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**All Japan Association for Sustainable Eel Aquaculture**  
B1, Sankaido Building, 1-9-13 Akasaka, Minato-ku, Tokyo, Japan  
TEL : +81-3-5797-7690

Supported by

**The National Federation of Grilled Eel Sellers' Unions**  
**Unagi Hyakusen (Top Hundred Eel)**

# Sustainable Resource Management

for Conservation of  
Japanese Eels







Our mission is to protect  
and conserve Japanese eels  
 (“unagi” in Japanese)  
for the next generation.

Japanese eels once used to be seen in beautiful rivers running from green mountains all over the country, but now they are endangered. They are migrating back and forth between rivers and the sea around Japan, South Korea, China, Taiwan and other East Asian countries. However, their ecology has not been well understood. As a result it has not been determined why their numbers are dropping, but changes in marine environments, habitat deterioration, and overfishing are considered to be the main causes.

Japan is a major consumer of the species, so we should take global leadership in dealing with this problem. We have already initiated every effort in our power, including limitations on fishing of glass eels, improvement of their habitat, and studies for the entire farming process from artificial incubation to breeding.

Japanese eels are called an “indicator species” that can live only in healthy ecosystems. Conservation of this species for the future also helps find the best way to live in good harmony with nature.

Thank you for your understanding and support for our activities.

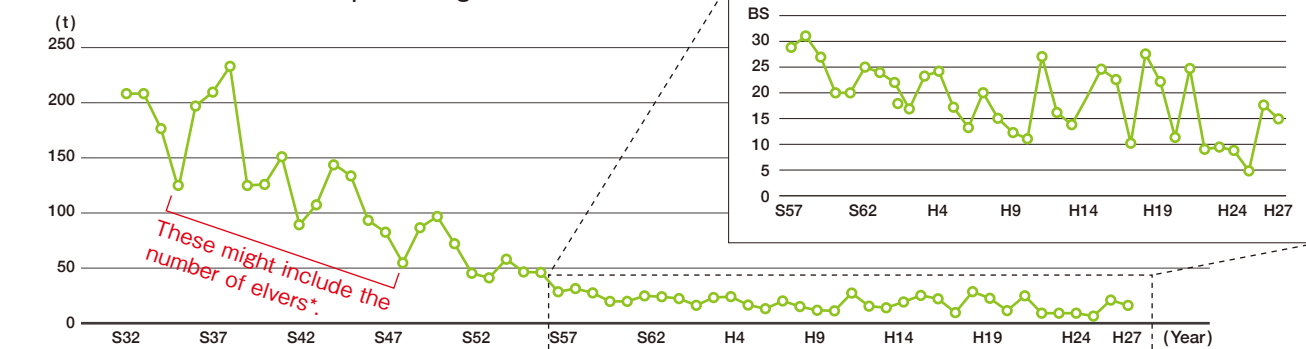


# Japanese eels on the endangered list

Eel consumption increased in the period of rapid economic growth after World War II. Enhanced purchasing power of consumers, easy-to-use fillets in plastic packages, as well as price wars triggered by an increase in the volume of imports led to its high demand. However, despite the growing popularity

of “unagi” here and abroad, catches of Japanese glass eels have been steadily declining in recent years. In June 2014, the International Union for Conservation of Nature (IUCN) added the eel to its Red List of EN (Endangered species).

■ Domestic catches of Japanese glass eels

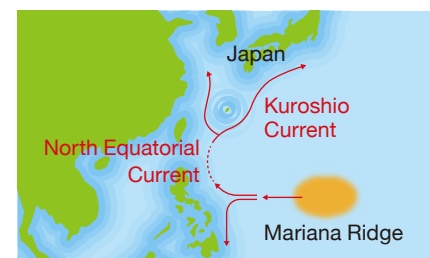


Source: “Statistics Report on Production of Fisheries and Aquaculture” (1957- 2002, Ministry of Agriculture, Forestry, and Fisheries of Japan), and data from the Fisheries Agency (2003- )  
 \*Elvers refer to grown glass eels with pigmented body.

## Why have numbers of Japanese glass eels decreased?

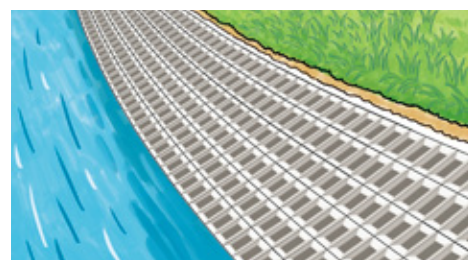
### ● Changes in marine environment

Changes in the currents that bring glass eels to the coasts of East Asian countries and in the frequency of whirling tides on the way, as well as numerous powerful typhoons caused by global warming may have led to the decrease in numbers of glass eels.



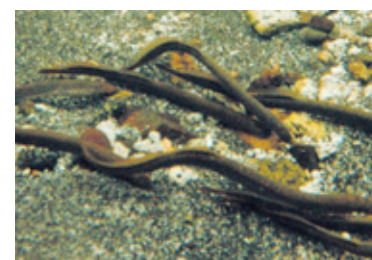
### ● Habitat deterioration

Construction of concrete embankments may have caused the deterioration of shelters for eels and living environments for their food sources, which include shrimps, crabs, and small fish. Polluted rivers and coastal areas as well as changes in ecosystems caused by dam construction may also have affected their habitats.



### ● Overfishing

Detailed information on catches of glass eels and wild adult eels in East Asia is not available. However, based on the fact that glass eels are also required as young fish for aquafarming, this species might have been overfished.



Both improving the habitat for eels and restrictions on fishing are important.

# We have initiated efforts to conserve Japanese eels.

## Effort ①

### Global resource management by cooperation among East Asian countries

We have initiated a resource management effort in alliance with China, South Korea, and Taiwan where Japanese eels are found.

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## Effort ②

### Comprehensive resource management by public and private sectors in Japan

Japanese governments and eel fishermen have introduced permission systems and restrictive policies on glass eel catching, eel farming, and eel fishing in rivers to manage the resources.

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## Effort ③

### Full-cycle farming with world-leading technology

With more than 50 years to develop artificial incubation techniques, we finally succeeded in full-cycle farming of Japanese eels — the whole process of raising adult eels from eggs and having them spawn—in 2010. We have been conducting research toward mass production of glass eels.

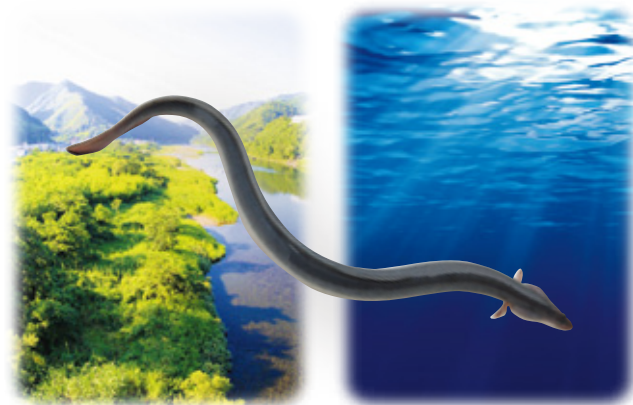
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Raising awareness and continuous studies help protect the species.

# What's eel?

## Eels swimming around the sea in East Asia

There are 19 types of eels found in the world. Among others, Japanese eels (*Anguilla japonica*) are caught and farmed in East Asian countries. Their ecology has not been well understood. However, recent studies showed that they live 5 - 15 years at the mouths of or in rivers and move to the sea, then lay eggs in the waters around the Mariana Islands, far away from Japan.



## Eel resources shared by 4 countries and regions

Glass eels ride the Kuroshio Current to reach East Asian coasts around December to the next April, then they are caught and used for farming in Japan,

China, South Korea, and Taiwan. These countries consume the same species, so they must work together to manage Japanese glass eel resources.

A collaborative partnership between the 4 countries and regions is essential to promote resource management as much as possible.

## A spawning ground of Japanese eels was found for the first time in the world

In 2005, researchers at the Behavioral Ecology Department of Atmosphere and Ocean Research Institute, University of Tokyo found that one of the eels' spawning grounds was on a seamount off the Mariana Islands in the Northwest Pacific Ocean. They first guessed where the spawning ground was by analyzing previous fishing records, current data, as well as bathymetric charts. Subsequently, their research ship conducted field work and succeeded

in catching some 400 baby eels 2 days after their birth (less than 7mm in body length), finally identifying the egg-laying site based on the data. Ongoing research will help commercialize full-cycle eel farming techniques by finding the optimal water temperature, brightness, and feed for eel spawning.

Japanese eels inhabit in East Asia.



# History and the current status of eel farming

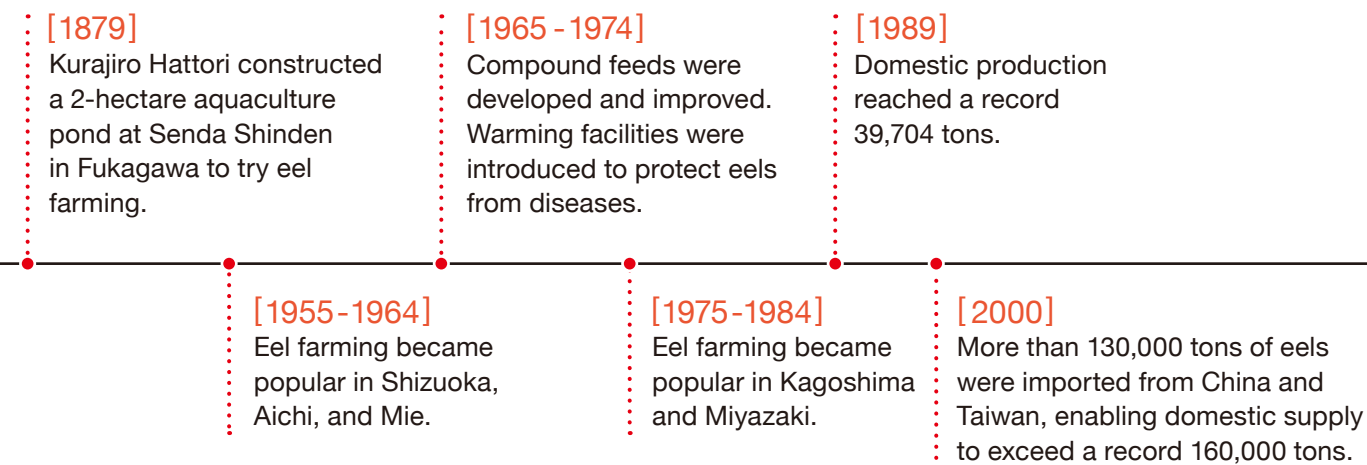
## Eel farming began at Fukagawa in Tokyo

Farmed eels currently account for 99% of the species consumed in Japan. Japanese eel farming was begun in 1879, reportedly by Kurajiro Hattori, who ran a long-established river fish wholesalers based in Fukagawa, Tokyo. Eel farming spread from Lake Hamana in Shizuoka within which he constructed aquaculture ponds, to the Tokai district, and then throughout the nation. Its

popularity grew in Shikoku and Kyushu between 1965 and 1974, then showed rapid growth in southern Kyushu around 1998 to 2007. Now Kagoshima produces the largest number of eels in Japan.

Advanced aquafarming technology has enabled a stable supply of farmed eels, which dominate the Japanese market.

## History of eel farming



## Resource management required for Japan, a major consumer of eels

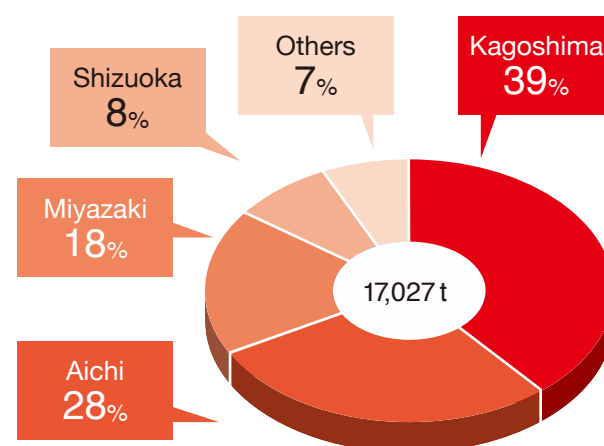
Domestic eel supply increased since 1985 with growth in imports, peaked at approximately 160,000 tons in 2000, and then started decreasing. Now it is some 40,000 tons, the same as that in 1970 (see the chart on the right).

This drastic decline resulted from a decrease in European eel imports. Since 1985, China saw rapid growth in European eel farming for export to Japan, but the export volume plummeted because the species was endangered.

Since European eels were listed by CITES under Appendix II in 2007, its trade has been restricted since 2009.

Japan, a major consumer of eels, should take leadership in management of the species for a sustainable supply.

## Eel farming production in 2014



Source: "Statistics Report on Production of Fisheries and Aquaculture" (Ministry of Agriculture, Forestry, and Fisheries of Japan)

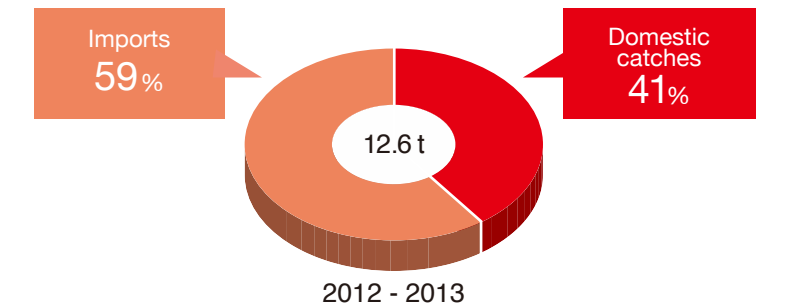
## Domestic supply heavily dependent on imports

Japanese eel supply for the Japanese market currently relies on domestic production and imports from China and Taiwan.

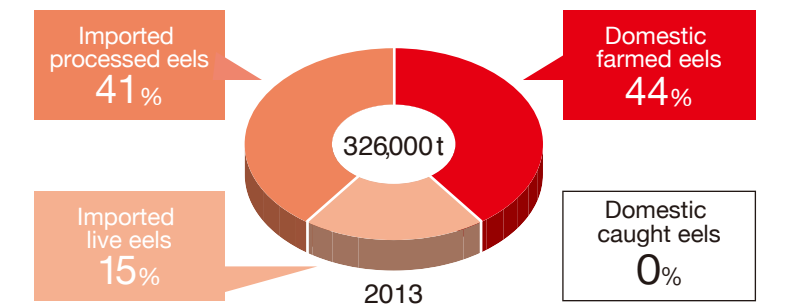
Imports often cover the shortfall of glass eels caught domestically for farming, accounting for half of total supply at the maximum. We also import large numbers of prepared eels (such as grilled ones) from China. The imports account for approximately 56% of eel products in the Japanese market.

We no longer need mass imports of European eels, but we still rely on imports of Japanese eels.

## The number of glass eels put into aquaculture ponds

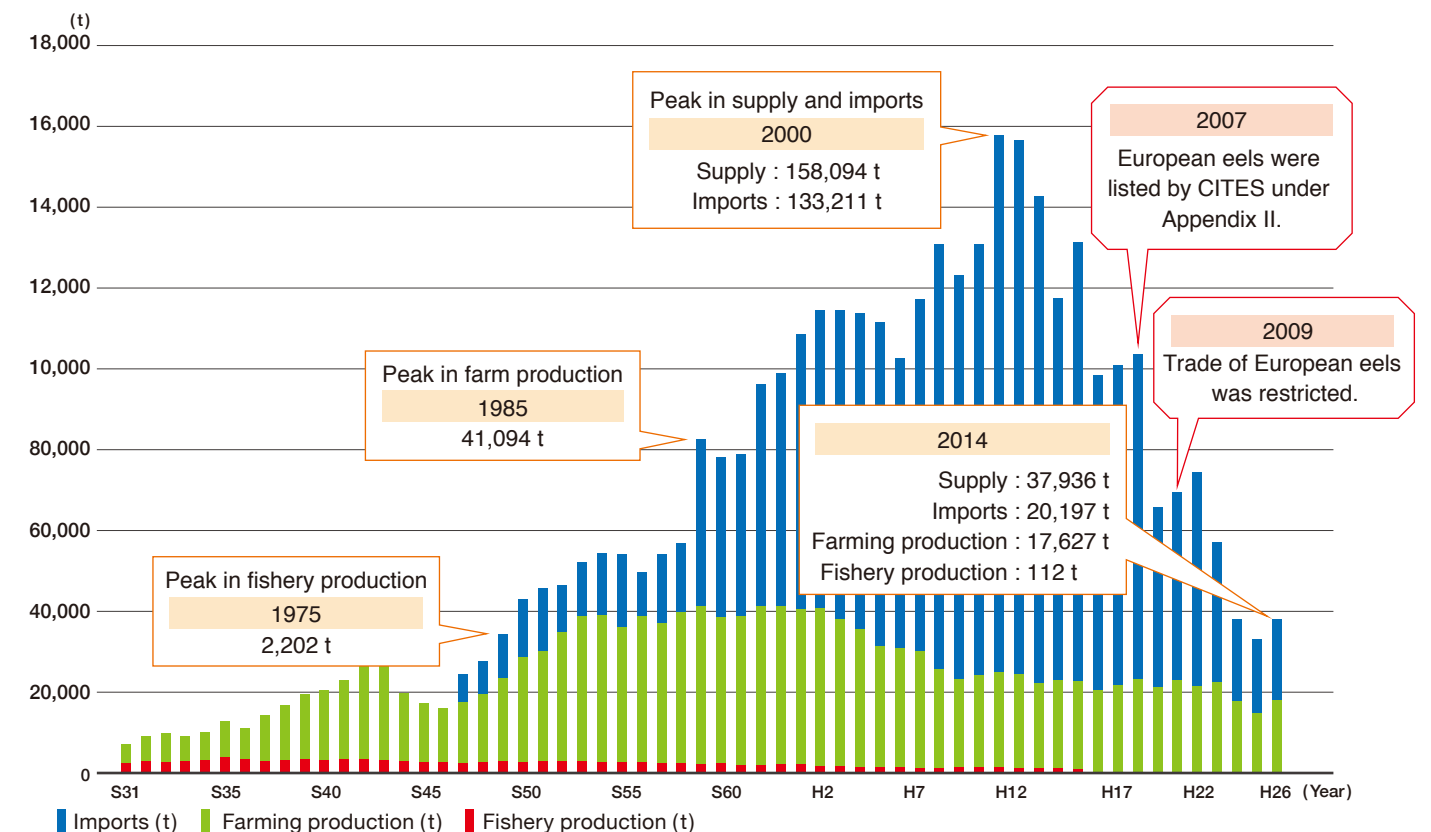


## Eel products on the Japanese market



Source: "Statistics Report on Production of Fisheries and Aquaculture" (Ministry of Agriculture, Forestry, and Fisheries of Japan), "Trade Statistics" (Finance Ministry)

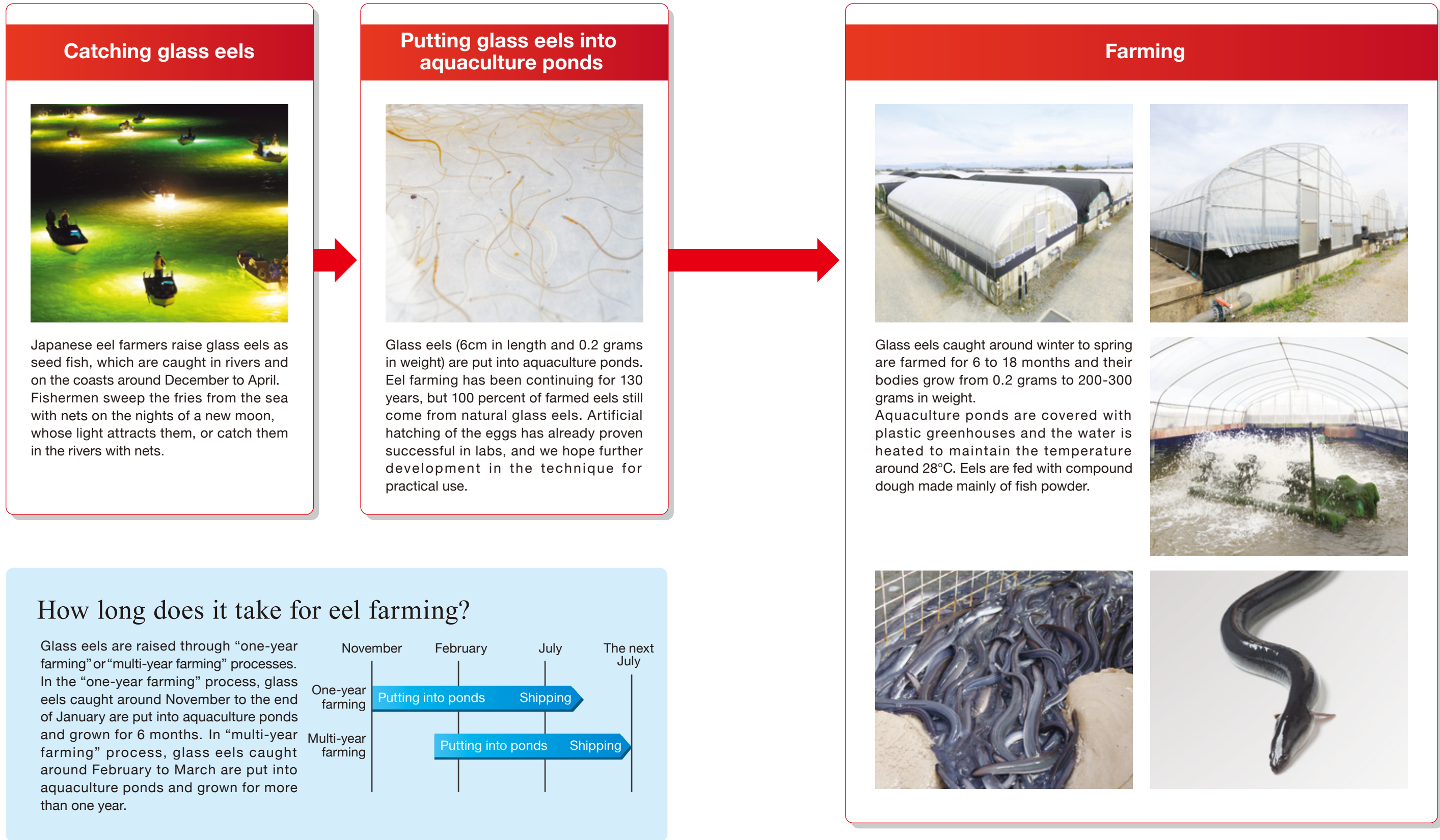
## Eel supply in Japan



Source: "Statistics Report on Production of Fisheries and Aquaculture" (Ministry of Agriculture, Forestry, and Fisheries of Japan), "Trade Statistics" (Finance Ministry)



# Farming process for making the best use of eel resources



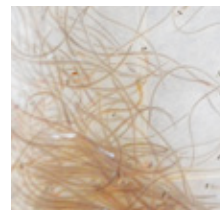


# International resource management in alliance with East Asian countries

## Resource management by 4 countries and regions.

Glass eels (young Japanese eels) ride the Kuroshio Current to reach China, Japan, South Korea, and Taiwan and are caught as seed fish for aquafarming. Therefore, these 4 countries and regions should work together to manage the resources for a sustainable supply.

Japan has been taking leadership in dealing with the problem, encouraging these countries and regions to promote discussions on cooperative efforts.



## Restriction on the number of glass eels put into aquaculture ponds

In September 2012, Japan, China, South Korea, and Taiwan launched talks on eel resources protection and released a joint statement including the following three commitments later in the year:

1. Reduce the number of young Japanese eels put into aquaculture ponds in the period from November 2014 to October 2015 by 20 percent from that in the same period the previous year, and also take every possible measure to maintain the consumption of other kinds of young eels – the same as those in the previous three years.
2. Establish a national eel farming management association in every participating country and region to ensure effective protection and conservation of the species. These organizations should work together to launch an international eel farming management association.
3. Consider the establishment of a legally binding restrictive framework.

The restriction on the number of young Japanese eels put into aquaculture ponds in the period from November 2015 to October 2016 is to be equal to that in the same period the previous year.



## Eel seeds put into aquaculture ponds

Country /Region	Species	2004 ~05	2005 ~06	2006 ~07	2007 ~08	2008 ~09	2009 ~10	2010 ~11	2011 ~12	2012 ~13	2013 ~14	80% of 2013~14
Japan	Total	18.8	29.2	25.1	21.7	29.0	19.9	21.8	16.3	13.9	29.6	21.6
	Japanese eels	18.8	29.2	25.1	21.7	28.9	19.9	21.8	15.9	12.6	27.0	
	Other kinds of eels	0.02	0.03	0.0	0.0	0.14	0.03	0.01	0.43	1.3	2.6	
China	Total	94.0	112.5	117.0	83.5	57.8	43.6	41.5	22.5	27.0	70.0	36.0
	Japanese eels	42.0	30.0	75.0	26.0	9.0	26.5	10.5	8.0	7.0	45.0	
	Other kinds of eels	52.0	82.5	42.0	57.5	48.8	17.1	31.0	14.5	20.0	25.0	
Taiwan	Total	22.3	35.1	20.5	14.3	25.0	13.1	3.8	7.7	11.5	14.0	10.0
	Japanese eels	22.3	35.1	20.5	14.3	25.0	13.1	3.8	2.2	1.5	12.5	
	Other kinds of eels	-	-	-	-	-	-	-	5.5	10.0	1.5	
South Korea	Total	7.5	22.1	13.5	11.0	23.5	12.1	11.1	9.5	16.2	16.8	11.1
	Japanese eels	7.5	22.1	13.5	11.0	22.0	10.6	9.5	3.6	3.0	13.9	
	Other kinds of eels	0.0	0.0	0.0	0.0	1.5	1.5	1.6	6.0	13.1	2.9	

\* "20XX – 20XX+1" refers to the period from 1st November 20XX to 31st October 20XX+1.  
 \*\* Figures in the 2013-2014 season are provisional values.

## Establishment of the Alliance for Sustainable Eel Aquaculture (ASEA) for non-governmental resource management

Following the joint statement of the four countries and regions, we launched the All Japan Association for Sustainable Eel Aquaculture in April 2014.

The association, established as an industry organization for all eel farmers in Japan, has been promoting non-governmental eel resource management and use of eels farmed under appropriate management. Then, an international cooperative organization called the Alliance for Sustainable Eel Aquaculture (ASEA) was established in order to encourage non-governmental associations in 4 countries and regions to get together and discuss eel resource management.

In the first meeting of ASEA in 2015, members exchanged information on their efforts for eel resource management and restrictions on the number of glass eels used for farming.

Governments of 4 countries and regions are also considering a legally binding restrictive framework on the amount to help promote management of the resource by public and private sectors.



Eels have been eaten since ancient times in Japan and became popular as a food to prevent exhaustion from summer heat hundreds of years ago. In fact, "unagi" is an important part of traditional Japanese cuisine culture.

However, eel resources are declining. Japan, as a major consumer of the species, should display strong leadership among the East Asian countries to reinforce efforts for resource management in order to preserve our traditional eel cuisine culture.

In order to protect and conserve eel resources and ensure a sustainable supply, we must enhance partnership between the countries and regions under an international framework for resource management, showing our commitment toward the international community.

Eel farming associations in Japan, China, South Korea, and Taiwan worked together to launch a new organization called the Alliance for Sustainable Eel Aquaculture (ASEA) in 2015 for ensuring consistent management from fry to adult eels.

Eel resource management cannot be carried out only by the farmers. All stakeholders should be aware of the importance of eel resource conservation, making efforts to protect the species. We all have to work together in order to pass down the traditional cuisine culture of "unagi" for the next generation.

Torami Murakami  
Chairman of All Japan Association for Sustainable Eel Aquaculture

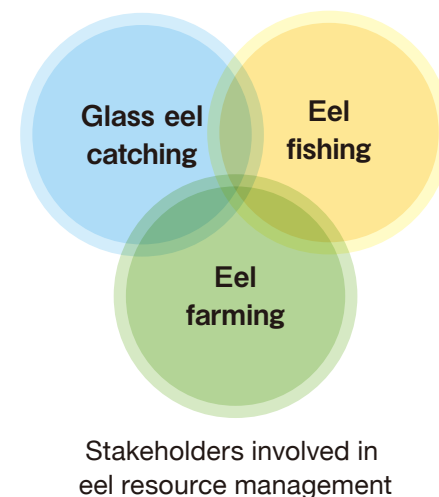


# Comprehensive resource management by public and private sectors in Japan

## Painful approaches promoted by all stakeholders

Some experts have attributed the decline in glass eel catches to changes in marine environment, habitat deterioration, and overfishing. The ecology of the species has not been well understood, so it is not easy to find effective measures to increase the catches of glass eels. However, we should try to do as much as we can to ensure sustainable eel supply.

The eel industry involves many stakeholders, including glass eel fishermen, eel farmers, and adult eel fishermen. In Japan, all of them have been making painful efforts for eel resource conservation by legal and voluntary regulation.



## Efforts by glass eel fishermen

Fishermen may not catch glass eels without special permission from a prefectural governor. And they have strict self-regulations on where, how, when to catch the fries for the resource management.

Recently they have introduced new rules to help increase the number of glass eels in the rivers. For example, they shortened the catching season and will stop catching when the number of glass eels put into aquaculture ponds reach a limit defined in Japan.



## Efforts by eel farmers

At the international meeting in September 2014, they set the upper limit on the number of glass eels and other eel fries put into aquaculture ponds in Japan, China, South Korea, and Taiwan.

In order to comply with the limits, the Act to Promote Fishing in Inland Waters came into effect in June 2015, which requires Japanese eel farmers to obtain permission from the Minister of Agriculture, Forestry, and Fisheries. This act also sets the upper limit of the number of glass eels and other eel fries put into aquaculture ponds per farmer.

Eel farmers without permission are subject to the penalties defined in the Act (a maximum of 3 years imprisonment or a fine of up to 2 million yen).



Source: The Nihon Yoshoku Shinbun

[Number of permitted eel farms] 543 (as of November 1st 2015)

[Quota of eel fries put into aquaculture ponds] Japanese eels : 21.7t Other kind of eels : 3.5t

[Validity period of the permission] November 1st 2015 – October 31st 2016

## Efforts by fishermen to catch wild eels in rivers

Wild Japanese eels grown in Japan move from rivers to the sea around October to December toward their spawning grounds in the Northwest Pacific Ocean. They are called “silver eels” because their bodies look like oxidized silver with black pectoral fins.

Fishermen who catch adult eels have considered controlling of silver eel fishing in order to increase the number of mother eels. As a result, some rules were established to ban or restrict eel farming around October to December.



Source: Noritaka Mochioka, Associate Professor, Kyushu University

## Local municipalities that ban and restrict eel catching

### Aichi

Restricts fishing of silver eels and releases them

### Fukuoka

Restricts fishing of silver eels and releases them

### Kumamoto

Bans eel catching in the inland waters and the sea from October to March by the order of the Freshwater Fisheries Management Commission

### Kagoshima

Bans eel catching in the inland waters and the sea from October to December by the order of the Freshwater Fisheries Management Commission

### Aomori

Bans eel catching in the inland waters from October to May by the order of the Freshwater Fisheries Management Commission

### Tokyo

Releases silver eels

### Shizuoka

Fishermen, eel farmers, eel processors, distributors, and eel restaurant owners contribute funding to buy adult eels and release them into Lake Hamana from October to November.

### Kochi

Bans eel catching in the inland waters from October to March by the order of the Freshwater Fisheries Management Commission

### Miyazaki

Bans eel catching in the inland waters from October to March by the order of the Freshwater Fisheries Management Commission





# Development of artificial seeds for eel farming

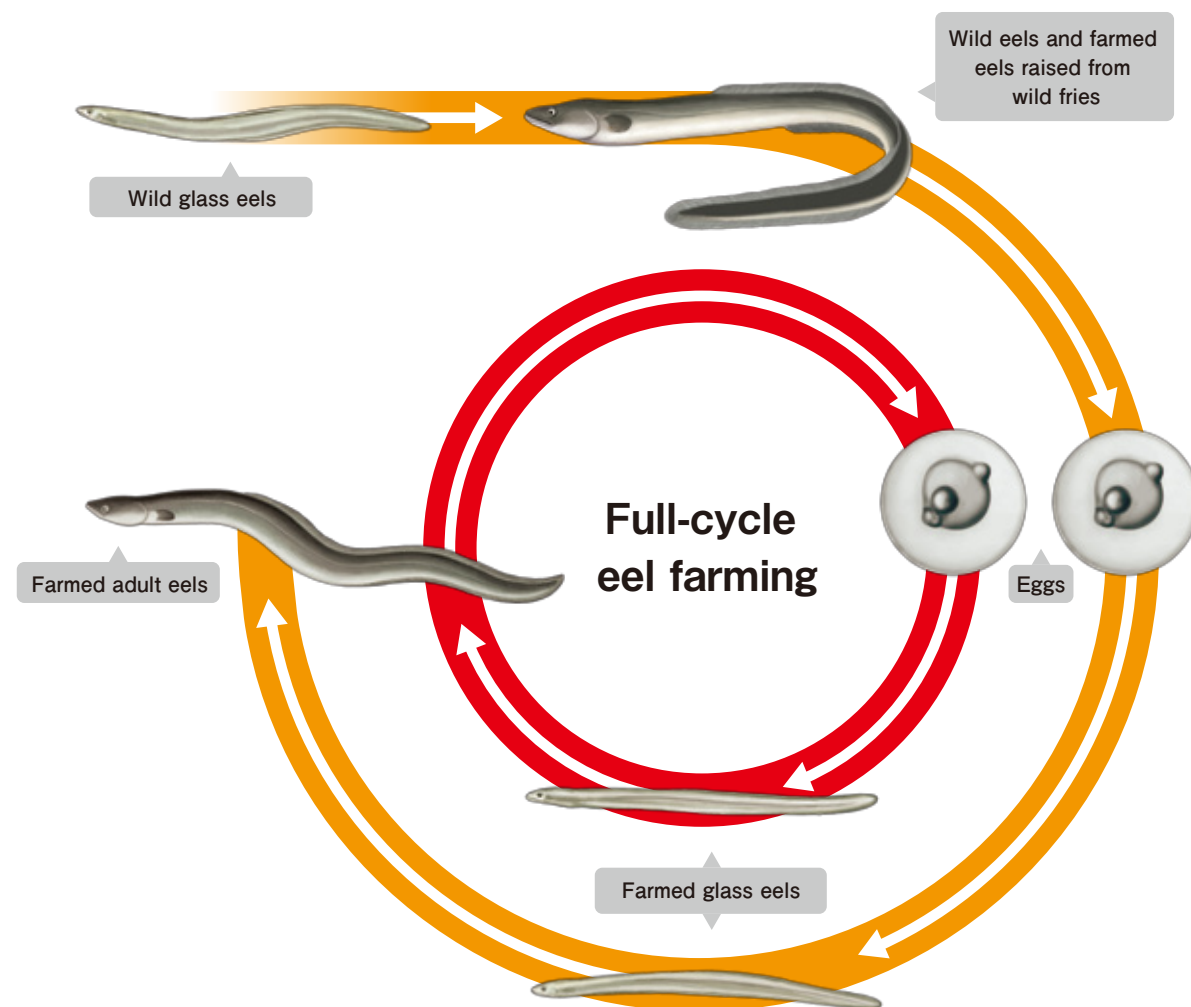
## ■ The world-first full-cycle eel farming

Full-cycle farming of Japanese eels — the whole process of raising adult eels from eggs and having them spawn — is expected to help ensure a stable supply system for the species. It is estimated that Japanese eel farming requires one hundred million glass eels, which still come from 100% natural resources. If we can artificially mass-produce glass eels, it would allow stable aquaculture production in any circumstances surrounding natural resources. Japanese researchers started studies on artificial eel seeding in 1955. They faced many difficulties

because they did not understand how and where eels grow, live, spawn or what fries ate.

However in 2002, after persistent studies, the National Research Institute of Aquaculture succeeded in raising glass eels from eggs collected from artificially matured eels by feeding meal made of shark roe.

In 2010, the Institute also succeeded in raising glass eels to adulthood and having them produce eggs, then raising glass eels from the eggs. Thus, they achieved the world-first full-cycle farming.



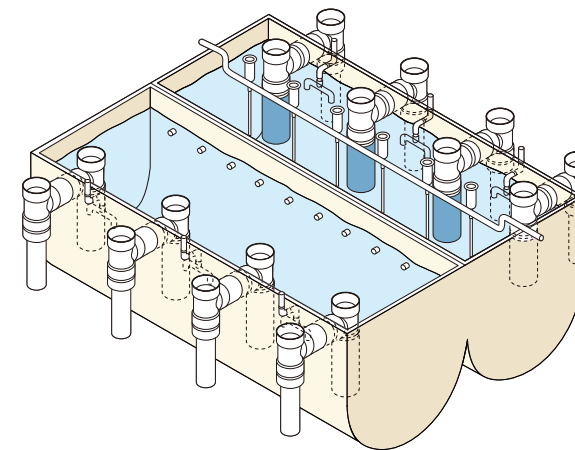
## ■ Promoting mass-production

Although full-cycle eel farming has already proved to be successful in labs, development of new feed and farming facilities is urgently needed to enable mass-production of glass eels in practical use. Now researchers are trying to breed the fries in large ponds for the purpose of mass-production and labor-saving.



glass eels

### ■ Glass eel farming process and facility



### ■ Farming trial in a 1000-liter tank



Source: National Research Institute of Aquaculture

## Progress in eel seeding technology

Because most farmed eels were found to become male and do not mature in aquafarms, researchers started developing technologies to feminize and mature them in order to have them spawn.

From the 1990s, researchers started developing technology to raise glass eels from eggs. In the late 1990s, compound feeds made mainly of shark roe were developed and researchers monitored the growth of hatched eels.

In 2002, the National Research Institute of Aquaculture succeeded in raising glass eels from eggs for the first time in the world.

In 2010, they succeeded in full-cycle farming of eels — the whole process of raising adult eel from eggs and having them spawn.

In 2013, they succeeded in raising glass eels in a 1-ton tank.



# Activities to preserve eel habitats

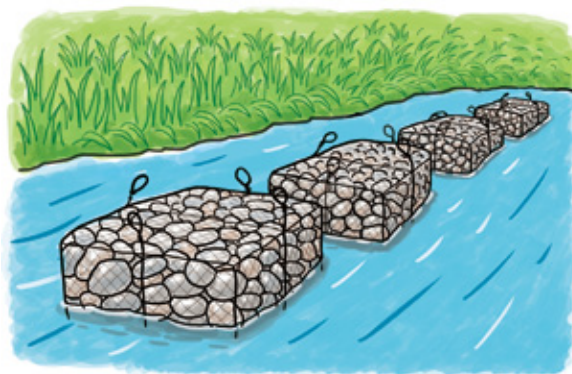
## Activities to improve river environments

We have been preparing fishways so that eels can move freely between rivers and paddies, taking measures to improve water quality and quantity as well as the ecosystem in order to create an ideal habitat.



fishways

## Activities to prepare eel shelters



We have started projects to install stone blocks covered by nets within rivers in order to increase the shelters for eels and animals they feed on (such as shrimps).



## Eel releasing

Fishermen and farmers of adult eels have been releasing eels in order to increase the number of those living in rivers and ponds. They have also been trying farming of female eels for releasing. It is difficult to raise female eels using normal farming methods.



## Summary

### We have initiated efforts to ensure a sustainable supply of eel resources.

Japanese eels are found and caught in Japan, China, South Korea, Taiwan, and other East Asian countries. Japan, a major consumer of the species, should take international leadership in conservation and management of eel resources.

For the purpose, four countries have agreed to limit the number of glass eels put into aquaculture ponds, while the private sectors have been promoting measures to ensure international resource management.

In Japan, eel farmers, glass eel catchers, wild eel fishermen have been working together to ensure sustainable supply.



Appropriate conservation and management of eel resources is critical to sustainable supply of the species.

The purpose of this booklet is to let you know the current status of eel resources and raise public awareness about how we have been working together for protection of the species.