

EELS ARE EATEN WHEN THEY HAVE GROWN 1,000 TIMES

How far will the popularity of the traditional Japanese dish, "Kabayaki" (eel broiled with sauce) grow?

In Japan most eels are artificially raised. A very tiny elver (fry) weighing 0.2g grows into an adult eel of about 200g.

With present eel culture techniques, the survival rate of the eel during the culture period from elver to adult eel is 50 ~ 80%. The marketing size of the eel in Japan is 180 ~ 250g in weight.

(Note) If the physical productivity of eel culture is calculated using the standard value of [body enlargement rate × survival rate], an average culture farmer would obtain 400 ~ 500kg of adult eel by inputting 1kg of elver and a competent culture farmer would get about 600kg of adult eel with the same input.

It seems that Japanese people of long ago ate eel more as a nourishing meal or medicine than as a delicacy. In the 15th to 16th century, however, a dish called "Kabayaki" appeared. From the late 17th century to the early 18th century, "Kabayaki restaurant" specializing in eel dishes appeared in the cities. The eel cuisine based on "Kabayaki" (eel broiled with sauce), which we presently eat was

thus established.

"Kabayaki" is an expensive, elaborate dish whose taste depends highly upon the specially skilled cook's techniques. The eel has to be alive until the moment it is cooked and for this purpose, a special channel passing the live eel from producer (eel cultivator) → wholesaler in the city → specialized restaurant exists. The eel business takes a pride in its long and unique tradition within the fishing industry in Japan.

In recent years, the consumption of eel by the Japanese has increased greatly. The supply in 1979 with domestic production and import put together was approximately 50,000 tons. Compared with figures for 1970-1972, the annual consumption of eel has increased by one to two eels per person on average. Hence, the mass media is publicizing this fact as the "phenomenon of the popularization of eel." Is this true? If this is true, what kind of changes are taking place in the eel business and its peripheral industries?

During the past 10 years, the following facts have been observed: 1. production increase following the introduction of house eel culture, 2. the introduction of processing at producing areas, and 3. the increase of imports. In this issue, we

should like to examine the causal relations lying behind these facts, and discuss the characteristics of Japanese eel fisheries.

(Note) In Japanese markets, adult eels are strictly separated by weight:

"Youta" (medium size) 180 ~ 220g,
 "Boku" (large size) around 250g,
 "Daiboku" (super large size) around 500g

The medium sized "Youta" has the highest marketing price, whilst the larger sizes, from "Boku" to "Daiboku", have a lower commodity value. On the other hand, in Europe, where eels are usually smoked, "boku" or even larger eels are highly valued.

En Japón la mayoría de la anguila se cría artificialmente. La diminuta anguila que recién nace pesa sólo 0,2g, en la edad adulta pesa unos 200g.

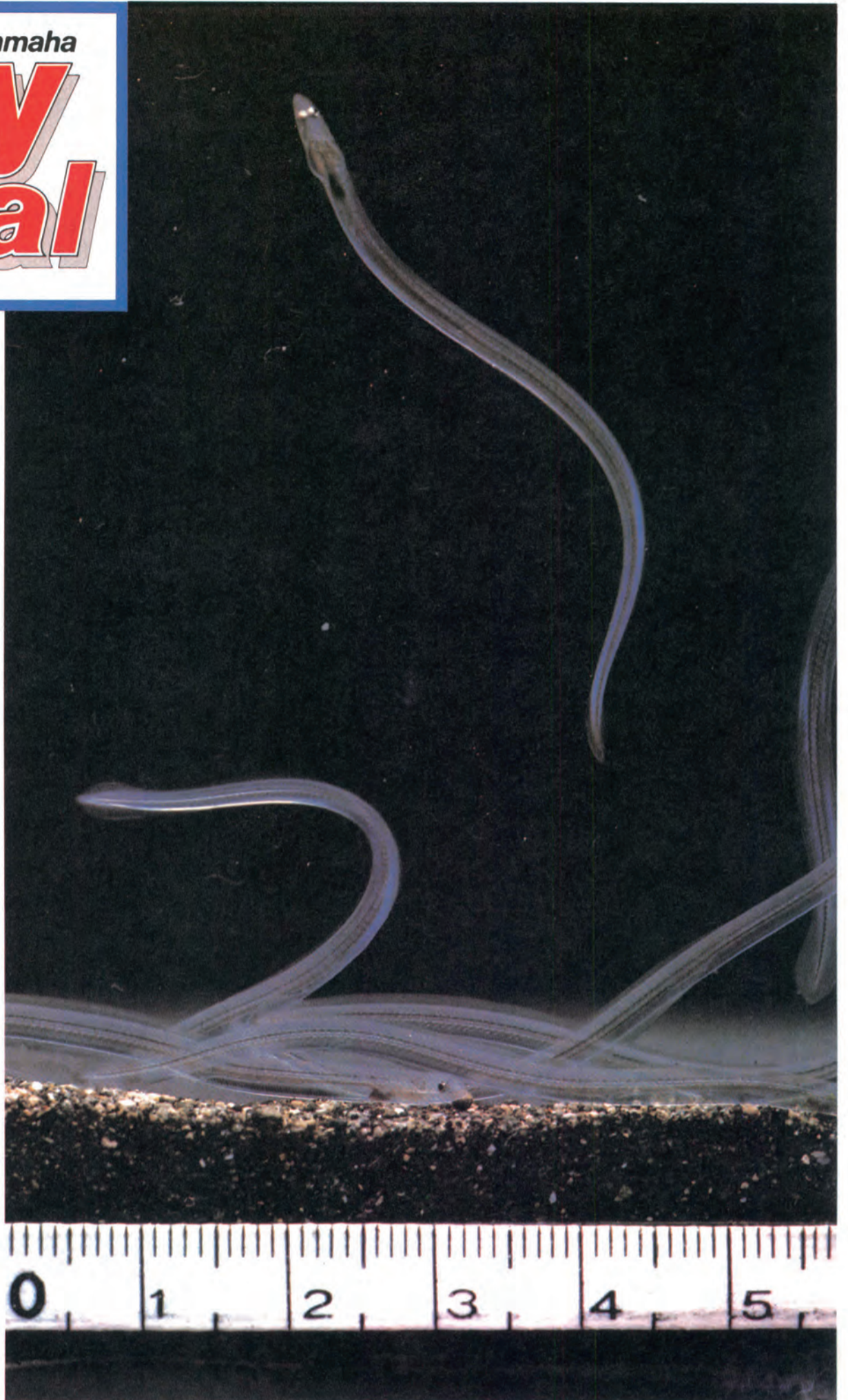
En años recientes el consumo de anguila entre el pueblo japonés ha aumentado enormemente. Entre producción nacional e importación, el suministro de 1979 fue de 50.000 tds. aproximadamente. En comparación con las cifras de 1970-1972, el consumo anual de anguila ha aumentado en promedio de una a dos anguilas por persona. De aquí que los medios de comunicación masiva estén

publicando este hecho como "fenómeno de la popularización de la anguila". ¿Es así? Si lo es, ¿qué clase de cambio se está efectuando en el negocio de anguilas ya existente, y en sus industrias relacionadas?

Au Japon, la plupart des anguilles sont élevées artificiellement. Une minuscule civelle (alevin) pesant 0,2g se développe pour devenir une anguille adulte d'environ 200g.

Dans les années récentes, la consommation d'anguilles par le peuple japonais a augmenté grandement. L'approvisionnement en 1979, comprenant la production domestique et les importations a été approximativement de 50.000 tonnes. Comparée aux chiffres de 1970 ~ 1972, la consommation annuelle d'anguilles a augmenté d'environ une à deux anguilles par personne en moyenne. De là, les masse-média ont versé de l'encre sur ce fait et l'ont appelé le "phénomène de la popularisation de l'anguille".

Est-ce vraiment ainsi? Si cela est vrai, quelle sorte de changement y a-t-il dans le commerce déjà existant de l'anguille et de ses industries périphériques?



Capturing of

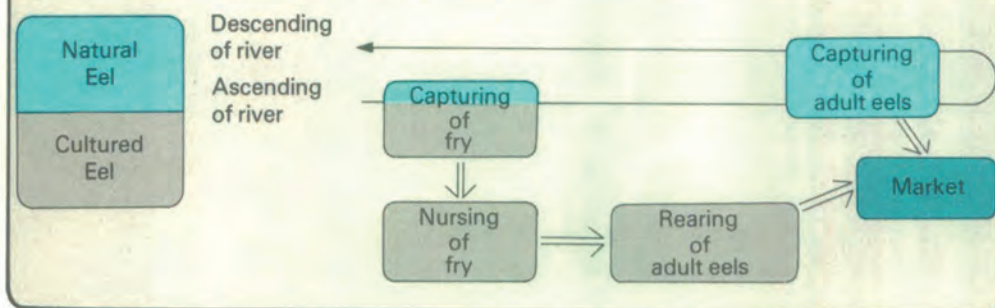


The life history of the eel and its relationship to the structure of the fisheries is illustrated below.

The eel fisheries in Japan can be divided into two types: (1) Those capturing natural eels, and (2) those practicing eel culture.

The capturing of natural eels can be further divided into: (a) The capturing of adult eels, and (b) The capturing of fry for culture.

From the technical point of view eel culture can be classified into two areas; the nursing of fry and the rearing of adult eels.



1 Capturing of Fry (Elver)

The problem in culture fishery which has to be solved in the very beginning is how to capture the fry which will become the seedlings for culture.

There are cases where the artificial hatching of eel was carried out successfully, but that was in the research laboratory; and it is still impossible to conduct artificial hatching on a commercial basis. Eel culture begins by capturing natural fry in every case. In Japan this fry is generally known as "Shirasu" or "Shirasu Unagi" (elver).

The fishermen normally capture the fry when they have approached the coast and are just entering the rivers in the bay or estuary areas. Fry approach the coast after sunset and start ascending the river. Their movement, having a close relationship with the ebb and flow of tide, becomes active with the flowing tide, and gradually decreases with the ebbing tide. Then towards the dawn, the fry stop ascending the river and bury themselves in the sandy mud. This pattern of activity proceeds in accordance with the cyclic movement of the tide.

Many kinds of fishing gear are used to catch the fry in various districts. Of course the fry as seedling have to be caught without damage. Generally scooping nets are used and this requires a very simple fishing gear. The small-sized set net shown in the picture is an exceptional method. The light used here is for the convenience of the workers to see and work easier and not for the purpose to gather fish. In fact, too strong a light may scare away the elver.

The captured elvers are put inside a wire netting, by which any other matter such as algae can be removed (the elvers will pass through the mesh by themselves) and are then put into a container.

Immediately after the catch or after preserving for a short period in a crawlnet, fishermen will sell them to the eel culture farmers.

The size of the catch of elver can vary enormously. Because the eel culture sole-

ly depends on the supply of natural seedlings, the amount of captured elver totally affects the marketing condition of adult eels one year later.

The capturing of elver requires the Governor's permission. In the Japanese eel business, the eel fishermen's union, the eel culture union and the consignee, make agreements on the distribution methods and prices for the fishing season each year. The prices are generally revised several times during a fishing season according to the size of the elver catch. In 1979, 1 kilogram (about 5,000 eels) was sold from the fishermen to eel culture farmers at 100,000 yen. In 1980, however, 1 kilogram of eel was traded at 60,000 ~ 80,000 yen during the early fishing season, because of the big catch of elver in the preceding year.

In 1969 due to the shortage of fry for culturing caused by bad catch of elver in Japan, the eel fishery circle adopted measures to import the fry of *Anguilla japonica* from Taiwan and the Republic of Korea.

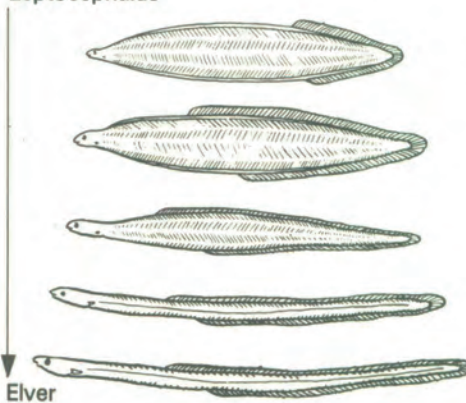
Furthermore, the import of elver of European eel (*Anguilla anguilla*) from Great Britain and France started. The import competition saw its peak during 1970 ~ 75; however, Taiwan and the Republic of Korea had changed their policy by restricting the export of elver in order to protect the eel culture of their own countries. Also the import fever for the fry of European eel gradually declined, because it was discovered that they do not suit the existing culturing methods in Japan. Actually, there are still a few culture farmers who raise European eels as illustrated in the separate table indicating the continued import of European eels.

Estimated Catch of Elver (*Anguilla japonica*)

Unit: ton

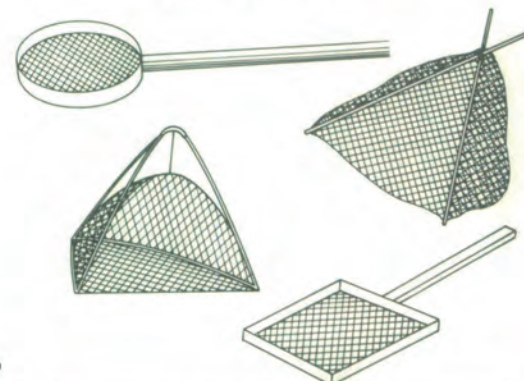
Year	Country			Total
	Japan	Taiwan	Rep. of Korea	
1972	33	11	4	48
1973	36	5	10	51
1974	54	11	11	76
1975	67	3	12	82
1976	57	11	9	77
1977	52	5	11	68
1978	69	7	7	83
1979	126	23	14	163

Leptocephalus

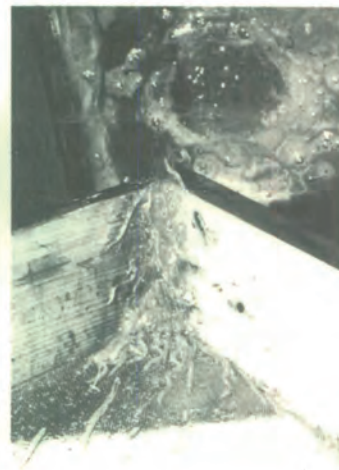
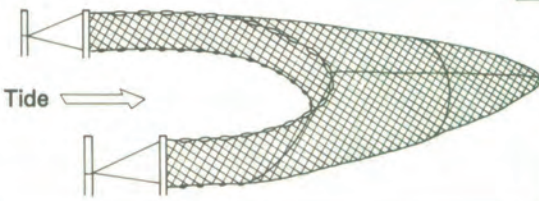


Elver

Fishing gears for elver



Transforming from leptocephalus to elver. This is rarely the case with fish.



Statistics for Seedling Import of European Eel (*Anguilla anguilla*)

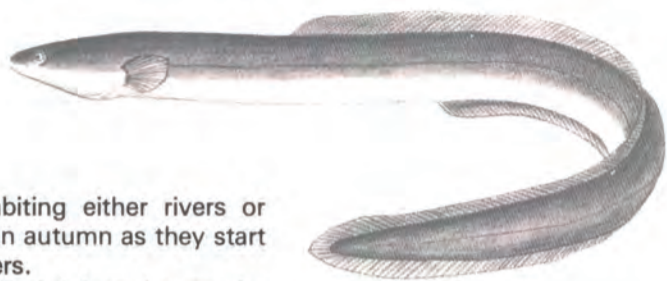
(by Customs Statistics)

Unit: kg

Year	Country	France	Great Britain	Italy	West Germany	Morocco	EC & others	Total
1968					69			69
1969		19,685	642	287				20,614
1970		10,386	3,587	6,116				20,089
1971		23,602	4,571	7,291				35,464
1972		70,649	8,040	2,660				81,349
1973		219,277	8,565	2,532		532	11,097	242,003
1974		44,923	4,655					49,578
1975		15,934	750					16,684
1976		46,500	970					47,470
1977		50,155	4,510					54,665
1978		46,226						46,226
1979		22,486	339					22,825

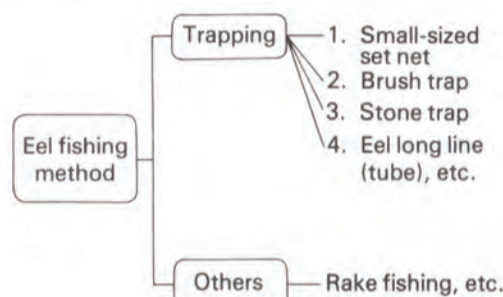
Natural Eel

2 Capturing of Natural Adult Eel



Adult eels inhabiting either rivers or lakes, are caught in autumn as they start to descend the rivers.

The fishing method is based upon the trapping method using a knowledge of the eel's ecology, and different kinds of traditional gears have been used in various regions since olden times.



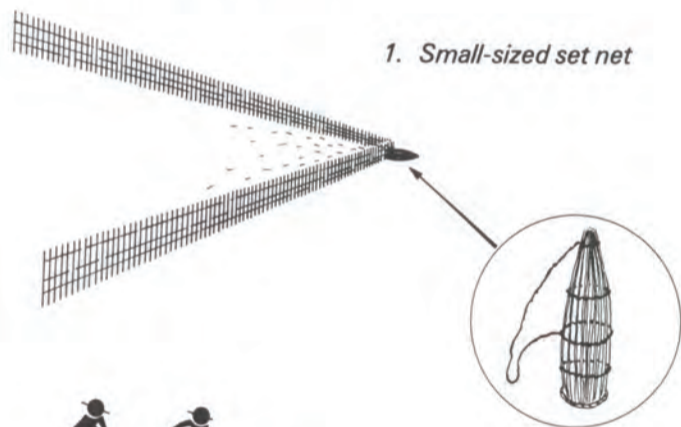
- Eels dislike light and prefer to live in dark places. The fishing methods making use of the eel's habit of burrowing in narrow places such as holes or between piled up rocks are: eel long lines, small-sized set nets, brush traps, stone traps.
- The fishing methods to attract eels with a

paste bait, a mixture of powdered larvae of silkworm and rice bran making use of eel's highly developed sense of smell are: eel long-lines, small-sized set nets, etc.

- The fishing methods to catch eels by changing the kind of bait according to seasonal changes in the diet of eels are; eel long lines, etc.
- The fishing method making use of eel's habit of hibernating in mud during the cold season is: rake fishing.

In the past, fishing was widely carried out in almost any river from the lower stream area to the upper stream area. At present, however, along with the development of the mining and manufacturing industries and the expansion of urban areas, rivers have become polluted and resources have decreased in many areas; and now the fishing grounds are limited to only certain regions. The yearly domestic total catch has declined to approximately 2,000 tons.

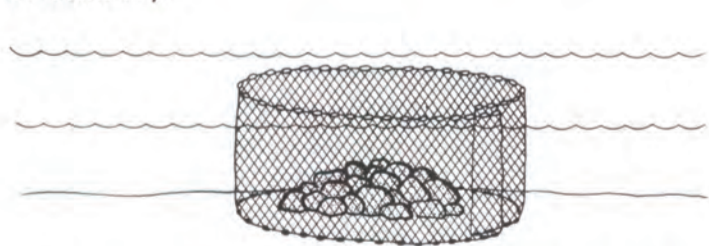
Trapping Methods



2. Brush net

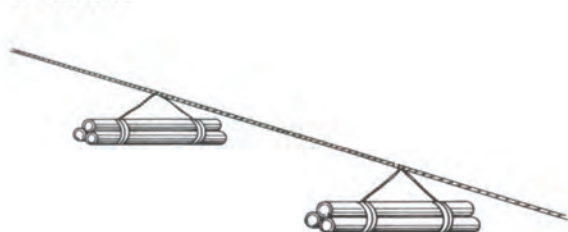


3. Stone trap



A number of stones are piled up in the river and left as they are. After few days the stones are surrounded by a net, and at low tide the stones are removed and the nets are drawn to catch the eels.

4. Eel tube



5. Rake fishing



The eels are caught by raking the mud at low tide from a rowing boat.

En la fig. se ilustran la historia de la anguila y su relación con la estructura de la pesca. La pesca japonesa puede dividirse en dos tipos: (1) captura de anguila natural, y (2) cría de anguila.

La captura de anguila natural puede subdividirse en (1) captura de anguila adulta, y (2) captura de anguila joven para cría.

Técnicamente, dicha cría se puede clasificar en dos áreas: cría de cardumen, y mantenimiento de anguilas adultas.

L'histoire de la vie des anguilles et de leur rapport avec l'industrie des pêches est illustrée dans le tableau La pêche aux anguilles au Japon peut être classée en deux types: (1) la capture des anguilles libres, et (2-) l'élevage des anguilles.

La capture des anguilles dans leur milieu naturel peut encore être divisée en: (1) la capture des anguilles adultes, et (2) la capture du frai pour l'élevage.

Du point de vue technique, l'élevage des anguilles peut être classé en deux catégories: l'élevage du frai et l'élevage des anguilles adultes.



the ocean riding on the surface of the current and will grow up as they migrate. In the case of *Anguilla japonica*, the larvae will approach the coast about 1 year after they are hatched (3 years for European eels), transform themselves into elver (fry) near the sea bottom, and soon after transformation they will enter the rivers. The water temperature will strongly influence the migration to the rivers; and the elvers will start to ascend rivers choosing the period when the difference of the water temperature between river and coast is smallest. *Anguilla japonica* starts the migration into rivers in late autumn to early winter when the water temperature is 8 ~ 10°C and remains so for 7 to 8 months. In this migration, various environmental factors besides water temperature such as tide, sunshine and wind work to change the migration to rivers.

Once the eels start living in the rivers, lakes or ponds that are their destination, they will burrow between rocks or into holes or into the mud during the day and will go out into the waters to feed at night. The amount of feed increases from spring to autumn and eels grow up quickly during this season. The eels eat various kinds of insects, small fish, shrimps and shellfish as natural feed.

The male eel becomes sexually mature in 3 ~ 4 years, whereas it takes 4 ~ 5 years for the female eel to reach sexual maturity. Towards the autumn the eels which have reached maturity become bluish black on their backs, light golden on their sides, and light pinkish on their abdomens, signifying that they have reached the breeding age. They then go down the river and enter the sea at the estuary. Immediately after entering the sea, the parent eels proceed to their particular spawning grounds, and they die soon after spawning and fertilization.

(Note) This issue is based upon a research thesis written by Dr. Isao Matsui.

Species and Distribution

There are in total 19 species of eel in the world. 2 species are distributed in the Atlantic Ocean; one type inhabiting the side of the European Continent and the other the side of the American Continent. As for the other species, 12 species are distributed in the Pacific Ocean, 3 in the Indian Ocean, and 2 in both the Pacific and the Indian Oceans.

Most of the eels are distributed throughout the tropical zone; however, 6 species inhabit the temperate zone and 2 species both tropical and temperate zones.

The eel discussed in this issue is the *Anguilla japonica*. *Anguilla japonica* is found in the waters of around the Japanese Islands, except Hokkaido, as well as in the Korean Peninsula on the Asian Continent; the Chinese continent facing the Yellow Sea, the East China Sea and the South China Sea; and in the Tongkin region of North Vietnam. In the island zones, it is distributed in the Izu Islands, Ogasawara Islands, Ryukyu Islands, Taiwan, and Hainan Island.

Life History

Eels are born in the sea and grow up in the fresh waters of rivers, lakes and ponds. The facts regarding the birth of eels, were veiled in mysterious myths from ancient times until the Medieval Ages. Although their ecology has been gradually understood since modern times, it was not until the beginning of this century that a Danish oceanobiologist, Dr. Johannes Schmidt discovered some of the spawning grounds of the eel.

Eels spawn in the middle layer zone of the ocean where the temperature and salinity are high. Within 2 to 10 days after spawning, the eggs will be hatched. The larvae, which are transparent and leaf shaped, are called leptocephali.

Leptocephali, while moving up and down during day and night, will spread out across

Hay en total 19 variedades de anguila en el mundo, 3 de ellas asiáticas. En el océano Atlántico se distribuyen dos especies: una hacia el continente europeo, y la otra hacia el americano. En el océano Pacífico se distribuyen 12 variedades; 3 en el océano Índico; y 2 en los océanos tanto Pacífico como Índico.

La mayoría de las anguilas se distribuyen en la zona tropical; sin embargo, 6 variedades habitan la zona templada; y 2, las zonas tanto tropical como templada.

On compte au total 19 espèces d'anguilles dans le monde, dont 3 particulières à l'Asie. De ces 19 espèces, 2 fréquentent l'océan Atlantique, l'une du côté européen, l'autre du côté du continent américain. Quant aux autres espèces, on en trouve 12 réparties dans l'océan Pacifique, 3 dans l'océan Indien, et 2 à la fois dans l'océan Pacifique et l'océan Indien.

La plupart des anguilles vivent dans les zones tropicales; cependant, 6 espèces fréquentent les zones tempérées et 2 espèces à la fois les zones tropicales et tempérées.

Spawning grounds of eels in the world



by Dr. Isao Matsui

Eel Culture

The fisheries which are carried out in inland waters such as rivers, lakes, or inlets can be divided into roughly two developmental types.

The first type is the part-agriculture and part-fishery type of industry. Namely, this is fishing carried out by farmers whose main production work is agriculture but whose work also involves the capturing of fish ascending rivers or fish, shellfish and others inhabiting lakes; or the culturing of fresh water fish on the shore of lakes or in irrigation ponds as side job. The fish catch is either self-consumed at the farmer's home, or sold within a very limited area. The fishery carried out here contributes in supplying animal protein to a rather self-sufficient farm household and also in bringing very important cash income into the family earnings.

The second type is the culture fishery, using inland waters systematized as an enterprise with the purpose of producing commercial goods.

In Japan, for many years the extensive farming of culture raised carp or crucian carp, using paddy fields or irrigation ponds was once widely carried out in many districts. However, as the high economic growth advanced domestically, this style of culture fishery gradually became inactive.

On the other hand, with the increase of the national income through economic growth, the culture raising of certain fish has rapidly developed in certain areas forming a local industry. (Fish cultured this way are: trout, sweetfish, carp, crucian carp, and eel in the inland waters as well as laver from the coast).

Of the many kinds of fish culture, eel culture is the most typical one.

Basic Necessities for Eel Culture

The following are the geographical necessities for eel culture:

1. Elver can be easily obtained,
2. It is mild in winter and the appropriate water temperature for the eel can be easily maintained over a long term,
3. An abundant water (supply is available to change the water in the ponds),
4. Feed can be obtained cheaply and in appropriate amounts.

As already mentioned, the artificial hatching of elver is not yet ready for practical use, and so the present eel culture industry relies 100% on natural fry.

The most important environmental condition is the water temperature. The appropriate water temperature for rearing eels is 15°C ~ 25°C, and when it drops below 10°C, eels will start hibernating by burrowing into the mud and when it rises again to around 13°C, they will start looking for feed. On the other hand, when the temperature exceeds 28°C, the amount of oxygen respiration rapidly increases and the danger of mass death occurs.

Because in eel culture it is necessary to maintain the environment of appropriate water temperature, to encourage feeding and to promote growth, a mild climate is required.

The second most important condition is the water quality control. The oxygen content of the water must be maintained and the decomposition of organic substances has to be avoided. [See Fig. 1]

Normally appropriate phytoplankton such as diatom are propagated in the culture pond, and oxygen is supplied by their function to assimilate carbon. Moreover, by controlling the amount of feed thrown into the water and by eliminating the excretions of eels, much can be done to preserve the water quality.

Especially in the case of a high density culture in which the number of eels reared per unit area is large, a certain amount of water of an appropriate temperature has to be constantly supplied to the pond for water-exchange purposes. It is generally

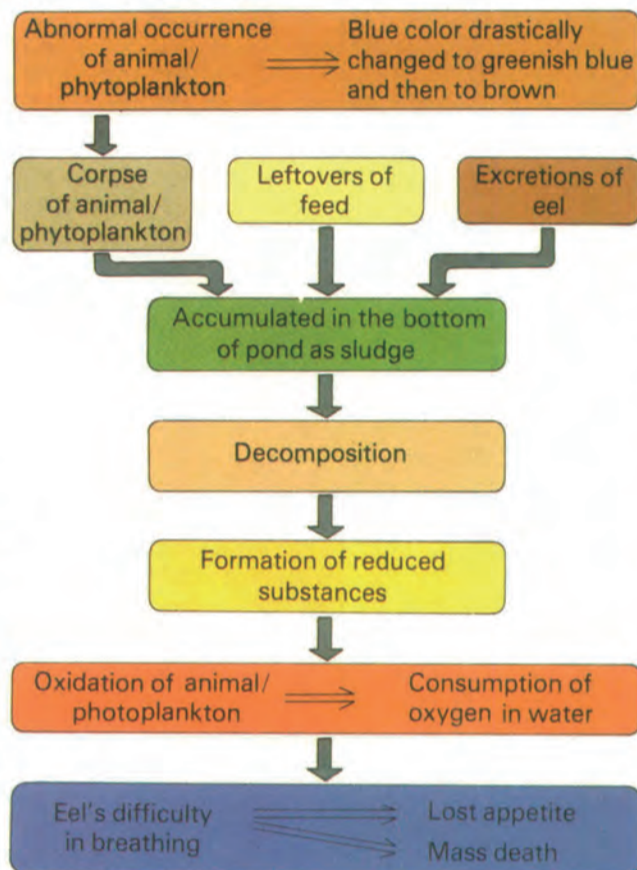
held that a total of 25 tons of fresh water is required to produce 1 kilogram of adult eel from elver. Hence a location where abundant flowing water from springs or rivers is available, is considered as a suitable one for culturing.

Finally there is the question of feed. Eels eat almost anything and their sense of smell is very highly developed. Taking this habit into account, weight increase

Being blessed by all the conditions of location — climate · water · seedling availability · feed, the eel culture of the three prefectures of Shizuoka, Aichi, and Mie of Tohakai district have developed enormously, and are firmly established as the main producing areas. Until about ten years ago, the above three prefectures alone were supplying 90% of the domestic cultured eel production.

During the past ten-odd years, the Japanese eel culture has experienced two technological innovations, leading to a great leap forward. The style of culture has drastically changed from an extensive type to an intensive type and the productivity greatly improved. Moreover, as the management form of family came to be fixed, highly profitable business was established.

Fig. 1 Necessity of Water Quality Control in Eel Culture



over a short period is possible by selective feeding. Fresh and frozen fish can be used for the feed. Low priced fish such as atka mackerel, saury pike, sardine, anchovy, horse mackerel, mackerel and the like are generally used, but sometimes remainders of fish from fishery processing factories are also used.

(1) In the 1960's research on assorted feed advanced, and around 1965 theories were put into practice. There are three types of feed for culture: powder feed, solid feed (pellet), and semi-solid feed (Oregon pellet); however, powder feed is used for the eel culture. A certain amount of fat and water is added to the mixed feed, consisting mainly of fish meal, and after it has made into a paste using a mixer, it is given as feed.

In eel culture circles, the standard amount of feed given to eels as well as the seasonal fluctuation in the amount of feed is calculated based upon many years of research and experience. According to research, the amount of feed required to put 1kg of flesh on an eel is considered as 6 ~ 7kg of either fresh or frozen fish, and is about 2kg (dry weight) if the feed is a mixed one.

Although, mixed feeds cannot be considered as good as fresh feed, economically, mixed feeds are convenient in terms of transportation and storage.

Besides, they make the feeding work easier and also more hygienic. Moreover, they have the big advantage of making eel culture possible even in districts where fresh raw fish is hard to obtain. Because of this, cultured eel producing areas have spread nationwide.

(2) Also in the 1960's, vinyl house type culture ponds, very different from the former water stoppage-type open field



1) Eel culture firm in Shizuoka Prefecture. Standard culture firm owns a pond area of 30 ~ 50 acres and is managing the labor of 3 ~ 4 families and hires workers.



2) 1/3 or 1/4 of the total pond area, i.e. about 10 acres, is in the house system. During the cold season eels are reared inside the house and stocked in the open field ponds during the summer.



3) Water agitator wheel: Whilst supplying oxygen, this also provides the pond water with a current.



7) Base pond for nursing elver. For about 20 days, they are fed at a water temperature of 25 ~ 27°C. They are fed initially starting with stringy earthworm, and gradually progress to mixed feed.



8) Adult eels are captured with a hauling net, gill net or towing net.

Brief History of Japanese Eel Culture

1879	Eel breeding by capturing natural fry was attempted.
around 1900	Eel culture as a business started.
1915 ~ 1923	In the 3 prefectures of Aichi, Shizuoka and Mie, the local industry of eel-culture was formed.
1943 ~ 1947	Culture was suspended because of WWII.
1948	Eel pond culture resumed operation.
1965	Mixed feed was put to practical use. A national eel culture union was set up.
1966	Processing at the production area was attempted for the first time (Shizuoka).
1969	Large volume of European eel fry was imported from France. 24 tons of adult eel imported from Taiwan.
1970	Processing industry at production area was established.
1972 ~ 1975	Import from Taiwan expanded
1973	Big supermarket chain advanced into eel sales.
1975 ~ 1976	House eel culture became widespread. Producing area spread nationwide.

pond started to appear in the eel culture business. A new (indoor) house eel culture method was developed. The house eel culture method started with the initial aim of raising the water temperature using solar energy by covering the pond with a vinyl roof, but it was further developed into a system in which underground water of a fixed temperature drawn up by pump was heated.

It was found that by heating the underground water, 1. the survival rate of fry (elvers) put into the pond after capture during the coldest season could be raised by more than 30 ~ 40% and sometimes even to 50% above the former rate; and 2. the rearing period was reduced from the 18 ~ 24 months of the former method, where the water stoppage type open field ponds were used, to 8 ~ 12 months by maintaining the water temperature over 10°C throughout the year to prevent the eel from hibernating, and thus a big economic effect was realized.

The house eel culture system initially appeared in districts other than the 3 prefectures of Tohoku which have been the main producing regions since old times. Farm households cultivating vegetables in green houses have converted to eel culture systems forming new producing areas in the coastal districts of Shikoku and Kyushu where they possess the advantage of being close to an area for catching elvers. Since the early

1970's, the house eel culture system has spread to the areas other than capturing place of fry, and presently the eel culture is carried out throughout Japan.

The house eel culture has the characteristic of improving the productivity by raising the culture density; and for this, the water of the pond has to be exchanged artificially by pumps and not by natural flowing water circulation so that oxygen is actively supplied and water quality is preserved.

The improvement of productivity was realized as follows: In the case of Shizuoka Prefecture (which developed this system at an early stage), the annual yield per unit area using the old open field pond system is now 2 ~ 13kg for every 3.3m² (1 tsubo), and after WWII was on the level of 4 ~ 14 kg.

The yield after the introduction of the house eel culture system increases the figure to as much as 30 ~ 40kg per 3.3m².

En Japón, desde hace mucho tiempo y en numerosos distritos se han aprovechado campos inundados de arroz o pozos de irrigación para la cría de carpas y crucian. Sin embargo, este estilo de pesca disminuyó gradualmente al paso del rápido crecimiento económico de la nación.

Por otra parte, con el aumento de las rentas nacionales a través del crecimiento económico, la cría de ciertas especies de peces se desarrolló rápidamente para formar en algunas áreas una floreciente industria local. (El pescado así criado es: trucha, pescado de agua dulce, carpa, crucian y anguila en aguas interiores; y algas en las costas).

La cría de anguila puede considerarse típica entre las diversas crías de peces.

Au Japon, pendant de nombreuses années, l'élevage étendu des carpes communes ou carrasins, en utilisant des champs de riz ou des bassins d'irrigation a été autrefois très répandu dans de nombreuses provinces. Cependant, à mesure de la croissance économique générale du pays, ce type de culture a progressivement diminué. D'un autre côté, avec l'augmentation du revenu national, suite à la croissance économique, la méthode d'élevage de certaines espèces de poissons s'est rapidement développée dans certains secteurs pour former le contrefort de l'industrie locale. Parmi les sortes de poissons élevés de cette manière, on compte: les truites, poissons d'eau douce, carpes communes, carpes carrasins et les anguilles d'eau douce, ainsi que la culture du varech comestible.

De toutes ces sortes d'élevages de poissons, celui de l'anguille est le plus typique.

Fig. 2 Producing Areas of Elver



Fig. 3 Producing Areas of Cultured Eels

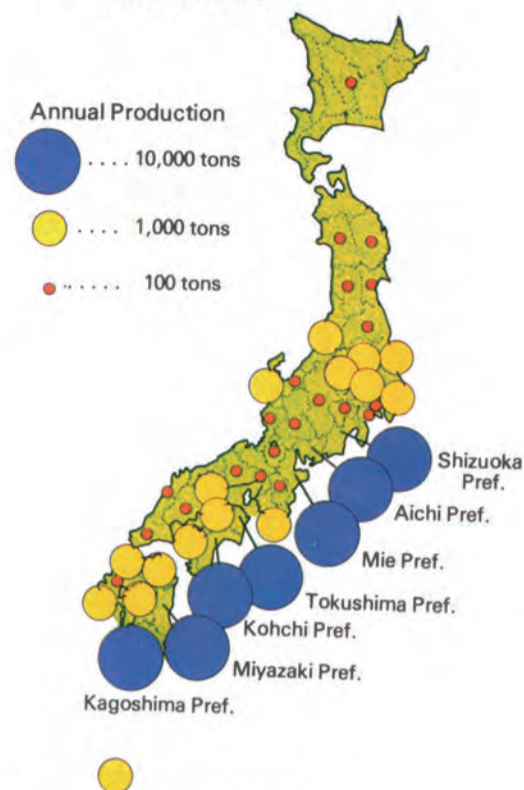


Fig. 4 Change of Yield of Cultured Eel by Producing Areas

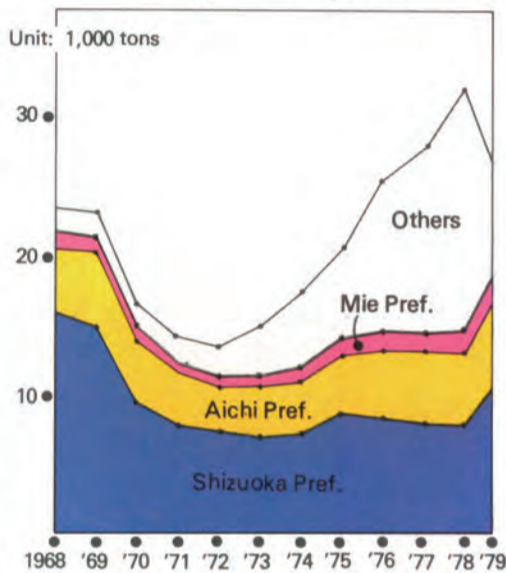


Table 1 Fisheries Output in Japan (1979)

		100 Million Yen
Fishing boat fisheries	Surface fisheries	20,559
	Inland water fisheries	527
Culture fisheries	Surface fisheries	4,228
	Inland water fisheries	1,164

Table 2 Breakdown of Output by Inland Water Culture (1979)

		Million Yen
Eel culture		71,465
Carp culture		12,319
Trout culture		14,347
Sweetfish culture		12,266
Others		6,018

Table 3 Consumption of Feed for Eel Culture (Nationwide)

		Unit: ton						
Year	Type	Fish (Fresh & Frozen)	Fresh larva	Dry larva	Fish meal	Assorted Feed	Others	Total
1974		15,916	7	20	23	28,706	762	45,434
1975		11,774	18	21	555	38,541	892	51,802
1976		7,719	27	15	14	42,161	766	50,702
1977		6,590	2	17	15	40,034	788	47,446
1978		9,656	15	24	1,484	54,165	1,546	66,890
1979		5,834	5	9	227	49,868	1,907	57,850

From Statistics by the Ministry of Agriculture, Forestry and Fisheries



4) Preparing feed using mixed feed.



5) Feeding ground.



6) Since eels reared exclusively on mixed feed are said to be poor in taste, live baits are sometimes provided. The picture shows mackerel.



9) Sorting



10) "Ikeshime" After sorting, eels are put into baskets, water is showered on them and the baskets are stacked for 3 ~ 4 days. The purpose is: 1. to excrete the feed from the digestive systems in order to stave off "mass death" during transportation; and 2. to remove fatty acids which were absorbed from fresh fish feed, as well as to eliminate odour and to tighten up the flesh of the eel.



11) Packing and shipping of live eels: Eels are put into plastic bags into which oxygen is injected and are shipped after they are sealed and packed in cardboard boxes.



Eel Distribution in Japan

The marketing of eels in Japan seems complicated; however, basically two methods are in existence, the traditional and the modern, with both forces trying to find out their future directions for development. An outline of the traditional force and that of the new force are as follows:

Selling Live Eels

1 Traditional Marketing Business

Until the middle of the 1960's, all eels, whether natural or cultured, were shipped in the form of "live fish".

Since eel cuisine is traditionally considered to be an expensive fancy dish, the consumption centers in the urban cities. According to figures for 1967, the four major cities of Tokyo (50%), Osaka (30%), Nagoya (15%) and Kyoto (15%) account for the major part of national consumption.

These big cities have their own specialized wholesale dealers who are in charge of distribution to various parts of the country. These wholesale dealers, large and small, have more or less managed to hold the right to determine the price.

Because recent cultured eel production has spread widely throughout the country and the local production has stimulated the local demand, the consumption by the four big cities in recent years has seemed to drop to as much as 50-60% of the whole country. Yet with the live eels, the wholesale dealers in the big cities are still in charge of approximately 90% of the total marketed eel, so only after passing through their hands, will the eels be delivered to the local secondary wholesalers.

Along with the eel wholesaler in the major consuming areas, what characterizes the eel marketing is the function of the middlemen in the production areas.

The fact that eel culture can be divided into the two stages was mentioned earlier. The two culturing stages of nurs-

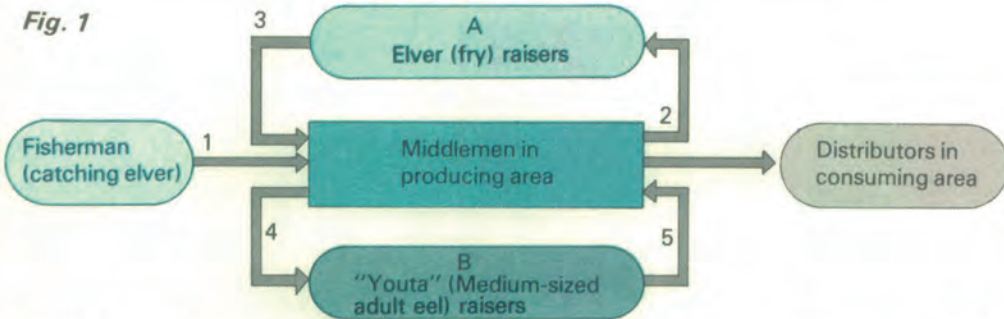
ing from elver to fry and rearing from fry to adult eel were carried out in the past by the division of work within the same area or among different areas according to the management scale of the culture farmers. Here, the middlemen in the producing area play an important intermediary role.

- 1-2 Purchasing and selling of elver
- 3-4 Purchasing and selling of young eel
- 5-6 Purchasing and selling of adult eel

In the above process, the middlemen in the producing area maintain a close relationship with the culture farmers. In other words, these middlemen not only support the management of eel culture farmers by their financial power, but also take the initiative in price determination at transactions of each stage of 1-6.

Lately along with the increase of eel culture farmers who carry out integrated production from elver up to the adult eel, modernization toward joint purchasing and joint shipping has come to take place by the activities of eel culture cooperative unions. Thus the middlemen's control in the market has become less powerful than it used to be.

We have to say that the role the central wholesale market plays for eel is very small. As for the distribution of fisheries products in Japan, central markets are set up in both the producing areas and the consuming areas, and these markets are dealing with approximately 60% of all the fisheries production. However, for the eels alone, the transaction on these markets amounts to only about 10% for both live and processed eels.



A Nursing of elver elvers (0.15-0.20g) are purchased, and cultured in the base pond until they become "Youchu" (alevin of 10-30g)

B Raising of "Youta" "Youchu" are transferred to sub-ponds and are raised until they become adult eels of marketing size (100-200g).

Processing at Production Site and Packing Sale

2 Increased Supply and Popularization of Sale

Upon entering the 1970's, the Japanese eel business seemed to reach a turning point. Unexpected conditions for the eel business were brought about by at least four major changes.

1. As mentioned earlier, the start of house eel culture had expanded the producing areas and increased the domestic production.
2. Imports of adult eel increased.
3. Sales of processed goods started to appear in producing areas.

4. Supermarkets had advanced into the eel retailing business.

Introduction of Processed Eels

As the production increases, the producers begin to hope to raise the commodity value of eel and to conduct their sales with more profit.

In 1966 one experiment introduced a new aspect to the eel culture business. The Yaizu Eel Culture Fisheries



Cooperative Union had for the first time in Japan started to conduct the processing of eel at the producing site. What they did was to process the eel into "Kabayaki" (eel broiled in sauce), freeze and store them in a processing plant operated by the cooperative union. This made shipment control possible and because time and labor are saved in transportation, the goods can be transported in a larger volume.

"Frozen Kabayaki" at first seemed strange to the Japanese people, but it gradually spread throughout the country owing to the demand from restaurants. The production of "Shiroyaki" (plain broiled eel), semi-finished "Kabayaki", also began. In 1970, 1,200 tons of processed eel products were shipped from Shizuoka Prefecture, and it was during this period that the full scale processing at the producing site began. The processing industry at producing site comprises of plants directly operated by the eel culture cooperatives, subsidiary companies of big fishery companies, and the surrounding small cottage industry.

Expansion of Imports

Taiwan appeared on the scene as the supplier of elver when Japan had a poor catch of elver around 1967-1968, but later by introducing the Japanese eel culture techniques into their own country, Taiwan began the culture and export of adult eels. 24 tons of adult eels were exported to Japan in 1969, and 494 tons in 1970. It is an amazing fact that Taiwan had come to produce nearly a half of the total production amount of cultured eel in Japan in less than 10 years. In 1979 they exported 13,000 tons of eel to Japan.

Due to a very high eel import fever in Japan, natural or cultured adult eels are being imported from the Republic of Korea, People's Republic of China, Thailand and even from the U.S.A.

Imported eels are air-freighted live; but after being carried into Japan, they are either sorted for "live eel" or "processed eel" use and are distributed passing through the same route as the domestically produced eels. Moreover, Taiwan has recently started "Shiroyaki (plainly broiled) processing." Presently, 4-5,000 tons are being imported annually to Japan.

As the import of eel has been increasing year by year, lately there is a rising necessity to adjust the friction with the domestic producers; and so in order to maintain a proper control of import, import regulatory measures through negotiation with the import agents of the main export country, Taiwan, have come about.

Formation of New Marketing Channel

Now a new force in eel sales has entered the stage. In 1973, one big supermarket company has succeeded in marketing "packed Kabayaki." Supermarkets originally started their marketing with mass sales and bargain prices as their feature; at the same time, supermarkets were aiming to elevate their brand image by attempting the sales of luxurious goods. The introduction of



"Kabayaki", which is a traditionally high-class dish to the food department was a well-timed event. Overnight, many supermarkets followed suit, greatly stimulating the demand for eel dishes to be prepared at home.

The (estimated) production of processed eel ("Kabayaki" and "Shiroyaki") in 1980, including imported processed goods, was about 10,000 tons (calculated in terms of raw fish, 15,000 tons), and this amounted to 30-35% of all eels marketed. Out of this, the retail sales by supermarkets are estimated to account for approximately 60%.

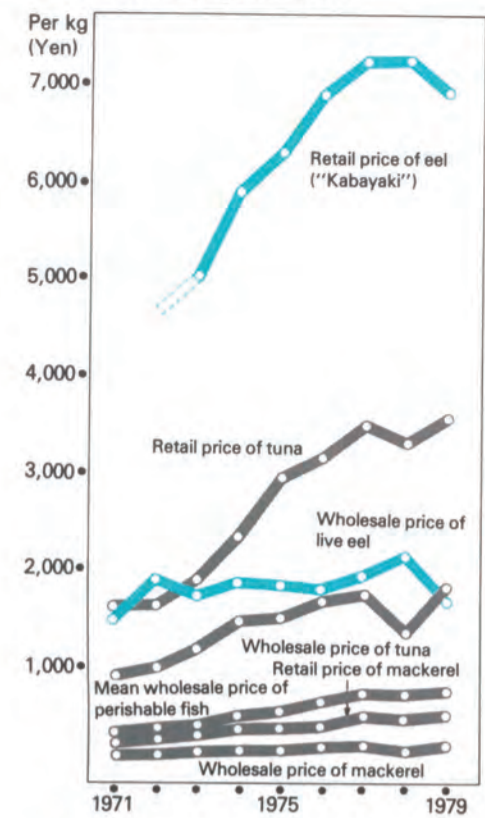
General Change in Situation

Here we shall summarize how the situation has altered as a result of the four phenomena of increased domestic production, increased import, sales of processed goods, and participation of supermarkets.

1. Demand: Until ten years ago, eels were seasonal goods and 50% of the annual sales was shipped during the three month period from June to August. This was due to the fact that the Japanese people preferred to eat eels in summer around "Ushi no hi" (the day of ox) in the hottest season (July). Moreover this eating habit was in accordance with the management methods of speciality restaurants who sell eel dishes in spring, summer, and autumn and transfer their menu to loach dishes or oyster dishes towards autumn and winter.

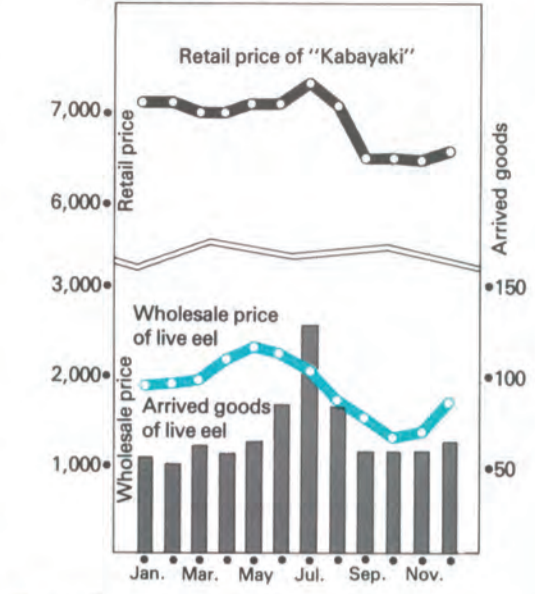
With the introduction, however, of the age of mass consumption, the demand has been spreading throughout the year. Recent sales in summer (June-August) decreased to less than 30%.

Fig. 2 Transition of Market Price on the Tokyo Market



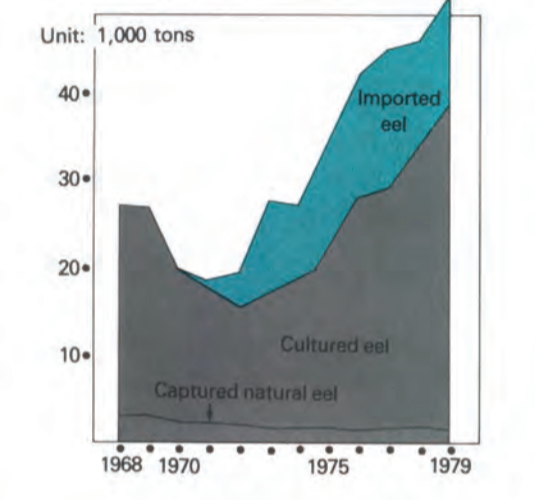
[Sources]
 Mean wholesale price of perishable fish: "Annual Statistical Report on Distribution of Marine Products", Ministry of Agriculture, Forestry and Fisheries.
 Wholesale price of tuna: "Annual Statistical Report on Distribution of Marine Products", Ministry of Agriculture, Forestry and Fisheries.
 Wholesale price of mackerel: "Annual Statistical Report on Distribution of Marine Products", Ministry of Agriculture, Forestry and Fisheries.
 Wholesale price of eel: Tokyo Fresh Water Fish Wholesaler's Cooperative Union.
 Retail price of eel (1 skewered "Kabayaki", about 70g): "Annual Report of Statistical Survey on Retail Price", Prime Minister's Office.
 Retail price of tuna (fillet of fish): "Annual Report of Statistical Survey on Retail Price", Prime Minister's Office.
 Retail price of mackerel (whole, 25-30cm long): "Annual Report of Statistical Survey on Retail Price", Prime Minister's Office.

Fig. 3 Seasonal Fluctuation of Distribution and Price on the Tokyo Market



[Sources]
 Arrived goods at Tokyo market: Tokyo Fresh Water Fish Wholesaler's Cooperative Union.
 Wholesale price in Tokyo market: Tokyo Fresh Water Fish Wholesaler's Cooperative Union.
 Retail price of "Kabayaki": "Annual Report of Statistical Survey on Retail Price, Prime Minister's Office".

Fig. 4 Supply of Eel



"Kabayaki" is a food depending on people's preference, there is a high price flexibility. It could be a very suitable strategic sales product. Recently, taking advantage of the difference in production cost, the import from a certain country has been promoted with the slogan, "A Price for the Masses, and Mass Sales." In order to increase the volume of sales in the future, the maintenance of a stable supply will become the biggest task.

Fig. 5 Distribution of Live Eels

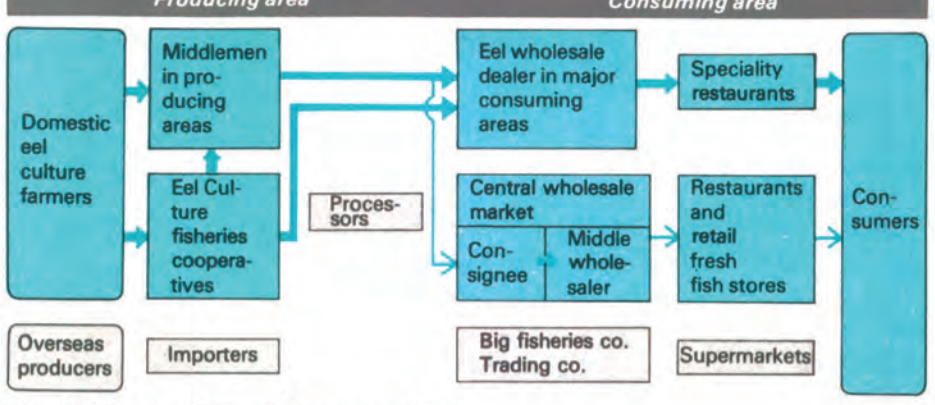


Fig. 6 Distribution of Processed Eels

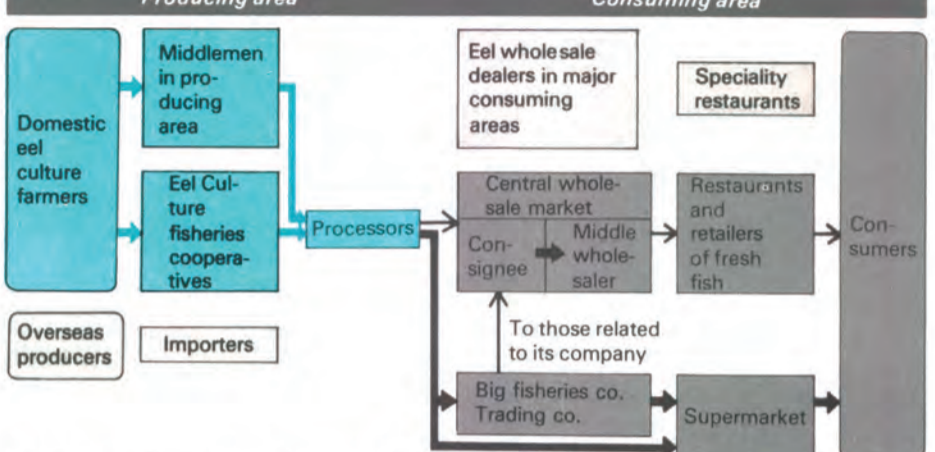
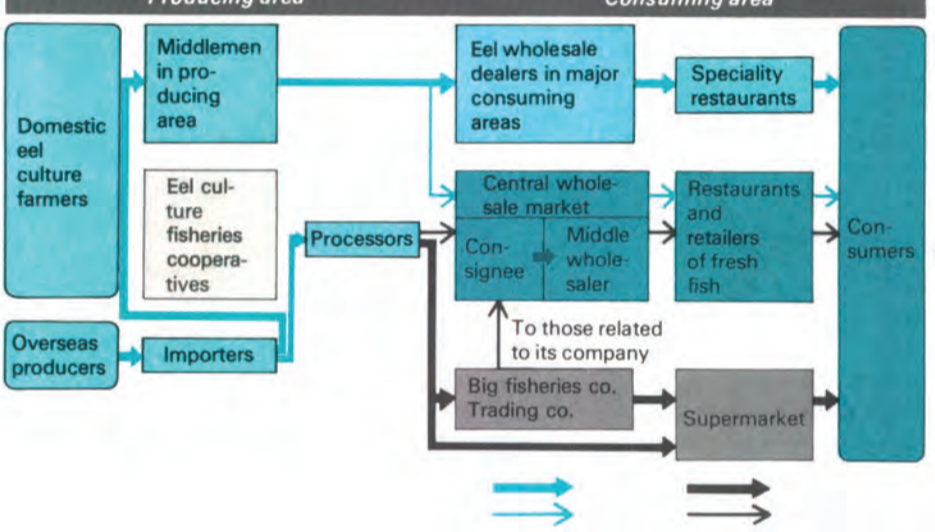


Fig. 7 Distribution of Import Eels



El mercado de anguila parece complicado en el Japón, y es de dos métodos: el tradicional y el moderno, que se disputan la mejor dirección hacia el desarrollo.

La comercialisation des anguilles au Japon semble être compliquée. Cependant, il existe deux méthodes fondamentales, à savoir la méthode traditionnelle et la méthode moderne. Ces méthodes ayant leur propres avantages, ne sont pas toujours compatibles; mais l'avenir nous dira quelle est celle qui prévaudra.

What can Japanese fisheries do to help the fisheries development of your country? And what can you gain?

YAMAHA has been participating in international fisheries training

Japan International Cooperation Agency (or JICA) is a Japanese Government organization which offers international cooperation towards the developing nations of the world.

Its main activities are: 1. Technical cooperation with developing nations, 2. Grant-in aid cooperation, 3. Services of Japan Overseas Cooperation Volunteers, 4. Investments and Loans extended for the cooperation in social development, agricultural, forestry and fisheries development and mining and manufacturing industry development, 5. Emigration services for the Japanese people, and 6. Training and recruiting of qualified personnel for technical cooperation.

As a part of the technical cooperation program, the Kanagawa International Training Centre was set up in Kanagawa Prefecture, and participants dispatched from various countries are received here where long-term practical fisheries training programs (5-6 months) are held.

There are two courses, one of which is a training course in Coastal Fisheries Expansion and the other a course on the Fisheries Cooperative Union; both courses operate on

a group training system. The course participants will have the opportunity to study the coastal fisheries of various parts of Japan and will work hard in practical areas besides receiving training in the centre.

The picture shows a practical training session in purse seine fishing at Enshunada in Shizuoka Prefecture in October, 1980. Local Hamana Fisheries Cooperative Union and YAMAHA Motor Co. (Ltd.) cooperated in this training. YAMAHA, comprehensively supplying fishing boats, outboard engines, diesel engines, and other machinery related to fishing operations, recognizes the great importance of participating in these programs.

The Japanese coastal fisheries have some of the highest technological standards in the world. At present, with the rise of fuel costs and personnel expenses, mechanization for the purpose of labour-saving and rationalization is being actively pursued.

However, the target every country aims at for her own fisheries will depend upon each country's situation. In order to make best use of the fisheries training program in Japan for the fisheries development of their respec-

tive countries, it is important for the participants to realise what can actually work in their country by comparing the present state of fisheries in both countries.

In this sense, the observation visits to fishing villages and fisheries-related plants in various parts of Japan are very significant. YAMAHA, is doing its best in cooperating with these observation visits and is also supplying training materials.



Las pescas costaneras del Japón disponen de las mejores normas tecnológicas del mundo. De presente se busca activamente la mecanización con el fin de racionalizar y ahorrar mano de obra, debido al alza de los costos de combustible y de los gastos de personal.

Sin embargo, el objetivo de todo país en su pro-

pia industria pesquera varía de acuerdo con las circunstancias del mismo. A fin de hacer el mejor uso del programa de adiestramiento de pesca para el desarrollo de la misma en cada país, es importante que los participantes se den cuenta de lo que conviene en la respectiva nación comparando con el estado de la pesca en el Japón.

En este sentido, son muy importantes las visitas de observación a las aldeas pesqueras y a las plantas relacionadas con la pesca de diversas partes del Japón. Haciendo uso del mayor número posible de recursos, YAMAHA está haciendo lo mejor que puede por cooperar con estas visitas de observación, y suministra también materiales de adiestramiento.

Les pêcheries côtières du Japon bénéficient des perfectionnements techniques des plus notables dans le monde. A présent, malgré l'élévation des coûts en carburant et en personnel, la mécanisation se développe rapidement pour économiser la main d'œuvre et rationaliser activement les opérations.

Néanmoins, chaque pays ayant des objectifs précis pour le développement des pêches dans le cadre de ses plans économiques, est à la merci des conditions respectives. Et en vue de mettre le mieux à profit le programme de formation dans le domaine des pêches au Japon, dans le but de développer sa propre industrie de pêche, il importe que les participants de chaque pays réalisent ce qui convient adéquatement à leur pays en comparant les conditions présentes des industries de pêche dans les deux pays. Dans ce sens, les visites d'étude dans les villages de pêcheurs et les usines en rapport avec la pêche dans diverses régions du Japon s'avèreront très utiles. YAMAHA, utilisant autant qu'il se peut les moyens à sa disposition, entend faire de son mieux pour favoriser l'esprit coopératif en fournissant des instruments d'instruction requis et en rendant ces visites d'étude les plus fructueuses possibles.

Pursuit of Deliciousness and Supply of Stamina

This is how "Kabayaki" is prepared. After filleting, the eel is skewered and broiled plain over a medium charcoal fire. Then the eel plain broiled is dipped into "tare", a sauce made of soy sauce and sweet sake, and it is broiled again over the fire. The Japanese consider that the blend of flesh, skin and "tare" produces a certain delicate fragrance and taste, and love this cuisine. It is believed that the texture of the skin (called "nuta") contributes to this special flavor.

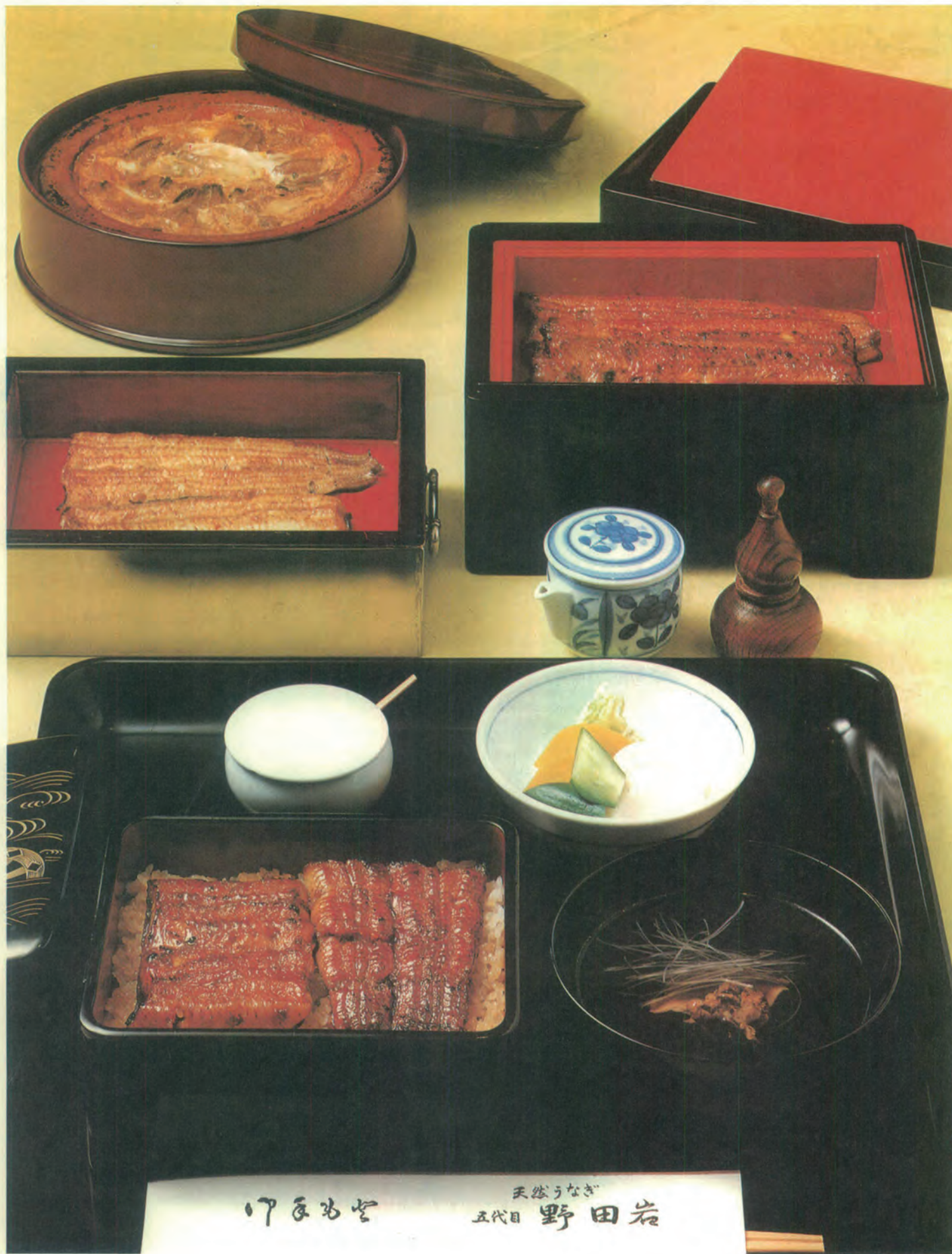
For a long time, eels have been considered as a highly nutritious food providing energy and preventing weight loss in summer. There is a dietary custom of eating eel on a certain day in July, the hottest season in Japan.

This custom is significant from the point of nutrition as well.

The eel belongs to the category of fish which has a very high energy value, and with plenty of oil it has a high vitamin content. The vitamin A contained in one eel is well in excess of the figure for daily adult consumption. (2,000 ~ 6,000 IU). Eels, then, are an extremely effective supply source of nutrition during summer, with its high temperatures and humidity.

Así se prepara "Kabayaki". Cortada en filetes, la anguila es traspasada con agujas y asada a fuego lento sobre brasas. Luego se la empapa en "tare", que es una salsa de soya y sake (licor japonés) dulce, para ser nuevamente colocada sobre el fuego. Los japoneses gustan de este plato, en el cual encuentran cierto sabor y fragancia delicados, procedentes de la mezcla de carne, piel y "tare". Se cree que contribuye a este sabor especial la textura de la piel (llamada "nuta").

Voici comment est préparé le "Kabayaki". Après en avoir retiré les filets, l'anguille est coupée en biseau puis grillée telle quelle sur un feu moyen au charbon de bois. Ensuite, on la plonge dans le "tare" qui est une sorte de sauce faite à base de soja et de saké doux (vin de riz), puis on la grille à nouveau sur le feu de bois. Pour les japonais, cette chair et cette peau de poisson grillées et mélangées au "taré" leur apportent une saveur délicate très appréciée dans la cuisine du pays. On croit que c'est la texture de la peau d'anguille (appelée "nuta") qui contribue à cette saveur spéciale.



How to prepare "Kabayaki" at a producing area



Before preparation, eels are put into baskets, water is showered on them and the baskets are stacked for 30 to 4 days.



Preparation



Plain broiling



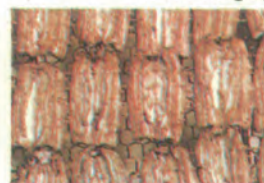
Skewering by hand



Skewering of livers



Skewering by machine



Cooling of plain broiled eels (before shipment)



An eel processing plant