the fishery system by means of fishing rights and licences. The fishery coordination committees are democratic institutions which strive for an effective implementation of the fishery system, taking into account the views of the fishermen themselves.

The waters off each prefecture are divided into from one to three "Fishery Coordination Areas" and "Fishery Coordination Committee" is set up for each area, with the members consisting of people elected by the fishermen of the area as well as those with a particular knowledge and experience in the field of fisheries appointed by the prefectural governor. The Committees discuss the detailed implementation of the fishery regulations in an advisory capacity to the prefectural governor, giving necessary instructions to fishermen regarding fishing operations and taking measures to prevent operational conflicts among fishermen, for the purpose of ensuring coordinated and efficient use of the fishing grounds. It should also be mentioned

that, at the national level, the "Central Fisheries Coordination Committee" has been set up as an advisory organ to the Minister of Agriculture, Forestry and Fishery, which is instrumental to representing fishermen's interests in the process of formulation of national fishery policies.

### Role of Fishery Cooperatives

Practically all the coastal fishermen in Japan are members of fishery cooperatives set up in the fishing communities. Fishermen join the cooperatives not only because of the fact that the common fishing rights are granted to the cooperatives, but also because of other reasons, which include:

1. Need of fishermen to land their catch at the fish market operated by the cooperative.
2. Need for obtaining financial assistance from the cooperative, e.g. for operational funds, funds for fishing boat construction, etc.
3. Need for buying supplies through the cooperative, e.g. fuel oil, gear and other requisites for fishing operations. Fishermen depend, in their daily activities, very heavily on their local cooperative.

#### Le système de pêche et les institutions au Japon.

Juridiquement, les pêches japonaises se classent en deux catégories:

1. Les pêches avec droit de pêche.
2. Les permis de pêche.

Légalement faites l'une pour l'autre, ces deux catégories sont destinées à maintenir le principe fondamental des pêches japonaises.

De manière à rendre ce système effectif un "Comité de Coordination pour la Pêche Régionale" a été fondé pour chaque région du Japon.

D'un autre côté, les pêcheurs côtiers ne peuvent être séparés de leurs coopératives de pêche, non seulement juridiquement mais aussi pour d'autres raisons, telles que les opérations de pêche régulières, l'aide financière nécessaire, etc.

#### SISTEMA DE PESCA E INSTITUCIONES EN JAPON

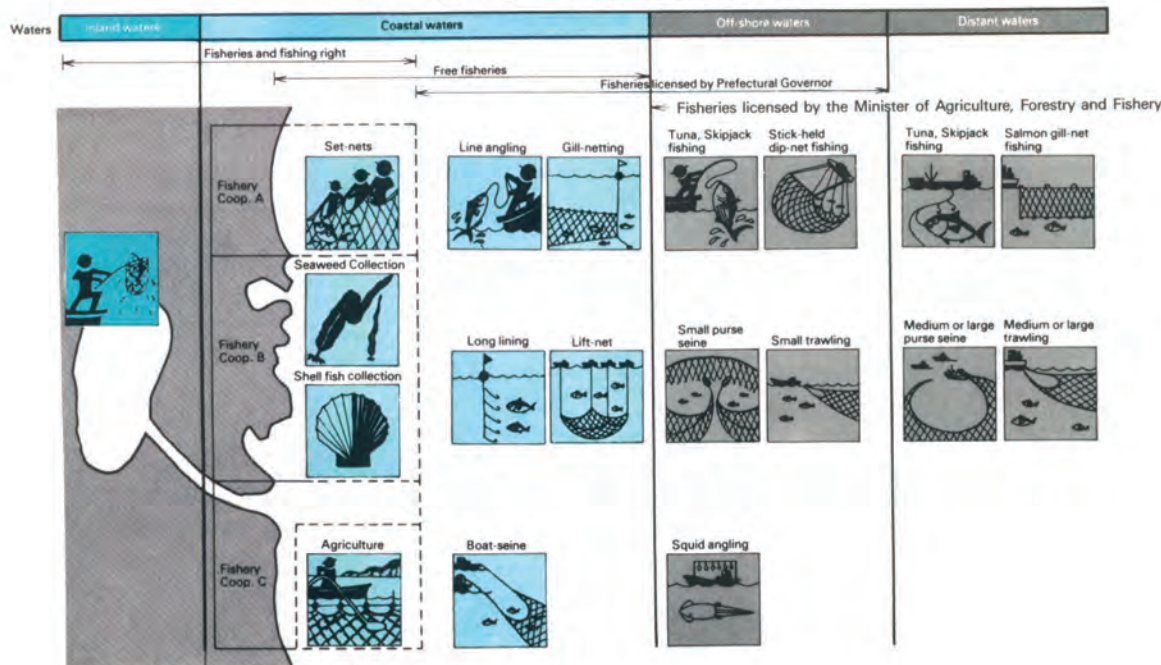
Según las leyes establecidas para la pesca en Japón esta se encuentra clasificada en las siguientes categorías:

1. Derechos de pesca
2. Licencia de pesca

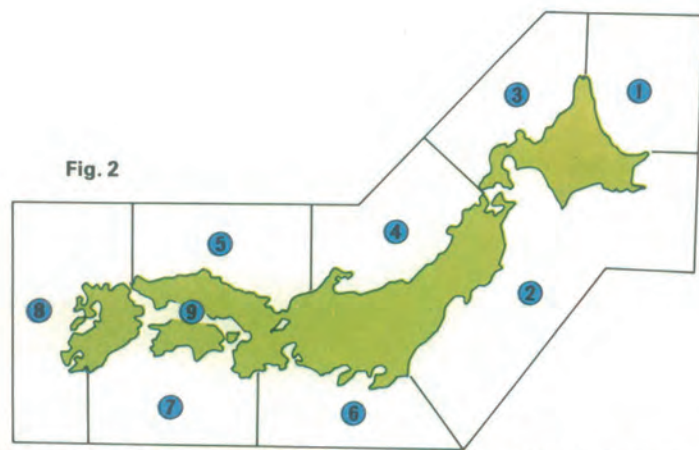
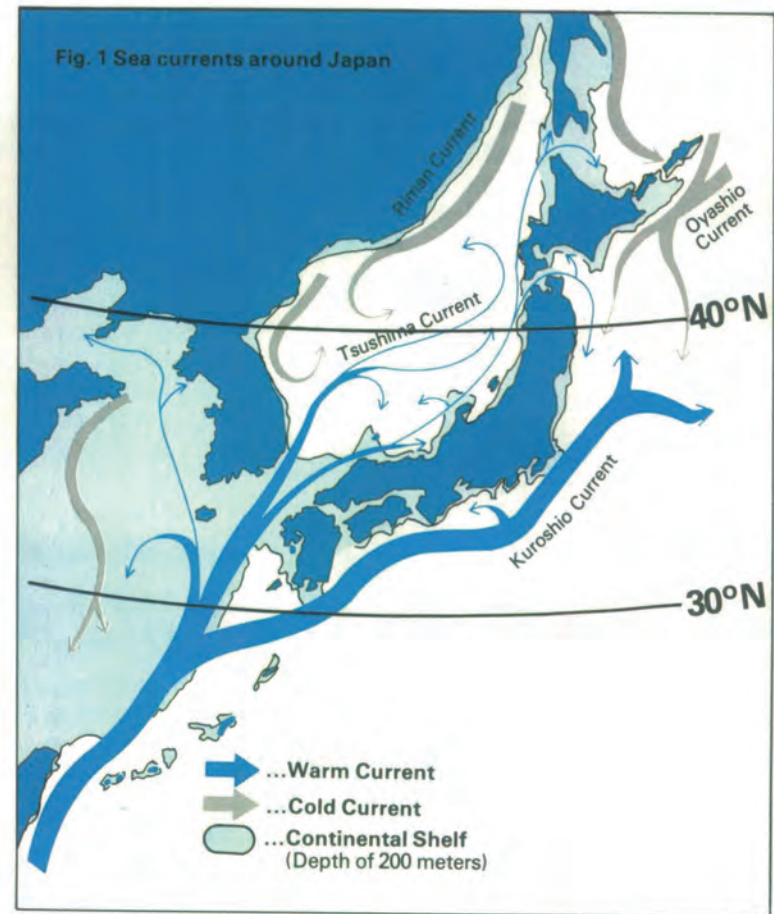
Ayudándose mutuamente en la parte legal ambas categorías tienen por fin el mantener un orden básico en todo lo concerniente a la pesca en Japón. Con el fin de implementar de modo que sea efectivo este sistema un Comité de Coordinación de las regiones de pesca ha sido establecido para cada una de las regiones dedicadas a la pesca por todo el Japón.

Del mismo modo los pescadores de la costa están incorporados a las cooperativas de pesca regionales no solamente por motivos legales, sino también por otras razones de común interés como el conseguir una pesca coordinada, la ayuda financiera necesaria, etc.

### Fishing rights and licences



# Fisheries in the Shallow Coastal Waters around



Remarks: (for table 1)  
 1. Coastal waters of Japan are divided into 9 areas as shown in Fig. 2  
 2. The signs indicate relative importance of the quantity of production:  
 Production area producing majority of the total  
 Middle class production area with sustained productivity  
 Area of small production situated at marginal habitat

Fig. 3 Production of marine fisheries in Japan (1983)

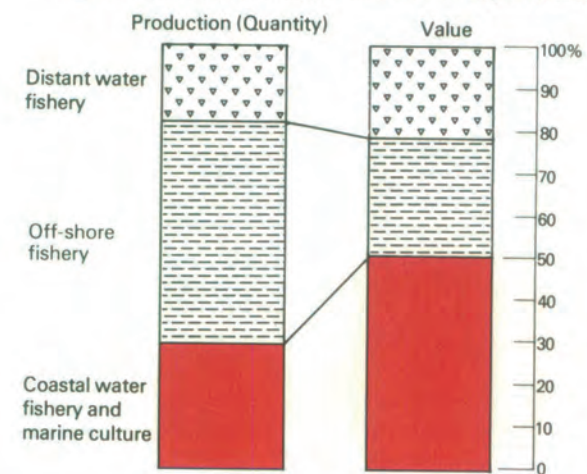


Table 1. Coastal fisheries and Marine fish culture in Japan by areas

Categories	Production Resources	Total production (1983) (Coastal waters only) Based on statistics of the Min. of Agr.	Cold current areas	Warm and cold currents mingling areas	Warm current areas								
			Sea of Okhotsk	Pacific	Japan Sea		Pacific	East China Sea	Seto Inland Sea				
			①	②	③	④	⑤	⑥	⑦	⑧	⑨		
Demersal marine animals	Lobster	Natural 1,179 tons											
	Prawn	" 3,578											
		Culture 1,949											
	King crab	Natural 152											
	Tanner crab	" 8,366											
	Blue crab	" 5,602											
	Octopus	" 41,648											
	Sea urchin	" 25,254											
Sea cucumber	" 8,295												
Shellfishes	Abalone	" 4,578											
	Top-shell	" 7,120											
	Hard clam	" 1,369											
	Short-necked clam	" 160,424											
	Scallop	" 128,136											
		Culture 85,134											
	Hen clam	Natural 4,981											
	Bloody clam	" 4,640											
Oyster	Culture 253,247												
Seaweeds	Kelp	Natural 129,043											
		Culture 44,345											
	Undaria	Natural 9,565											
		Culture 112,835											
	Laver	" 360,694											
Agar-agar	Natural 9,728												
Cultured fishes	Yellowtail	Culture 155,879											
	Sea bream	" 25,480											
	Horse mackerel	" 345											

# Japan

The waters off Japan are noted for rich fishery resources, including large varieties of species, due to various reasons such as its long and indented coastlines with many islands which dot its total distance of 3,000km, and the presence of areas where warm and cold currents meet with seasonal changes. Marine fish resources in Japanese waters, extending from north to south, include a wide range of species, i.e. those of cold waters, sub-cold waters, warm waters as well as of sub-tropical waters.

Table 1 presents the coastal fishery production, including demersal and cultured fish plus marine animals, e.g. prawns, crabs, shellfishes and seaweeds. Marine fishery production in Japan totalled 11,967 thousand tons in 1983, with the total value reaching 29,163 billion yen. Out of the above, the production from coastal waters and marine fish culture accounts for 3,010 thousand tons (28% or 12,254 billion yen 50%).

The comparatively high rate of the production value shows the high economic value here of coastal water products. The products shown in table 1 constitute approximately 50% of the total production from coastal waters and marine aquaculture. The Fisheries Agency of the Japanese Government has been developing large-scale projects for the purpose of increasing the productivity of the coastal waters. (See pages 6 and 7).

## Une mer productive.

### -Productivité fondamentale de la mer.

Jusqu'à maintenant, les études sur les ressources en poissons ont été faites sur la base que toute alternance du système écologique était au-delà de l'initiative humaine. Mais, en ce qui concerne la vie de certaines espèces, les fermes marines visent à une alternation partielle ou totale du système écologique.

Dans les régions côtières peu profondes, les fermes marines peuvent être engagées, comme il en est le cas pour l'agriculture, dans la culture des fonds marins, dans les semences, dans l'extermination des prédateurs, dans la fertilisation ou dans l'alimentation de la faune marine, ceci afin d'obtenir une plus grande productivité que dans les régions naturelles. On espère voir les recherches et les études sur les fermes marines se développer dans l'avenir. Mais de nombreux détails du système écologique des régions marines restent encore à résoudre.

## FERTILIDAD DEL MAR

### PRODUCTIVIDAD DE BASE DEL MAR

Hasta la fecha estudios realizados sobre recursos de pesca han sido fundados en la suposición de que cualquier alteración del sistema ecológico se encuentra mas allá de las posibilidades humanas. No obstante la cría marina de pesca tiende a una alteración parcial o total del sistema ecológico por lo que hace a ciertas especies durante el tiempo que tienen de vida.

El cultivo de peces en las aguas del litoral de la parte poca profunda de la costa puede envolver, como en el caso de la agricultura, el cultivo del fondo del mar, el sembrar semillas, eliminar predadores y la fecundación de crías, todo esto para conseguir una mayor productividad que la que se obtiene solo mediante ambientes naturales.

Se espera que los estudios y ensayos sobre la cría marina de pesca se desarrolle aún más en el futuro. Detalles sobre el sistema ecológico de las aguas de mar de muchas regiones están todavía por ser estudiados, pero los datos recogidos ofrecen garantía de éxito.

## Fertile Sea

### Fishery Resources in Shallow Coastal Waters

Oceans, having an area of  $361,059 \times 10^3 \text{ km}^2$ , account for 70% of the total surface of the earth. Now, let us look at the submarinetopography. A gentle slope extends out from most shorelines to 100m - 200m. This section is called continental shelf, and it is a topography common to almost all the sea areas in the world. The continental shelf is thought to have been a part of the land at the time of glacial age.

Out from the continental shelf, the sea bottom slopes down rather steeply. This section is called the continental slope. Reaching a depth of about 3,000m, the sea bottom resumes a gentle slope, until it reaches a depth of about 6,000m, which is called the "deep sea floor". Sometimes, there are trenches which are 6,000-10,000m deep at points on the deep sea floors.

stabilizing and facilitating the natural reproduction process in the ecosystem of the open sea for certain useful marine fish resources such as prawns and sea-breams. In other words, the aim is to influence, by means of artificial breeding and recruitment, the ecosystem in a larger sea area in order to promote increased reproduction of high-value fishes. Studies on fish resources, so far, have been based on the assumptions that any alteration of ecosystems was beyond human capability. However, "sea-ranching fisheries" aim at partial or total alteration of ecosystems only with regard to certain species at certain points during their life cycle. Sea-ranching fisheries in coastal shallow waters may involve, as in the case of agriculture, cultivation of sea bottom, sowing seeds, elimination of predators, and fertilization or feeding, to ensure higher productivity than in natural environments.

Research and studies on "sea-ranching fisheries" are expected to show further development in the future. Many details of the ecosystems in marine water areas, however, are yet to be clarified. So far, progress in these studies has been slow, being hindered by the difficulty of the object of the study, i.e. water masses. Recently, however, oceanography and marine biology have been making very rapid progress, owing to the development of various new research instruments. It is expected that new knowledge will be accumulated as result of trial and error in the course of time, and that precise plans for "sea-ranching fisheries" for warm water areas, cold water areas as well as for tropical waters will be drawn up.

### Basic Productivity of the Sea

Biologists and oceanographers call the waters above continental shelves "Coastal Waters" differentiating them from "high seas waters". Although the coastal waters constitute, in terms of area, only 9.9% of all the oceans, they are very rich in biota, with the productivity of the living resources being estimated at approximately 2 times that of the high seas waters. The features of the coastal waters include the following:

a. Coastal waters are constantly supplied by inflowing land waters with nutrient salts, facilitating propagation of phytoplanktons and zooplanktons on which fishes and other marine animals feed.

b. Coastal waters often have upwellings or vortexes which cause vertical mixing or agitation of sea water, providing biological environments which facilitate the propagation and growth of planktons. We may say that the original forms of life on the earth were microscopic water plants called phytoplanktons.

Phytoplanktons drift in enormous quantities in the surface waters penetrated by sunrays and form carbohydrates and other organic materials through photosynthesis, using the solar energy and nutrient salts in the water.

The most important and most numerous phytoplanktons are diatoms. They are primary producers in the marine ecosystem and therefore often called "marine pasture".

### Ecosystems and Food chains

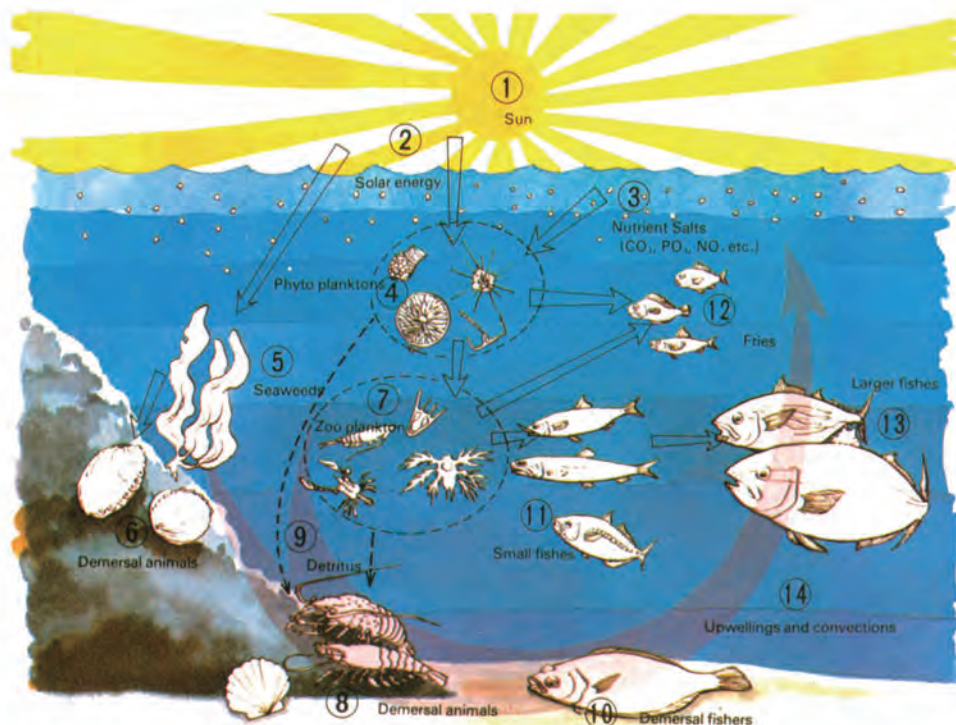
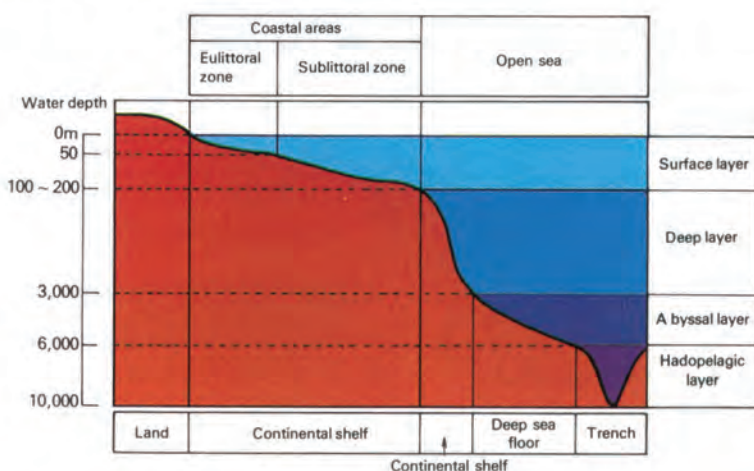
All forms of life have undergone a long evolutionary process to reach their present forms and places in the ecosystem. Each species has its own habitat suitable to its life cycle. Organisms can not live in isolation. Except for plants which are capable of forming nutritive substance for themselves, all animals live on other organisms, while they are, in turn, preyed on by some other animals.

There is also competition between different animals for common preys. These food relations are most important among living organisms. Animals and plants inhabiting given areas have certain "food chain" relations, which find

each animal and plant holding a certain ecological position in the habitat.

However, food chain relations are never uniform. In each individual habitat, there is a unique ecosystem consisting of certain food chains. Even in the same habitat, the patterns of food chains also vary with the seasons, as animals feed on different organisms during different stages of their life history, e.g. fry, yearlings and adults.

The patterns of food chains reflect the structure of reproduction of the given area. Therefore, it is essential to understand the ecosystem in which a given fishery resource exist, if their increase is to be ensured.



### Prospect of Fish Culture and Propagation

Aquaculture in fish ponds and net pens is a traditional practice with a long history. This is a means to obtain a greater harvest than in natural environments, by controlled feeding in a closed ecosystem.

Recent remarkable developments in aquaculture in Japan involve "sea-ranching" or "culture-based fisheries" beyond the traditional practice of fish culture in a closed habitat. Some of these new activities are already being practiced on a commercial basis. The activities enable increased production by

### Pêche côtière en eau peu profonde autour du Japon.

En 1976, la production de pêche marine s'est montée à 10.455 tonnes au Japon, la valeur totale a été estimée à 20.636 milliards de yens. La production des eaux côtières et de l'aquaculture marine a compté pour 2.850 tonnes (27,2%) et pour 8.798 milliards de yens (42,6%) de ce total.

Comparativement, le haut taux de la valeur de production montre la valeur économique des produits des eaux côtières.

### LA PESCA EN LAS AGUAS POCO PROFUNDAS DE LA COSTA ALREDEDOR DEL JAPON

La producción de la pesca de mar en Japón alcanzó 10.455 mil toneladas en 1976 con un valor total de 20.636 billones de yenes.

Además de esta hemos mencionado mas arriba la producción de la pesca en las aguas de la costa y el cultivo de peces se considera en 2.850 mil toneladas (27%) de toda la pesca con un valor de 879,8 billones de yenes (42,6%).

Este valor comparativamente alto de la producción demuestra el valor económico que envuelven los productos conseguidos en las aguas cercanas de la costa.



# Potential of Fish Production

## Development of Culture-based Abalone fishery

Mr. Kunizo Tanaka  
Chief of Marine Shallow Waters Resources Section,  
Chiba Prefectural Fishery Research Laboratory

The abalones caught along the coast of the Boso Peninsula include *Haliotis discus* and *Haliotis sieboldii*. *Haliotis discus*, the most valuable species, accounts for half of the total abalone production in the prefecture. In the prefecture, efforts have so far been concentrated mainly on the construction of habitats (by means of placing rocks or concrete blocks in the shallow coastal waters) and in artificial breeding to increase production of *Haliotis discus*.

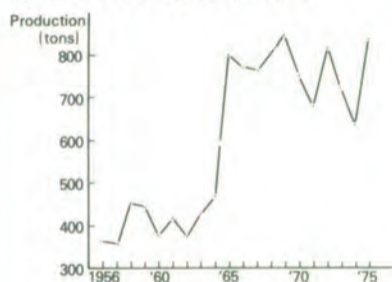
Recently, however, projects are being promoted to build large grounds for abalone propagation for the purpose of facilitating more efficient reproduction in natural environments. Below we will discuss the significance (both economic and resource-wise) of the artificial breeding of seeds, intermediate rearing of young abalones and construction of large-scale habitats.

### Production Increase through habitat control

Production of abalone in the prefecture amounted to only 374 tons in 1962. The catch increased rapidly to 801 tons in 1965 and 833 tons in 1975. The annual average in the last 10 years has been 765 tons, which is 1.88 times the average production during the period 1955-1964. (See figure 1) The increase in production is attributed to the following factors:

- (1) Efforts by fisherman divers and fishery cooperatives for resource protection and control resulting in:
  - a: Enforcement of the regulations prohibiting the collecting of small-size abalone (shell-length

Fig. 1 Trends of abalone production in Chiba Prefecture



less than . 12 cm).

- b: Voluntary establishment of fishing seasons and sanctuaries.
- c: Agreement by fisherman divers to operate simultaneously, thereby facilitating control.

- (2) Formation of good abalone fishing grounds by means of habitat construction and large-scale release of spats to natural sea areas.

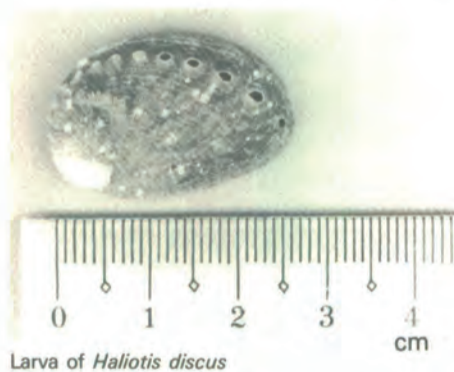
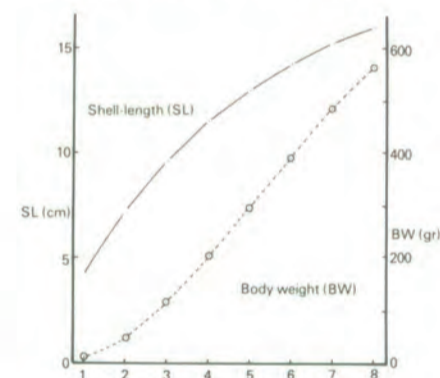
Since 1958, rocks and concrete blocks have been placed in the abalone grounds to improve the habitat, with assistance from the First and Second Coastal Fishery Structure Improvement Projects of the National Government, as well as on the initiative of the Prefectural Government. In the last 20 years, the Prefectural Government has carried

also out the transplantation and release of young abalones. Recently, some fishery cooperatives have started the transplantation and release of abalone on their own initiative.

- (3) Restriction on fishing methods and health control for fisherman divers. Fisherman divers abstain voluntarily from the use of wet diving suits or SCUBA which make extended-time diving possible. However, medical checkups are made periodically to protect the health of the fisherman divers.

Improved survival rate of abalones resulting from artificial breeding and intermediate rearing.

Fig. 2 Age and growth relations in Kawaguchi abalone (*Haliotis discus*) fishing grounds in Chikuracho



Larva of *Haliotis discus*

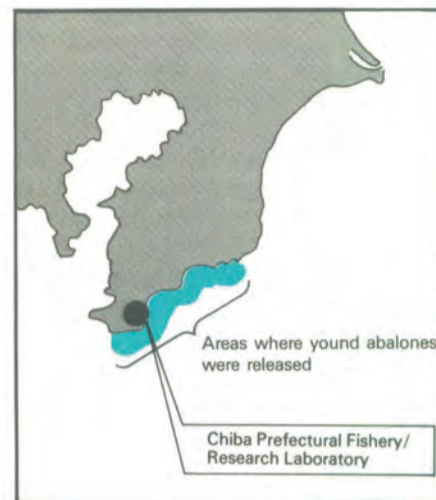
### Improved survival rate of abalones resulting from artificial breeding and intermediate rearing.

Artificial fertilization and breeding of the larvae of abalone was successfully conducted in 1935 (Murayama). Later in 1952, Ino succeeded in experimental breeding, in Kominato, Chiba Prefecture, up to a shell-length of 2cm in 13 months of rearing. This experiment clarified the early stages of the life history of *Haliotis discus*. Abalones are dioecious and fertilized externally. The number of eggs laid by a mother shell is estimated at 2.5-3.0 million.

Assuming a sustained natural reproduction of abalone resources, the natural survival rate is estimated to be in the order of one-millionth ( $10^{-6}$ ), taking into account both natural and fishing

mortalities. Particularly at the larva stage, up to the shell-length of 5mm, the survival rate is considered to be one-ten thousandth ( $10^{-4}$ ) to one-hundred thousandth ( $10^{-5}$ ), resulting from predators and natural mortality.

The purpose of artificial breeding is to increase survival rate by improving the living environments during the critical larva stage. At present, Chiba Prefectural Fishery Research Laboratory breeds an annual maximum of 600 thousand larvae up to the shell-length of 2.5cm and distributes them to the fishing grounds in the prefecture for release to natural sea areas. The process involves the stage from egg removal to the



Outdoor breeding tanks of Chiba Prefectural Fishery Research Laboratory

growth up to 2.5cm in shell-length and the corresponding survival rates are described as follows:

Eggs, on the order of 1 billion to 1.5 billion, are removed from mother shells. Out of the above, approx. 100 million are collected and placed in intermediate raising tanks, the larvae being attached to breeding boards. The larvae are reared intermediately in these tanks and finally, 600 thousand of them are released to the sea.

Therefore, the survival rate of abalones at this stage is one-thousandth, which is 10 to 100 times greater than that seen in natural environments. Regarding the

released abalones which have grown to commercial size and are caught in the fishing grounds in the prefecture, the survival rate is estimated to be 19-23% (on the average, 20%).

In other words, 120 thousand abalones, (20% of 600 thousand released spats) with a total weight of 36 tons (one abalone, 300gr.) (See fig. 2). The above explains the expected increase of catch. It is believed that the contribution of the artificial breeding and recruitment amounts to 4.5% of the present total annual catch, i.e. 800 tons.

### 25% production increase expected through formation of large abalone grounds

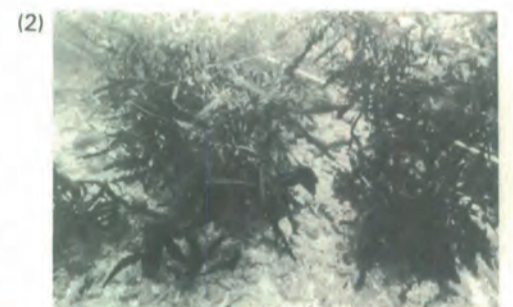
Much effort has been made so far to study and clarify the habitat and ecology of abalones. Spawned in the habitat and hatched in about 10 to 15 hours, larvae drift for 4-5 days and settle in reef areas not far from the mother shell's habitat. Many points still remain to be clarified about the exact movement of the larvae from the habitat of the mother shells to the final settling places.

However, in view of the fact that many of the places where the larvae tends to settle themselves are turbulent areas of shallow waters, various factors of the oceanographic environment such as water currents, temperatures, water qualities and plant distribution have been studied and analysed. The artificial formation of large propagation grounds has involved:

- (1) Raising the settling rate of larvae by improving the natural environment by means of expanding reefs artificially.
- (2) Ensuring large a number of mother shells as possible by constructing artificial reefs. Abalone production is thus expected to increase to a great extent. A tentative target for the project is to increase the annual production from the present 800 tons to 1,000 tons.



Habitat of abalone and flora.  
(1) *Eisenia bicyclis* (2) Gulfweed (*Sargassum*)  
The instrument is a TV camera to study ecology.  
(by courtesy of Chiba Fishery Research Laboratory)



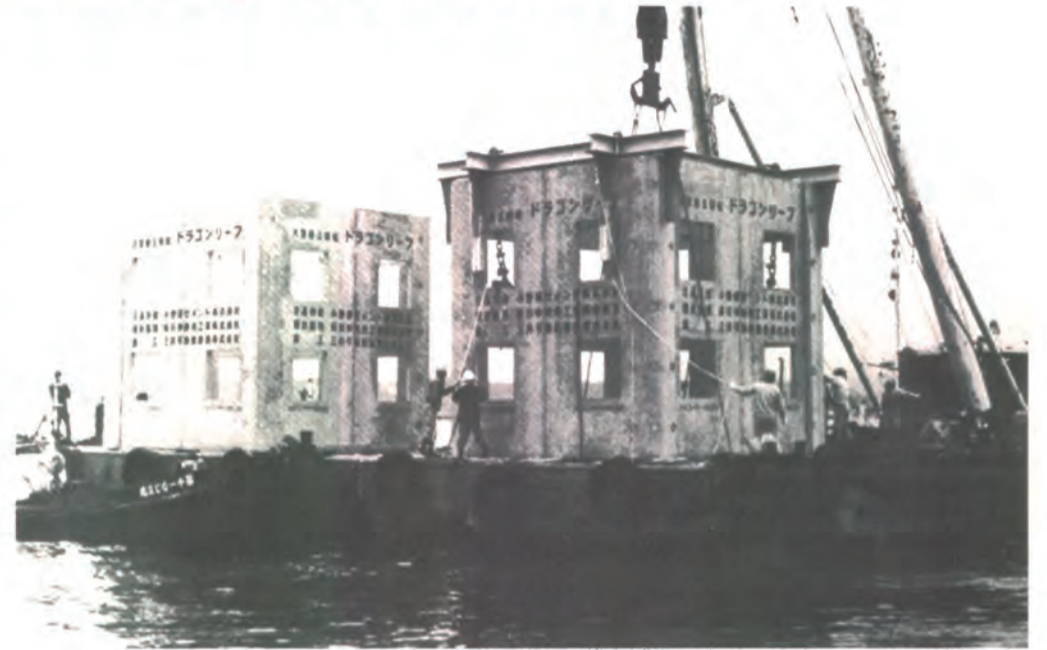
### Production potentielle de poissons. - Développement de la pêche à l'haliotide basée sur l'aquiculture.

Dans la préfecture, jusqu'à maintenant les efforts ont surtout été concentrés sur l'aménagement des habitats (en plaçant des rochers ou des blocs de béton dans les eaux peu profondes des régions côtières) et sur le naissain, ceci afin d'accroître la production d'haliotides. Mais récemment, des projets ont été mis à l'étude pour l'aménagement de grands terrains pour la propagation de manière à faciliter une reproduction de meilleur rendement dans les environnements naturels.

### POTENCIALIDAD DE LA PRODUCCION DE PESCADOS DESARROLLO DE LA PESCA DE MOLUSCOS CULTIVADOS

En la prefectura hasta la fecha, los esfuerzos se han visto mas bien concentrados en la construcción de viveros mediante la instalación de rocas y bloques de hormigón en las aguas poco profundas del litoral y el cultivo artificial de mariscos con el fin de aumentar la producción de moluscos. Sin embargo ultimamente hay grandes proyectos en marcha para preparar grandes espacios para la propagación de moluscos con la vista puesta en facilitar lo más posible una reproducción más eficiente en los parajes naturales.

# Projects are going on to build large fishing grounds and propagation areas in Shallow Coastal Waters around Japan



Large-size artificial fish-gathering shelters are put under water. Photo: Offered by The Suisan Keizai

- a: Creation of suitable habitats by placing artificial reefs and destroying unsuitable reefs,
- b: Building artificial fish shelters with concrete blocks,
- c: Construction of wave damping breakwaters and, dredging or cultivation of sea bottom in aquaculture grounds,
- d: Construction of artificial breeding facilities for shellfishes and seaweeds,
- e: Construction of waterways to facilitate exchange of sea water in inner bays
- f: Construction of aquaculture pens in open sea areas,
- g: Fertilization, and disease and predator control in aquaculture grounds.

## Development of large fishing grounds

In 1974, the "Law for Coastal Fishing Ground Consolidation and Development" was enacted. The purpose of this law was to develop large coastal fishing grounds for the purpose of aiding the steady development of coastal fisheries and increasing the supply of high valued fishes and shellfishes to meet consumer demand in the face of the new fishery age resulting from the 200 mile limits.

Projects for coastal fishing ground consolidation and development were started under a 7-year (1976-1982) development program of the National Government, involving a total project cost of 200 billion yen.

The projects included:

- a: Construction of artificial reefs and fish shelters,
- b: Construction of fish nurseries,
- c: Development of large scale aquaculture facilities,
- d: Development of aquaculture and propagation grounds in shallow coastal waters,
- e: Protection of the environment in the fishing grounds.

These projects are unique in the history of Japanese coastal fisheries. Particularly, those for development of large artificial reefs and floating breakwaters are attracting much attention from abroad, as well. While artificial breeding and releasing of fish and shellfishes correspond to "sow-

ing", the present projects intend to create and consolidate the "grounds" to which fishes, shellfishes and seaweeds are attracted, settle, live and propagate, (The large propagation grounds for abalones described on page 6 are also a part of these projects.)

It is expected that under these projects coastal waters can be developed in a coordinated manner and that the fishery productivity in shallow water areas will be greatly increased.

The projects are being implemented by prefectures, municipalities and fishery cooperatives with subsidies granted by the National Government (50-70% of the total project costs.)

## Aménagement de grands terrains de pêche.

En 1974, une loi sur la consolidation et l'expansion des terrains de pêche côtiers a été promulguée au Japon. Le but de cette loi était d'aménager de grands terrains de pêche côtiers afin de donner un développement régulier à la pêche côtière et d'accroître l'approvisionnement en poissons et en coquillages très estimés de manière à faire face à la demande des consommateurs et réagir à la loi des 200 milles marins.

C'est sous un programme gouvernemental rationnel de 7 ans (1976-1982) que ces projets pour la consolidation et l'expansion des terrains de pêche côtiers ont été mis en route, leur coût total se montera à 200 milliards de yens.

Ces projets feront sûrement date dans l'histoire de la

pêche côtière japonaise. Et c'est surtout les projets sur l'aménagement de grands récifs artificiels et de brise-lames flottants qui attirent l'attention du monde extérieur.

## DESARROLLO DE REGIONES EXTENSAS PARA LA PESCA

En Japón fué dictada una ley en 1974 con el objeto de desarrollar y consolidar las regiones pesqueras de la costa. El fin de esta ley es el de preparar unas extensas regiones de pesca y conseguir con esto un desarrollo constante de la pesca costera y aumentar la producción de mariscos de gran valor comercial, así mismo como de abastecer a las demandas de los consumidores en las nuevas circunstancias impuestas por la ley de las 200 millas de limite.

Un programa de 7 años (1976-1982) promovido por el gobierno ha comenzado en el que vienen incluidos varios proyectos para el desarrollo y la consolidación de las regiones pesqueras de la costa.

El coste total de este programa ambicioso se considera en unos 200 billones de yenes.

Sin duda estos proyectos dejarán sus huellas en la historia de la pesca costera en Japón. Es desarrollo de estas amplias regiones artificiales con arrecifes y rompeolas flotantes están atrayendo la atención también del exterior del Japón.

## Historical Background:

Protection and propagation of fishery resources in shallow coastal waters are practiced in Japan based on traditional method and experience.

These practices have included transplantation and release of abalone, artificial breeding and release of salmon, creation of artificial reefs with rocks, elimination of harmful seaweeds in beach areas, etc.

The traditional techniques have been supplemented and supported by scientific research since the Meiji Restoration in the middle of the 19th century, and many of these findings have now been applied to commercial operations.

To deal with the need for attaining greater self-sufficiency of food supply and also for establishing a firm policy in the face of the change of fishing environments caused by rapid industrialization, an urgent task is now the consolidation and development of the coastal fishing grounds within the 200 mile limit and particularly in the 12 mile territorial waters around Japan.

## Government Assistance

Government assistance to the development of shallow coastal water fishery commenced in 1952.

Projects first taken up were the following:

- a: Creation of reef areas suitable as fish habitats by placing artificial rocks or destroying unsuitable natural rocks or reefs,
- b: Transplantation and release of fry and spats,
- c: Provision of artificial devices to collect seeds of laver,
- d: Cultivation of the sea-bottom in shellfish culture grounds.

Subsequently in the 1960's, projects for the improvement of the coastal fishery structure were started, in order to modernize coastal productivity and improve the income level of coastal fishermen.

At the first stage long term projects were implemented on a national level during the period from 1962 to 1970, being followed by second stage projects executed during the period 1971 to 1975.

These projects included:

## Yamaha's Small-sized Boats Work boat and Jig boat

Model W-28: Used for seaweed culture



Model J-21C: Engaging in inshore catching of abalone, top shell, octopus, flat fish, etc.



Among Yamaha FRP boats (Fibre Reinforced Plastics boats), there are two types which are used for commercial purposes such as fishing or transportation. They are "Yamaha fishing boats with diesel engines (internal combustion) and "Yamaha small-sized boats" with outboard engines.

"Yamaha small-sized boats" are under 30 feet in length and more than 60,000 of them have already been constructed and are used for a variety of purposes in Japan. Also for Mexico and Venezuela, suitable types of "Yama-

ha small-sized boats" have been built by the KD method.

There are 3 types of "Yamaha small-sized boats", i.e. W-type, J-type and U-type, the first two types are used mainly for commercial purposes. Descriptions of the two types, W-type and J-type are given below:

### W-type

Boats of this type are called "work boats". Being broad and relatively deep, boats of this type are widely employed in fishing, partic-

ularly in gill-netting, shellfish or seaweed collection and aquaculture operations. They are also suitable as transports of catch or fishing requisites. Further, they come in two types, one with deck-floors and the other without them. Both types meet the following requirements:

- a: Large loading capacity
- b: Good maneuverability
- c: Seaworthiness and good stability
- d: Speed

### J-type

The other is called the "jig boat". It is slimmer compared with the W-type boats. Generally, this boat is not deep, with bow (or both bow and stern) bending backward. In Japan, there is a fishing method of catching fish with a spear or collecting seaweeds with long bamboo poles both from aboard using underwater glasses.

J-type boats are used primarily for this kind of beach fishing. As it were, the boat itself is a part of the fishing gear and therefore a great maneuverability is required, together with the following qualities:

- a: The breadth must not exceed one fathom length.
- b: The centre of gravity must be low and stable, as the boat is operated in an inclined position.
- c: The hull must be shaped in such a way

that the boat is least affected by winds and waves.

The above will explain the reasons why the J-type boats are slim, shallow, and have bows bending backward to avoid wave interference while running.

### Petits bateaux Yamaha.

Plus de 60.000 petits bateaux Yamaha" de moins de 9 mètres et équipés de moteurs hors-bord ont déjà été construits et utilisés pour diverses raisons au Japon. Au Mexique et au Venezuela, "des bateaux Yamaha de style japonais" adaptés à ces pays, ont été construits dans des usines de montage.

### BOTES DE TAMAÑO REDUCIDO YAMAHA

Los botes de tamaño reducido Yamaha tienen 30 pies de largo y vienen equipados con motores de fuera de bordo. Mas de 60.000 de estos botes han sido fabricados ya para toda una variedad de empleos aquí en Japón.

También para México y Venezuela han sido fabricados unos modelos Yamaha basado en el método KD.

# Dive Fishing

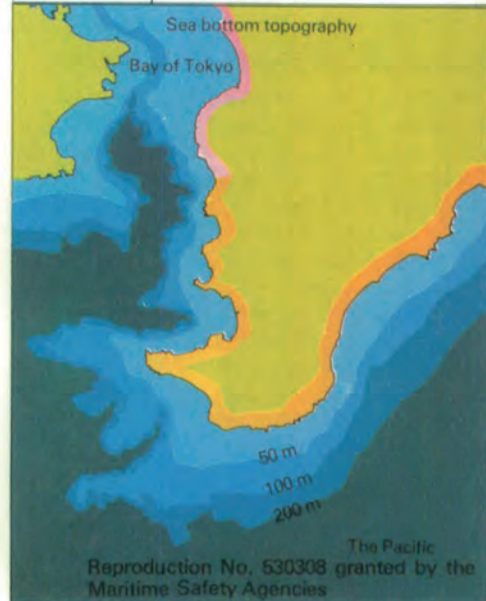
Efficient application of traditional skill



Going out fishing: Formerly row boats were used but nowadays powered boats quickly take fishermen out to the fishing grounds.

## Boso Peninsula

Division	Typical products
<b>Inshore fishing grounds</b>	<ul style="list-style-type: none"> <li>• Shellfishes</li> <li>• Seaweeds (cultured laver)</li> <li>• Fishes (Flat fishes, half break, sea bass)</li> <li>• Other marine animals (Prawn, sea urchin)</li> </ul>
<b>Open Sea fishing grounds</b>	<ul style="list-style-type: none"> <li>• Shellfishes (Abalone, top shell)</li> <li>• Seaweeds (Undaria, agar-agar)</li> <li>• Shallow water fishes (Big eye, parrot bass, squid)</li> <li>• Off-shore fishes (Sardine, mackerel, horse mackerel, skipjack, marlin)</li> <li>• Other marine animals (Lobster, sea urchin)</li> </ul>



The Boso Peninsula consists of hilly areas, of comparatively low altitude, with marine terraces, small bays and inlets, and either rocky or sandy beaches.

The East and South coasts face the Pacific Ocean and the west coast faces Tokyo Bay. The coastal fisheries include, therefore, both inshore fisheries and open sea fisheries. Tokyo Bay used to be a typically good inshore fishing ground but most of it now has been destroyed because of land reclamation and development of sea-side industrial complexes. At present, some laver culture, prawn gillnetting, shellfish collection and small trawling survive only in the southern coastal area. The "Outer Boso Coast" facing the Pacific Ocean is noted for a number of scattered dive-fishing villages.

Divers collect seaweeds and shellfishes in the coastal waters during the period from April to October. There are female divers and male divers, the former normally work close to the beach and the latter diving in deeper reef areas employing boats.

### Pêche côtière et en haute mer.

#### -Péninsule de Boso-

Sur les côtes est et sud de la péninsule, face à l'Océan Pacifique et sur la côte ouest face à la Baie de Tokyo, la pêche côtière comprend aussi la pêche en haute mer.

Dans le temps la Baie de Tokyo avait d'excellents terrains pour la pêche côtière, mais la plupart d'entre eux ont été détruits par les complexes industriels du bord de mer.

De nos jours seules quelques cultures subsistent dans les régions côtières du sud, la pêche à la crevette au filet, la récolte de coquillages et la pêche au petit chalut.

La côte extérieure de Boso, face à l'Océan Pacifique, est connue pour ses villages de pêcheurs sous-marins.

### CERCANIA DE LA COSTA Y MAR ADENTRO - PENINSULA DE BOSO -

El Este y el Sur de la costa de la península de Boso hacen frente al Océano Pacífico, mientras que la costa del Oeste hace frente a la bahía de Tokio.

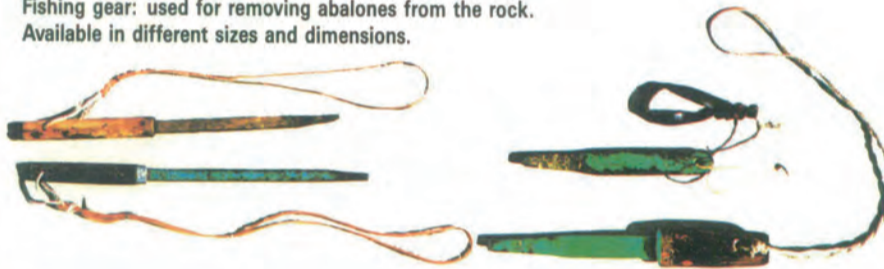
La pesca costera incluye naturalmente la pesca cerca de la costa, así como la pesca del mar adentro. La bahía de Tokio fué en sus tiempos una región típicamente fructuosa donde abundaban las extensiones para la pesca. Hoy día la mayoría de estos sitios de pesca han sido destruidos a causa de los rellenos que se han ido realizando para ganar terreno al mar y también los muchos centros industriales que se han establecido cerca del mar. Actualmente el cultivo de algas, quisquillas, mariscos y otros, sólo han podido sobrevivir en las regiones de la costa meridional de la península.

La parte de la costa de la península de Boso que hace frente al Océano Pacífico es muy conocida por sus numerosos esparcidos aquí y allá que viven de la pesca y donde los pescadores usan el método de bucear con mucha destreza.



Fisherman diver, with nothing but a mask on, dives into the water. The mask is fitted with water-pressure regulating balloons.

Fishing gear: used for removing abalones from the rock. Available in different sizes and dimensions.



No boat is used by these woman divers. They collect shellfishes and seaweeds around inshore reefs.

Boats are drawn up one by one with care after work.



Catch: Abalone and turbo. A day's catch!