FINAL REPORT (DEVELOPMENT AWARD)

AWARD CODE and TITLE

2012/408 FRDC People Development Program: 2012 International travel bursary

AWARD RECIPIENT: Mehdi Doroudi

ADDRESS: Primary Industries and Regions South Australia, GPO Box 1625, Adelaide 5001

HOST ORGANISATION: None

DATE: 30 October 2012

ACTIVITY UNDERTAKEN

1. Attended the 19th meeting of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) held in Takamatsu City, Japan.
2. Visited Kinki University to further understand Japan's progress in bluefin tuna propagation and the National Fishery Agency and National Research Institute of Aquaculture to improve management and technical skills in the areas of stock enhancement, ranching, nutrition, disease of kingfish and recreational fishing.

OUTCOMES ACHIEVED TO DATE

The visit provided me with the opportunity to establish networks with key Japanese research stations to facilitate the exchange of fishery management tools and aquaculture husbandry techniques. Such techniques will benefit industry in South Australia and the whole of Australia.

My immediate observations were that there are clear areas of research/practices where Australian industries could learn from Japan (e.g. bluefin tuna propagation, kingfish growout and stock enhancement programs) and where Australia can educate Japan (e.g. kingfish propagation).

Acknowledgments

I would like to thank Fisheries Research and Development Corporation and PIRSA for financially supporting this trip. Mr Todaka of the Japanese Consulate in Melbourne was very helpful in assisting me with travel arrangements and organising appointments with key people.

Background

The purpose of the travel was to attend the 19th meeting of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) to be held in Takamatsu City, Japan. I attended as an observer as part of the Australian delegation to take part in international negotiations around the Australian quota allocation for SBT.

I also visited a number of research facilities (Kinki University, the National Fishery Agency and National Research Institute of Aquaculture) to further understand Japan's progress in bluefin tuna propagation and fisheries management issues that relate to South Australian fisheries and aquaculture industries (e.g. stock enhancement, regional fisheries management, ranching of other species, recreational fishing).

Need

Since 2010, the South Australian government has had input into the future decision making processes of CCSBT through a close liaison with the Department of Agriculture, Fisheries and Forestry (DAFF). Such input has helped PIRSA to maintain and advance SA's input into the future success and sustainability of this important fishery and its ranching activity.

Kinki University has developed a successful program to close the life cycle of Northern Bluefin Tuna. Clean Seas Tuna Pty Ltd has had limited success with the closing the life cycle of the Southern Bluefin Tuna (SBT). Discussions with researchers from Kinki University may lead to improvements in South Australian techniques and opportunities to increase production.

Discussions with Fisheries Managers and researchers from the National Fishery Agency and National Research Institute of Aquaculture will inform PIRSA in relation to decision making processes around the management and development of fishing and aquaculture in South Australia. Specific management issues to be addressed are bluefin tuna propagation, stock enhancement, regional fisheries management, ranching of other species, nutrition, disease management and recreational fishing.

Objectives

1. To participate in the 19th meeting of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT) as part of the Australian deleagtion on behalf on the South Australian government.

Outcome – achieved. A full report from the 19th meeting of the CCSBT is available from the CCSBT website. For further information on the outcomes from this meeting please refer to Jonathon Davey from DAFF.

2. To discuss tuna propagation techniques with key researchers.

Outcome – achieved. See below.

3. To facilitate discussion on issues relating to fisheries management.

Outcome – achieved. See below.

Methods

Commission for the Conservation of Southern Bluefin Tuna (CCSBT) held in Takamatsu City, Japan from 01-04 October 2012. I attended as an observer as part of the Australian delegation.

Fisheries Research Agency, Minami-ise, Japan – met with Dr Koichi Okuzawa and discussed the stock enhancement programs in Japan.

National Research Institute of Aquaculture, Minami-ise, Japan – met with the Director General Dr Takaji Iida and discussions included broad aquaculture issues in Japan and their research programs to resolve the relevant issues. We also discussed the impact of the anthelmintic treatment Praziquantel on kingfish flesh as a treatment for fluke infestations.

I also met with Dr Hirofumi Furuita and Dr Hiroyuki Matunari and discussed the kingfish industry in Japan, its current issues including nutritional requirement and fish husbandry.

Kinki University, Shirahama, Japan - I met with the following:

Dr Osamu Murata, Professor at the Fisheries Laboratory,

Dr Biswas Amal, Assistant Professor at the Fisheries Laboratory,

Dr Keitaro Kato, Associate Professor, Deputy Head at Shirahama Station, and

Dr Kenji Takii, Director Uragami Experiment Station, Fisheries Laboratories.

The main purpose of my visit was to become familiar with the NBT propagation program undertaken at the facility in order to understand areas of improvement in the propagation of SBT in South Australia.

Results/Discussion

The Fisheries Research Agency conducts a wide range of research and development activities from basic and applied science to practical technologies concerning fisheries to secure a stable supply of fishery products and for the sound development of the fishing industry. Its main areas of focus are:

- Developing conservation technologies for the sustainable use of fishery resources both domestically around Japan and internationally
- Developing stock enhancement, and rational use of fishery resources, and environment conservation technologies for the promotion of coastal fisheries
- Establishment of productivity improvement and environmental friendly technologies for sustainable development of aquaculture
- Research and development for the development of fishery industry, safety of fishery products and to maintain consumer confidence
- Monitoring and basic and pioneering research

The main areas of research at the National Research Institute of Aquaculture Institute are:

- Stable seed production and breeding of commercially important species such as eel, yellow-tail and amberjack, and groupers
- Development of economical and functional feeds for aquaculture
- Improvement of aquaculture environment and sustainable production systems
- Prevention of aquatic diseases, accurate diagnosis, and dissemination of new diagnostic technologies
- Shallow water ecosystems, stock enhancement and resource management in Kuroshio current coastal zone
- Maintenance and enhancement of inland water ecosystems and resources, and physiological traits of freshwater fishes

The Fisheries Laboratory of Kinki University has developed hatchery and aquaculture techniques for a number of marine and freshwater species, helping to increase production and maintain sustainable development for aquaculture and fisheries in Japan.

A number of experiment stations are located throughout Japan and provide the framework for the research capacity of the Fisheries Laboratory of Kinki University. The stations focus their research programs in the areas of fish rearing, nutrition, selective breeding, morphology, physiology, biochemistry and fish diseases.

The outcomes of these visits were:

Ranching and stock enhancement programs

The main mechanism for seafood production in Japan is ranching (Attachment 1). The volume of Japan's production from commercial fisheries has declined to less than half that of the peak recorded in 1984. Japan's aquaculture, through the use of stock enhancement programs, provides the platform to create a stable, controlled production of seafood and boost wild stocks.

The Stock Enhancement and Aquaculture Division of the National Research Institute of Aquaculture conducts studies on resource management and stock enhancement of candidate species subject to aquaculture and stock release as well as for the purpose of conserving fishing grounds. A total of 16 national facilities and 57 prefectural facilities provide the platform for stock enhancement research and activity in Japan.

In order to increase fishery resources actively, juveniles of high-valued fishery resources have been released in various locations nationwide in Japan. To date, there are approximately 88 species that have been actively used in stock enhancement programs, including 39 fish, 13 crustacean, 29 mollusc and 7 echinoderm species.

The stock enhancement program in Japan is based on the *Coastal Fishing Ground Improvement and Development Law*, which was enacted in 1974. The object of this law is to systematically develop and improve coastal fishing grounds by construction of artificial reefs and the release of juveniles. Each prefectural government undertaking stock enhancement develops *Basic Plans* in accordance with *Basic Principles* determined by the Minister of Agriculture, Forestry and Fisheries.

Enhancement facilities and operational programs are funded by the national budget and by the individual prefectural budget. There is a strong association between the Fisheries Research Agency and individual prefectural governments to facilitate the exchange of necessary technology to achieve specific enhancement programs.

The candidate species are bred on land-based facilities and reared to juvenile stage before being released into the wild, either in sea-cages (e.g. tuna) or directly onto the sea-bed or open sea. A number of factors are used to determine the best time to release stock, based on size, location, season and methodology of release, such that the survival of released juveniles is maximised.

Prior to being released, juveniles are tagged or marked to distinguish them from the wild populations. This is particularly important to determine the survival rate and subsequent movement, behavior and growth of juveniles as well as being a tool to measure the success of the program through market landings.

In 2004, approximately 80 million juvenile fish (comprising 22 species) were released into the wild. In the same year, over 3000 million shellfish juveniles (comprising 6 species) were released. Some specific examples of successful enhancement programs are the Japanese flounder and Yezo abalone. The Japanese flounder fishery has been enhanced through stock enhancement programs since 1985. Tag return data suggests that the release has been successful with approximately 12% of tagged fish recorded at the market place. The profit rate for this species was 1.44:1 in relation to production value: cost of enhancement. Similarly, the Yezo abalone fishery has been the subject of enhancement since 1981, with an economic return ratio of 1.83:1.

South Australia is currently developing policies relating to stock enhancement and discussions at the National Research Institute of Aquaculture were important as stock enhancement is a widely used fishery management tool utilized in Japanese fisheries and aquaculture industries.

Attachment 2 is a copy of the presentation on the Japanese stock enhancement program provided by Dr Okuzawa.

Kingfish propagation and grow-out

In South Australia, Clean Seas Tuna Pty Ltd propagate and grow yellowtail kingfish (*Seriola lalandi*). For marketing purposes, this species is also called Hiramasa kingfish to distinguish it from the wild catch. In 2010/11, production was 3,620 tonnes, valued at AUS$ 27.9 million.

In Japan, three species of kingfish are commercial produced, Hiramasa (yellowtail kingfish - *Seriola lalandi*), Hamachi (Japanese amberjack - *S. quinqueradiata*) and Kanpachi (Greater amberjack - *S. dumerili*).

In terms of production, Hiramasa kingfish comprise a relatively small component of total production ~4%, mainly due to the lower abundance of this species in Japanese waters compared to the other two commercial species. Japanese amberjack (about 120,000 tonnes/year) and Greater amberjack are the most economically important species in Japan, accounting for 25% of the total production value of all aquaculture species.

In terms of propagation of kingfish, superior hatchery techniques developed in South Australia and Australia provide us with an advantage, in that we are not in a position to be dependent of wild-caught stock to complete the life cycle. In comparison, the majority of fisheries in Japan are supported from on-growing fingerlings produced from wild-caught fish.

While South Australia is ahead in terms of propagation, we have less success with subsequent grow-out technologies. Japan has developed advanced grow-out technology through more efficient husbandry methods. There are a number of factors that contribute to their success:

- Grow-out facilities are family based,
- Many of the operators are fishermen and have access to the wild fishery and hence broodstock,
- The facilities have developed superior nutritional programs using a combination of artificial pellets and raw fish, thus providing all required supplements and nutrients for fish growth. The Japanese grow-out facilities do not experience nutritional deficiencies that South Australian operators currently do.
- The facilities are more efficiently and effectively managing their fluke problem through the use of freshwater baths rather than using hydrogen peroxide or praziquantel, the methodology currently used in South Australia.

Disease and nutrition

At the National Research Institute of Aquaculture, we also discussed alternative methods used by Japan for the treatment of diseases affecting kingfish, and this knowledge can be shared with the South Australian and Australian industries. I also had particular discussions around the efficiency of processes and nutritional programs, specifically the addition of the amino acid taurine in feed. The addition of taurine in the diet improves spawning success of broodstock and growth and feed performance of juvenile fish, although there is still more research to be done to examine the optimal

doses and understand the physiological responses. Japan has worked on this issue for many years and the information they have accumulated is invaluable to the South Australian finfish industry, including Clean Seas Tuna.

Kinki University

On my visit to Kinki University facilities, I visited the Shirahama Experiment Station, the headquarters of the Fisheries Laboratory. Shirahama Experiment Station focuses its research on developing fish farming technologies that close the life cycle of commercially important finfish, including the Northern Bluefin Tuna (NBT).

Kinki University's NBT hatchery technology program commenced in 1970 and resulted in the spawning of NBT under natural ocean conditions in net cages off Wakayama in 1979 and the first successful completion of the tuna lifecycle in 2002. In September 2008, Clean Seas Tuna Limited and Kinki University signed a collaboration agreement which will allow the two aquaculture pioneers to exchange successful tuna propagation and husbandry technologies.

Through my discussions with Japanese researchers and personal observations, I can identify a number of areas where there are environmental and technological differences between Japan and South Australia which may give rise to the differences in success between the two regions. Specifically these are:

- History of research - the Fisheries Laboratory in Japan has a long history of research, spanning over 40 years. This has provided the opportunity to develop appropriate husbandry techniques including nutrition and genetics. This program has led to the production of 200,000–300,000 fingerlings per year with a commercial harvest of 100–150 tonne of tuna (average size 20 kg).
- Environment (e.g. water temperature and salinity) - these are important environmental factors for the successful breeding, development and growth of tuna. Japanese waters have elevated water temperatures compared to South Australia, with temperatures over 20°C recorded for most of the year.
- Broodstock conditioning - conditioning technologies are more efficient in Japan with broodstock conditioned at sea rather than in land-based facilities as is the case in South Australia.

The visit proved to be both productive and informative. The propagation program is efficient, effective and economically viable. The propagation of aquaculture fish becomes more important as a resource as the Japanese government is considering cutting back on wild-caught juvenile fishing.

There is much value in expanding the relationship with Kinki University, not only with regard to the tuna propagation program, but for a wide range of aquaculture related activities for South Australia and the whole of Australia.

Benefits and Adoption

I believe that there are areas of fisheries and aquaculture management, husbandry and hatchery techniques that can be shared to the benefit of all. South Australia can assist in terms of kingfish propagation methodologies, while we can learn to develop more efficient and effective grow-out techniques, bluefin tuna propagation and programs for stock enhancement from Japan.

Australian SBT industry – Input from Australian delegates provides some security over decisions on the future of this important fishery.

Finfish aquaculture sector – improved ranching technology, nutritional technologies, husbandry practices, disease controls. The establishment of networks amongst industry partners and government/research facilities to improve the exchange of knowledge.

Tuna aquaculture sector – improved propagation technology, improved nutritional technologies, husbandry practices, disease controls. The establishment of networks amongst industry partners and government/research facilities to improve the exchange of knowledge.

Aquaculture industry in general – improved nutritional technologies, husbandry practices, disease controls. The establishment of networks amongst industry partners and government/research facilities to improve the exchange of knowledge.

Wild-catch fisheries - stock enhancement knowledge, regional fisheries management processes.

Further Development

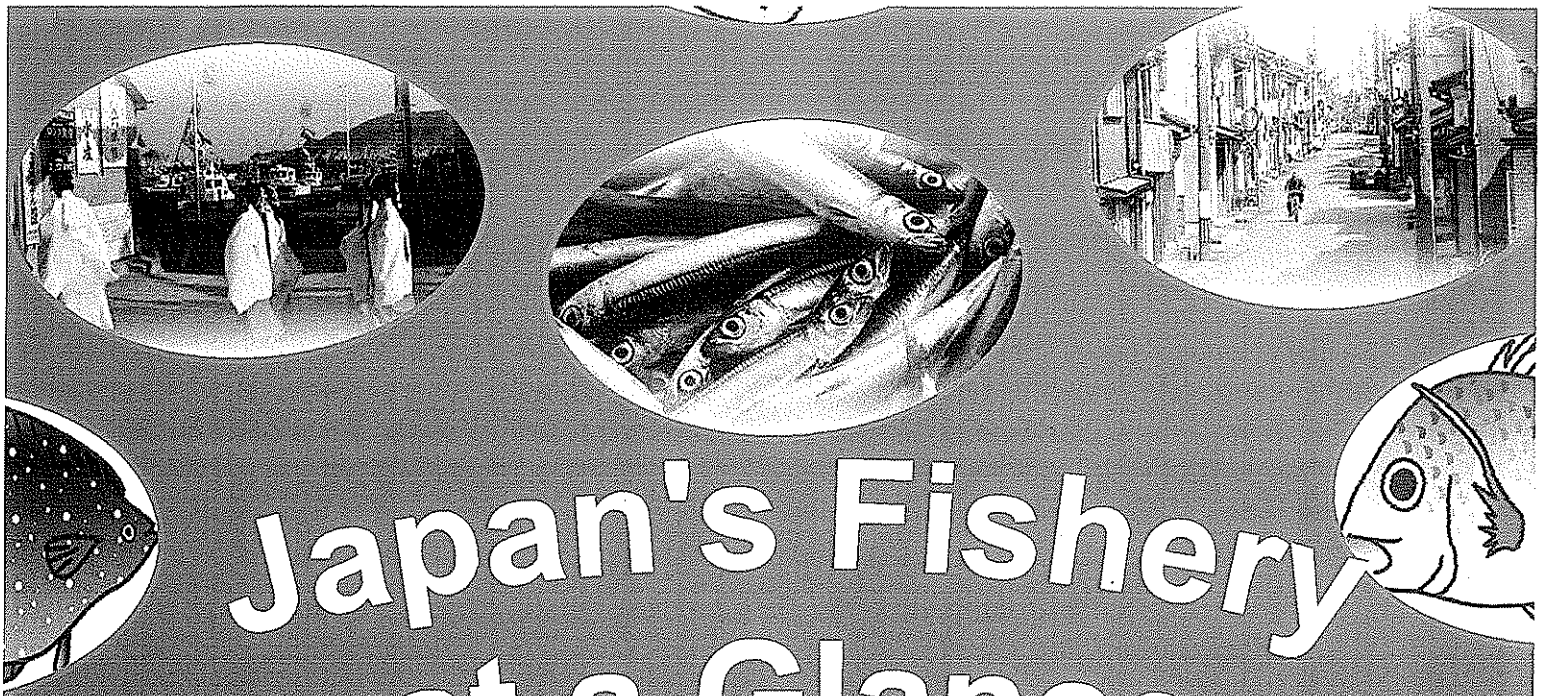
It is important that we establish and foster strong relationships between the Australian/South Australian governments and Japanese Fisheries Research Institutes and Kinki University for any future exchange of information or collaboration.

The development of similar relationships being industry members would also be beneficial. To facilitate this, I have asked the representatives that I met with to identify any interest within their commercial sector that would be willing to work directly with our South Australian industry.

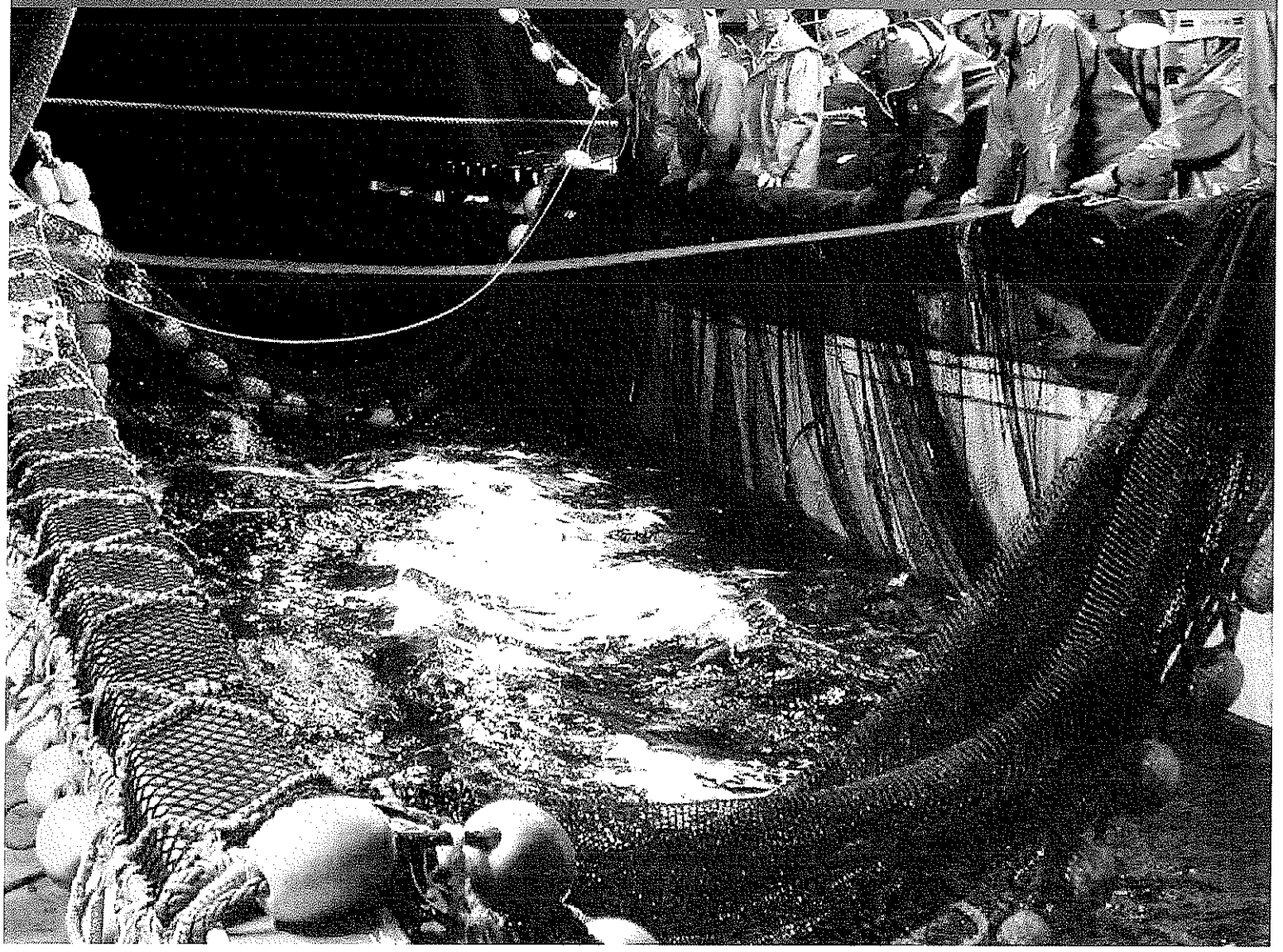
Appendices

Attachment 1 – Japanese Fisheries at a Glance

Attachment 2 – Stock Enhancement presentation



Japan's Fishery at a Glance



Fisheries Agency

March 2012

Contents

1. Great East Japan Earthquake

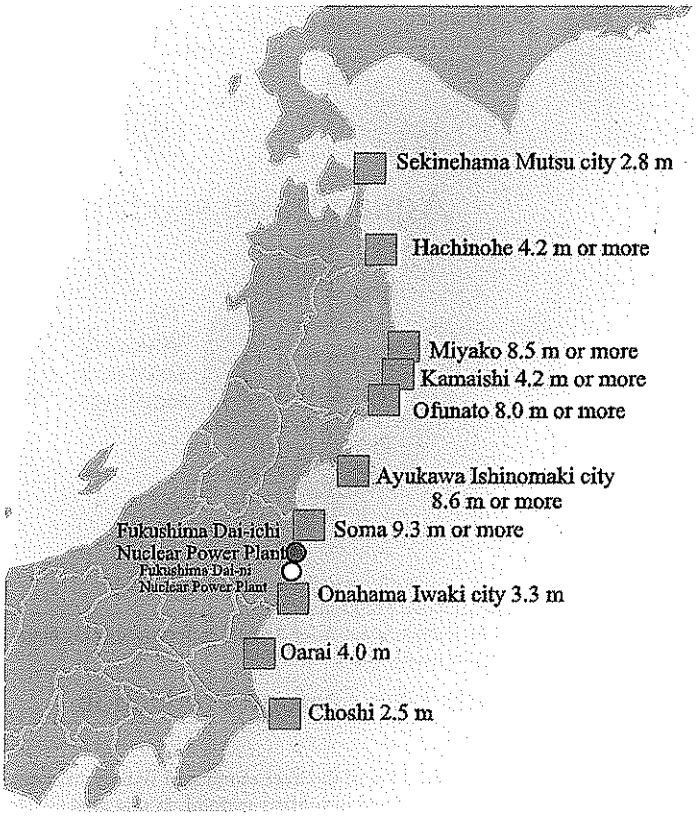
(1) Damage Caused by the Earthquake and Tsunami

The Great East Japan Earthquake, which occurred off the coast of Sanriku at 2:46 p.m., March 11, 2011, recorded the highest magnitude ever observed in Japan, at magnitude 9.0.

The tsunami caused by the earthquake inflicted tremendous damage on fishing communities not only in the Tohoku region, but in a wide area along the Pacific coast. The scale of damage was particularly large in Iwate, Miyagi, and Fukushima prefectures, which were close to the seismic source. Many precious lives were lost, and all kinds of infrastructure of the fishing industry, such as fishing vessels, fishing port facilities, and fish processing facilities, were badly damaged. The tsunami also caused extensive damage to areas outside the Tohoku and Kanto regions, including severe damage to the aquaculture industry in Hokkaido, Mie, and Kochi prefectures.

* A total of 15,824 people were killed and 3,824 people went missing due to this earthquake and the tsunami (as of October 18, 2011).

Observed tsunami heights



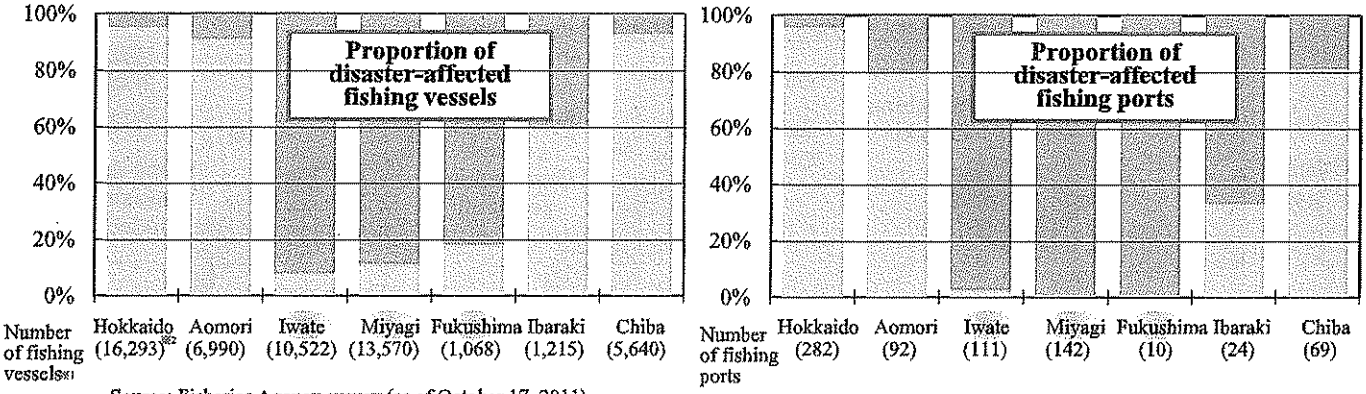
Nationwide damage

Major fishery-related damage	Scale of damage	Amount of damage (100 million yen)
- Fishing vessels	25,014 vessels	1,701
- Fishing port facilities	319 fishing ports	8,230
- Aquaculture facilities*		738
- Cultured organisms*		575
- Facilities for common use*	1,725 facilities	1,249
Total		12,493

Source: Fisheries Agency survey (as of October 17, 2011).
* Aquaculture facilities: rafts, floats, ropes, etc.
Cultured organisms: oysters, silver salmon, red sea bream, yellowtail, etc. that were being cultured
Facilities for common use: facilities owned by fisheries cooperatives, etc. for common use by their members, such as landing area market facilities and fueling facilities

Many fishing communities are scattered and aquaculture business is active along the deeply indented coastline in the Sanriku region, due to the intricate small gulfs and the calm waves. However, the deeply indented gulfs, which were advantageous for fishing business, also brought the risk of enlarging the damage from tsunami.

Proportion of disaster-affected fishing vessels and fishing ports (comparison by prefecture)

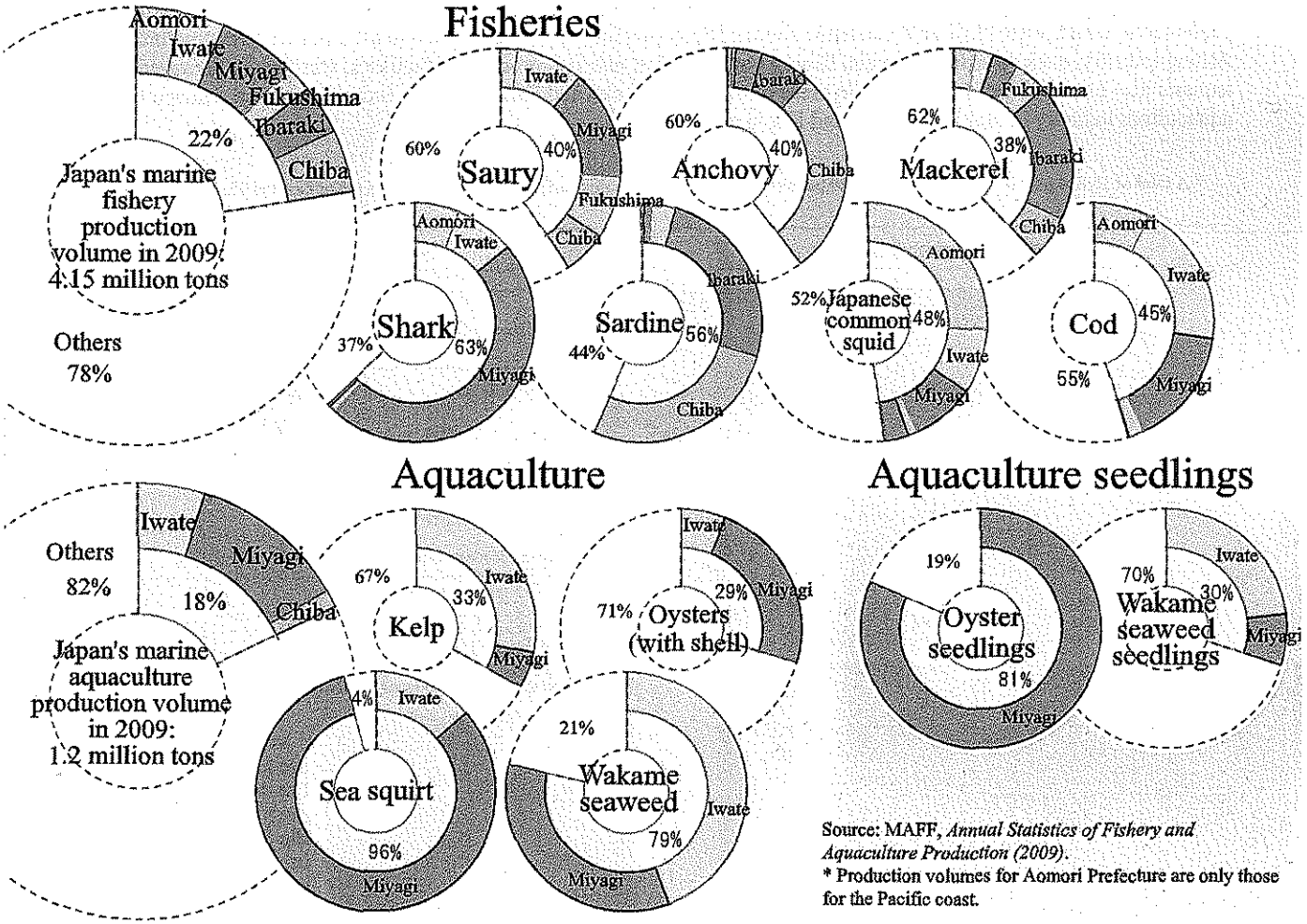


Source: Fisheries Agency survey (as of October 17, 2011).
※1: "Number of fishing vessels" denotes the number of fishing vessels registered with regard to Miyagi prefecture, and the number of fishing vessels covered by fishing vessel insurance with regard to the other prefectures.
※2: The "number of fishing vessels" for Hokkaido includes only those vessels operating on the Pacific side of the prefecture.

(2) Fishing Industry in the Disaster-affected Areas has Supported Our Dietary Lives

The areas that were severely affected by the Great East Japan Earthquake have played a significant role in supplying fish products throughout the nation and have played diverse functions to support the fishing industry in other areas. Marine fishery and aquaculture production volumes by fishers in the region from Aomori (on the Pacific Ocean coast) to Chiba prefectures account for 22% of Japan's total marine fisheries production volume and 18% of Japan's total marine aquaculture production volume. Some products in the area, such as saury, cod, and cultured wakame seaweed, account for a large share of Japan's total production volumes. In addition, the production volumes of oyster seedlings and wakame seaweed seedlings also take up a large share of the total production, and seedlings shipped from the area support the production in aquaculture production areas nationwide.

Shares of fishery and aquaculture production volumes from Aomori (on the Pacific Ocean coast) to Chiba prefectures in Japan's total production volumes

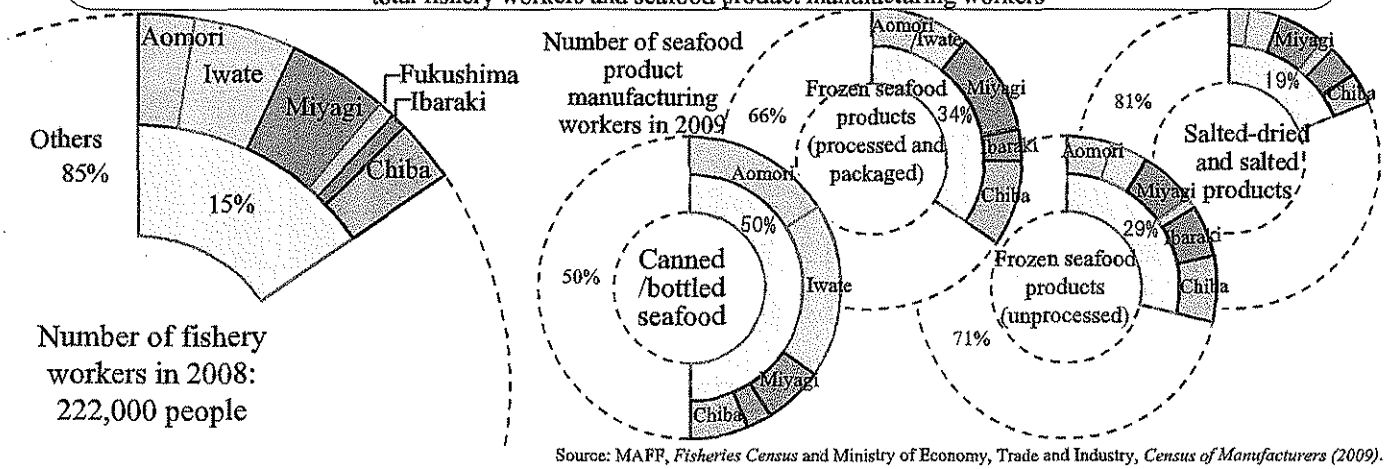


Source: MAFF, *Annual Statistics of Fishery and Aquaculture Production (2009)*.
* Production volumes for Aomori Prefecture are only those for the Pacific coast.

(3) Fishing Industry in the Disaster-affected Areas has Supported the Seafood Production Nationwide

The total number of fishery workers in prefectures from Aomori to Chiba prefectures accounts for 15% of the total number of fishery workers in Japan. Also, the numbers of workers engaged in the manufacture of frozen seafood products and canned or bottled seafood, in this area, account for more than 30% of the total number of such workers in Japan.

Shares of fishery workers and seafood product manufacturing workers from Aomori to Chiba prefectures in Japan's total fishery workers and seafood product manufacturing workers

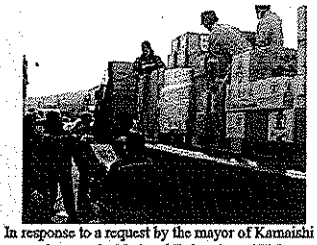


Source: MAFF, *Fisheries Census* and Ministry of Economy, Trade and Industry, *Census of Manufacturers (2009)*.

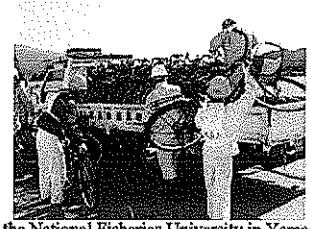
~Various support efforts by people in the fishing industry~

People in the fishing industry nationwide made prompt efforts to support the disaster-affected areas in response to the unprecedented scale of damage that occurred in the Tohoku region.

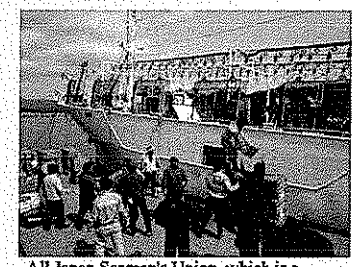
JF group, which is a nationwide group of fisheries cooperatives along Japanese coastal areas, transported emergency relief supplies to affected areas, using emergency trucks named "Todoke! Zenkoku No Ryōshi No Omoi Gō" (Delivering the sympathy of fishers nationwide).



In response to a request by the mayor of Kamaishi City, Iwate prefecture, the National Federation of Fishery Processor's Co-Operative Associations transported processed fish products, such as canned products, products boiled in soy sauce, and boiled and dried products, in cooperation with related bodies.



At the National Fisheries University in Yamaguchi prefecture, a training ship "Kōyōmaru" changed its plan of sail training, and, together with students, delivered relief supplies, such as sneakers and bicycles, and provided baths and meals onboard.

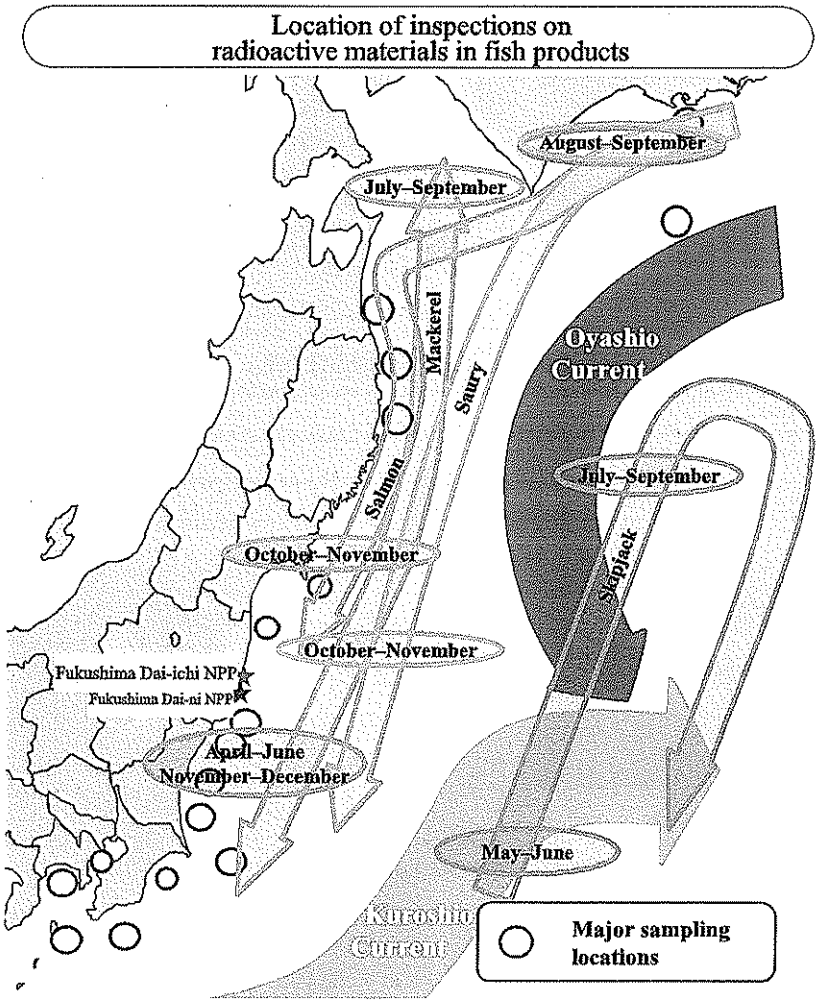


All Japan Seamen's Union, which is a national organization of ship crews, chartered a medium-size squid-jigging vessel, and delivered relief supplies to affected areas.

Cetacean research vessel "Nisshinmaru" (8,000 tons) made use of its large transportation capacity, and carried large amounts of food, daily commodities, fuel oil, and other supplies to affected areas.

The Fisheries Agency's fishery patrol/research vessels engaged in transporting relief supplies to affected areas, both independently and in cooperation with private fishing vessels and the Self-Defense Forces.

(4) Efforts to Supply Safe and Reliable Fish Products



The accident of Tokyo Electric Power Company's (TEPCO's) Fukushima Dai-ichi Nuclear Power Plant (NPP) has provoked concerns about the safety of fish products among consumers.

The Fisheries Agency, in cooperation with the relevant prefectures and organizations, has promoted inspections for radioactive materials contained in fish products, and has taken measures so that fish products with radioactive materials exceeding the provisional regulation level under the Food Sanitation Act are not distributed on the market.

Specifically, the following measures are taken:

(1) According to the Basic Policy for Inspections on Radioactive Materials in Fish Products formulated by the Fisheries Agency, the relevant prefectures and industrial organizations inspect radioactive materials in fish and shellfish sampled at major landing ports once a week, in principle.

(2) If the level of radioactive materials is found to exceed the provisional regulation level as a result of the inspection, the fishers suspend the relevant fishery operations in response to a request by the national or prefectural government.

(Reference) MAFF website

- Basic Policy for Inspections on Radioactive Materials in Fishery Products
http://www.jfa.maff.go.jp/e/inspection/pdf/110530_housin_en.pdf
- Questions and Answers on Fishery Products
http://www.jfa.maff.go.jp/e/q_a/index.html

(5) Toward Reconstruction of the Fishing Industry: Master Plan for Fishery Reconstruction

Early reconstruction of fisheries in affected areas not only directly leads to the reconstruction of local economies and the basis of living for the people in the area, but is also important for ensuring a stable supply of fish products for the people in Japan.

Based on recommendations by the Reconstruction Design Council in Response to the Great East Japan Earthquake, the Fisheries Agency has formulated the Master Plan for Fishery Reconstruction, which serves as a framework for efforts toward reconstruction of the fishing sector.

Since diverse fishery businesses are operated in affected areas, the relevant prefectures and municipalities are expected to formulate their own reconstruction policy according to their local circumstances, based on this master plan. The Fisheries Agency will provide necessary support to reconstruction efforts through various measures.

Comprehensive and integrated reconstruction of various sectors constituting the fishing industry

1. Fishing ports

- Secure the functions necessary for the whole region at an early stage, while sharing functions among fishing ports
  - (1) Fishing ports serving as the national production/distribution bases for fish products
  - (2) Fishing ports serving as the production/distribution bases for local fishing industry
  - (3) Other fishing ports

Response to the nuclear power plant accident

- Strengthen national government's efforts for tackling the accident, including promoting inspections for radioactive materials contained in fish products
- Disseminate food safety information overseas

2. Fishing grounds and resources

- Support removal of debris from fishing grounds in which early resumption of fishing activities should be prioritized
- Continuous research on the fishing ground environment

8. Fishing communities

- Promote disaster-resistant fishing communities while respecting the wishes of local residents
- Secure optimum disaster prevention capabilities according to the circumstances of fishing communities
- Promote implementation of more ecological operations and the creation of a sixth industry

Promote reconstruction of Japan's fisheries as a whole by taking care of various sectors constituting the fishing industry and considering the local wishes

3. Fishing vessels and fisheries management

- Promote modernization and rationalization of fishing vessels and fleets
- Introduce fishing vessels for joint use, and promote joint and collaborative operations
- Ensure supply of fish products through measures to respond to fuel price hikes, etc.

7. Fisheries cooperatives

- Restructure organizations of fisheries cooperatives that support local fisheries
- Ensure the soundness of JF marine banks through capital injections

4. Aquaculture and stock enhancement

- Promote joint or collaborative operations in order to foster highly productive aquaculture operators
- Reconstruct system for producing and releasing seedlings of salmon, etc.

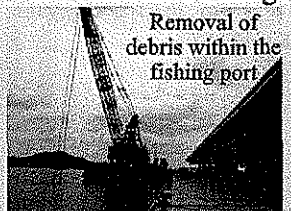
6. Fishery business management

- Secure employment opportunities for affected fishers through removal of debris, etc.
- Promote coordination between local fishers and private companies

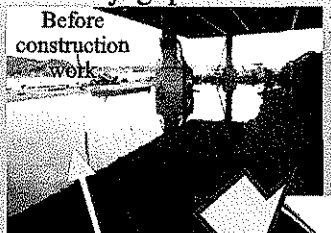
5. Fishery processing and distribution

- Promote integration of facilities or formation of facility complex according to local wishes
- Support creation of a sixth industry and the improvement of quality and sanitation management
- Restructure landing area markets in a manner consistent with the reconstruction of fishing ports

~Kesennuma Fishing Port in Miyagi prefecture~

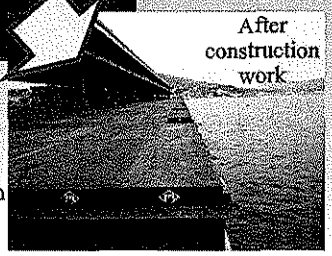


Removal of debris within the fishing port



Before construction work

Pier elevation



After construction work

Flooded due to land subsidence

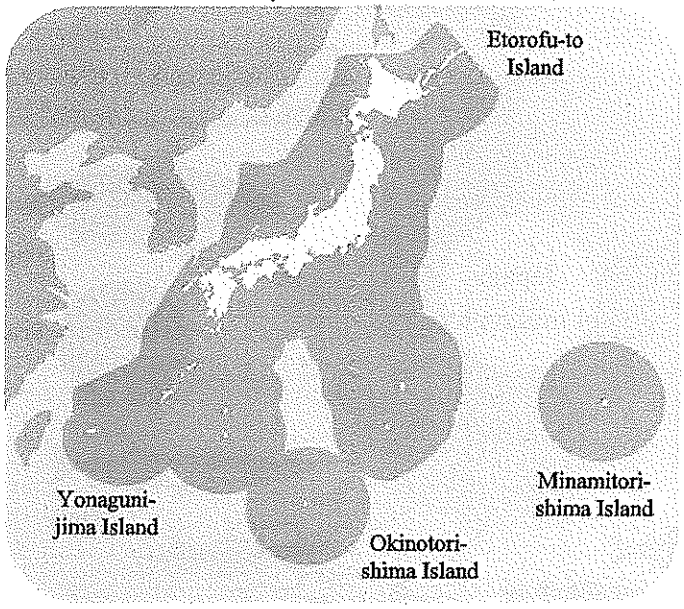
Pier elevation work

Fishing port's functions were partly recovered, and skipjacks were landed.

2. Japan's Seas and Fish

(1) Japan's Vast Exclusive Economic Zone (200 Nautical Mile Zone)

Japan boasts the world's sixth largest exclusive economic zone (EEZ),* at 4.47 million km². Although Japan's land area is 378,000 km², which ranks 61st in the world, it has a far wider EEZ than its land area since the country consists of more than 6,000 islands, many of which are remote.



EEZ size* by country

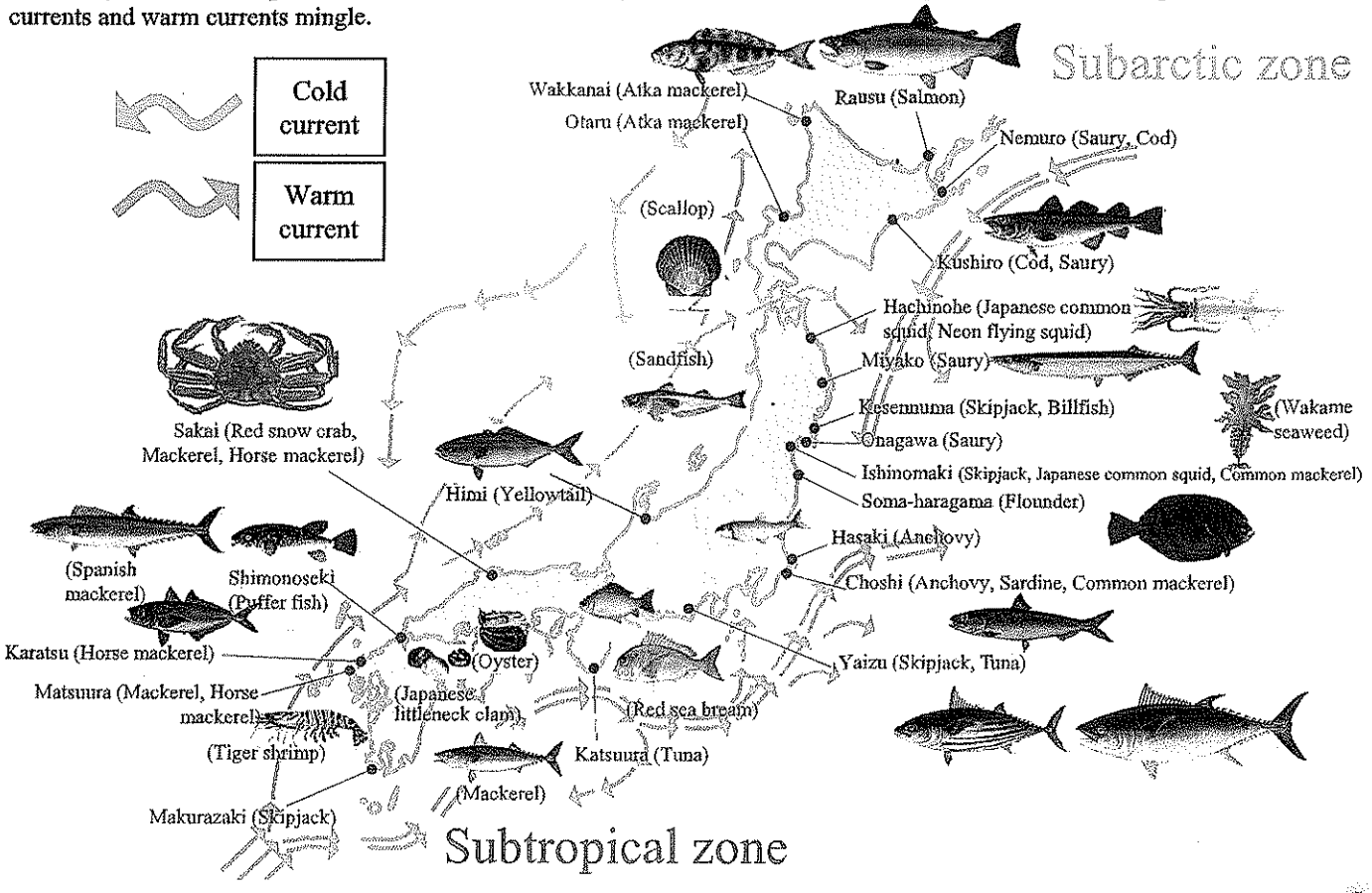
Ranking	Country	EEZ size*	Land area ranking
1st	USA	7.62 million km²	4th
2nd	Australia	7.01 million km²	6th
3rd	Indonesia	5.41 million km²	15th
4th	New Zealand	4.83 million km²	74th
5th	Canada	4.70 million km²	2nd
6th	Japan	4.47 million km²	61st

* Here, the area denotes the total area of territorial waters and the EEZ.
Sources:
Total area of territorial waters and the EEZ: U.S. Department of State, *Limits in the Seas* (data for countries other than Japan) and Japan Coast Guard website (data for Japan).
Land area ranking: U.S. Central Intelligence Agency, *The World Factbook*.

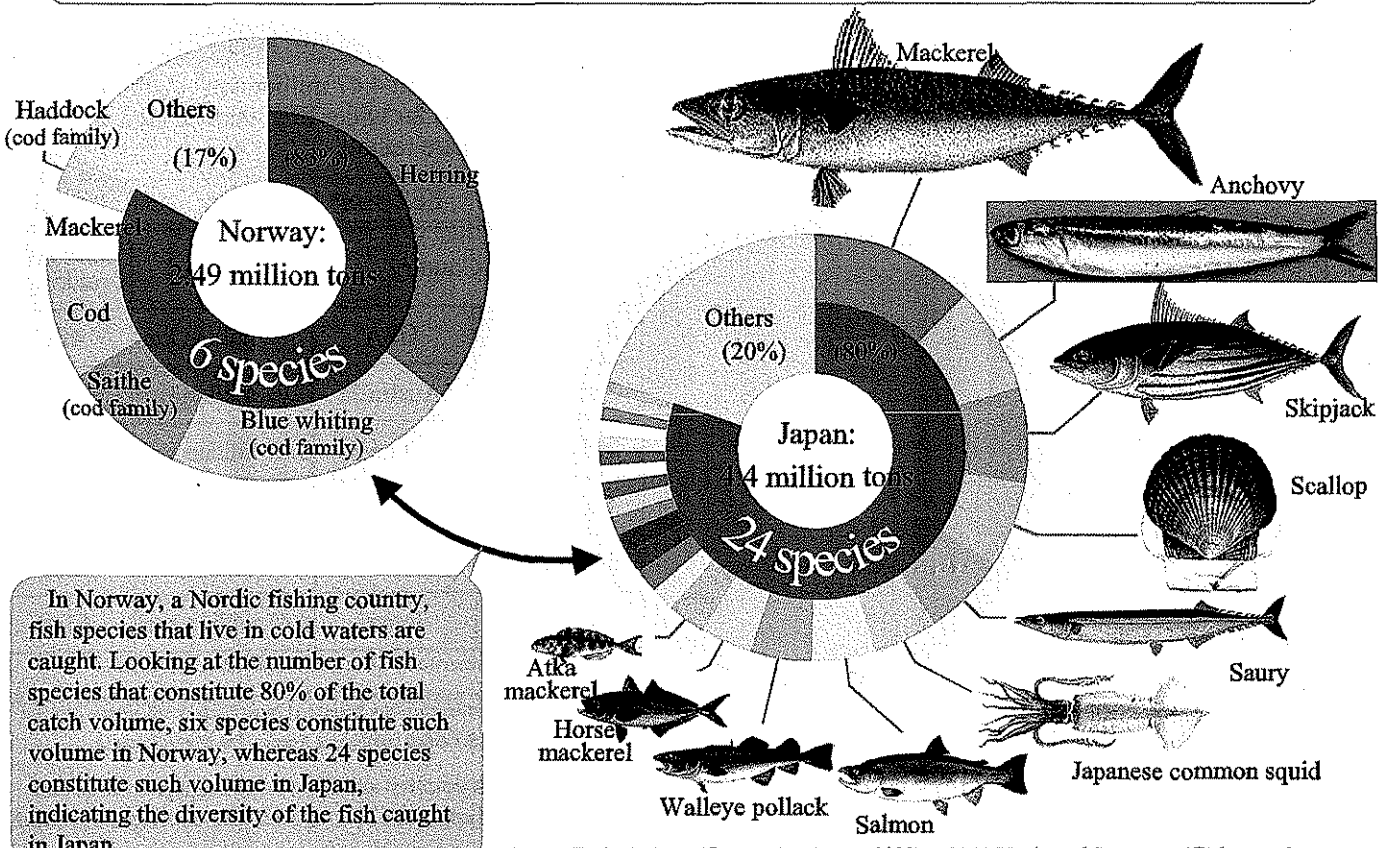
According to the United Nations Convention on the Law of the Sea, fishers of each country are allowed to engage in fisheries freely within the extent of the EEZ of their respective countries (200 nautical miles [approx. 370 km] from the country's coastline).

(2) Wide Variety of Fish and Shellfish Caught in Fishing Grounds around Japan

As many as 3,300 fish species are found and a wide variety of fish and shellfish are caught in waters around Japan where cold currents and warm currents mingle.



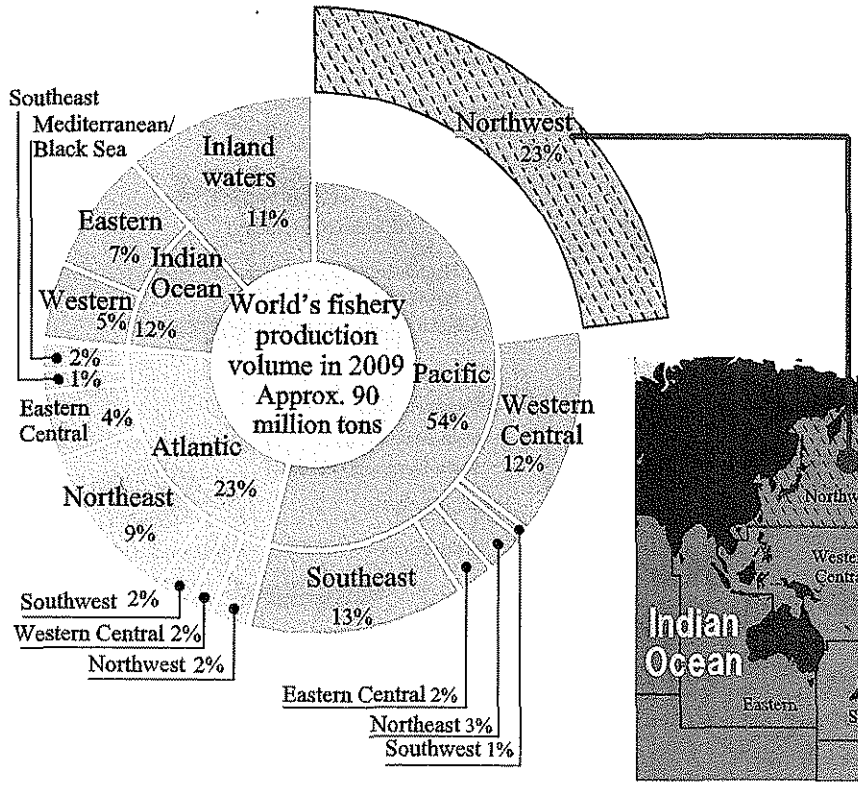
Comparison of catch composition between Japan and Norway



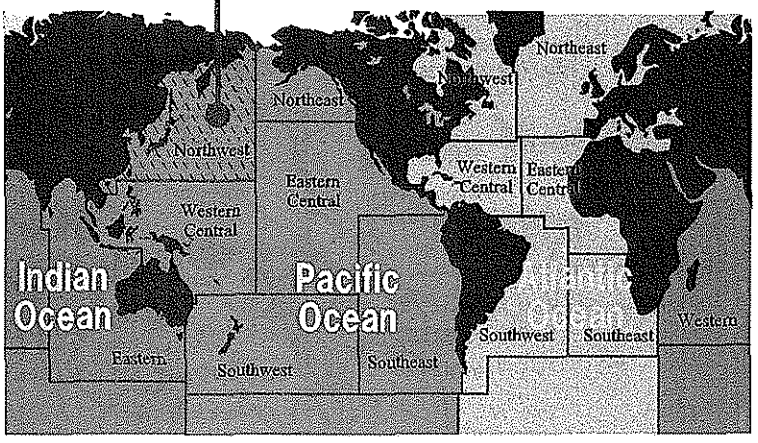
In Norway, a Nordic fishing country, fish species that live in cold waters are caught. Looking at the number of fish species that constitute 80% of the total catch volume, six species constitute such volume in Norway, whereas 24 species constitute such volume in Japan, indicating the diversity of the fish caught in Japan.

Source: FAO, *Fishstat (Capture Production 2009)* and MAFF, *Annual Statistics of Fishery and Aquaculture Production.*
Note: The figures are three-year averages for 2005 to 2009, excluding the years accounting for the maximum and minimum figures.

The world's major fishing grounds



The waters of the Northwest Pacific, which include Japan's EEZ, represent one of the most productive waters in the world, accounting for a catch volume of approximately 20 million tons, which equals 23% of the world's total catch volume of approximately 90 million tons.



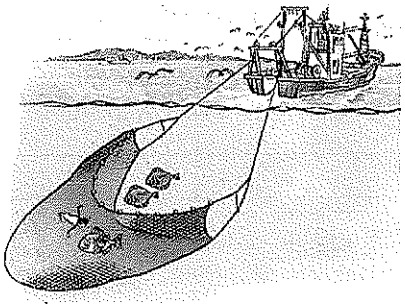
Source: FAO, *Fishstat (Capture Production 2009)*.

Fisheries

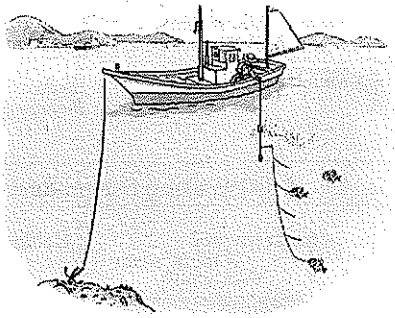
Various fishing methods

In Japan, a wide variety of fish and shellfish are caught by various fishing methods suitable for their habitat and behavior.

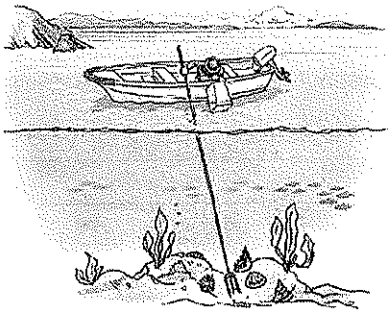
Trawl fishery



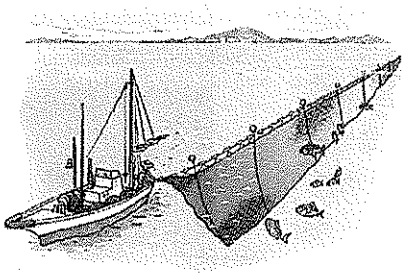
Angling



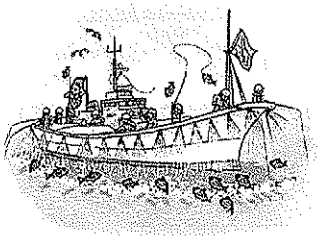
Shellfish/seaweed collecting



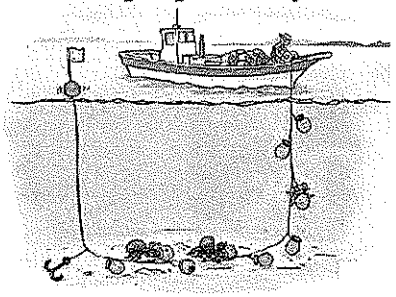
Gill net fishery



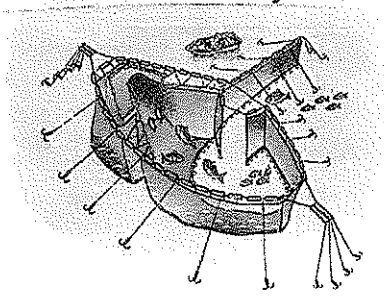
Skipjack pole-and-line fishery



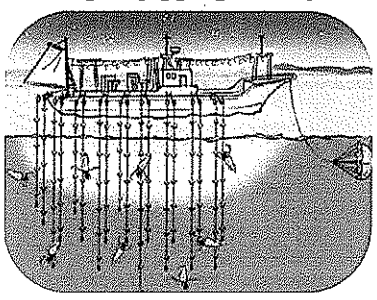
Octopus pot fishery



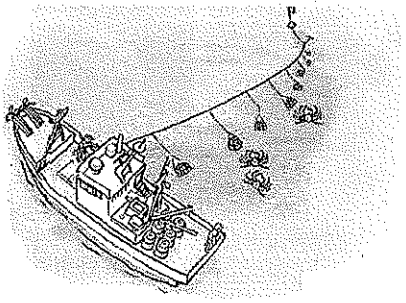
Set net fishery



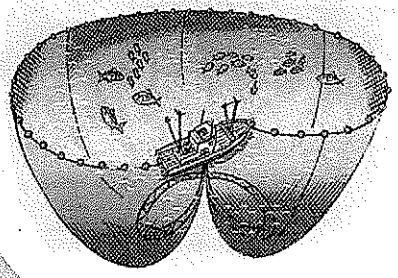
Squid jigging fishery



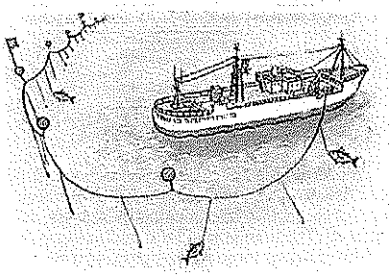
Crab cage fishery



Purse seine fishery



Longline fishery



(3) Japan's Fish-rich Culinary Culture

Japanese people have developed a *fish-rich culinary culture* with regional characteristics, using abundant resources in the waters around Japan. Today, the consumption of dairy products and meat has increased, causing a change to the traditional Japanese dietary habitat centered on rice and fish. Nevertheless, fish products still constitute 40% of Japanese people's animal protein supply source.* Japan is one of the world's top fish-eating countries.

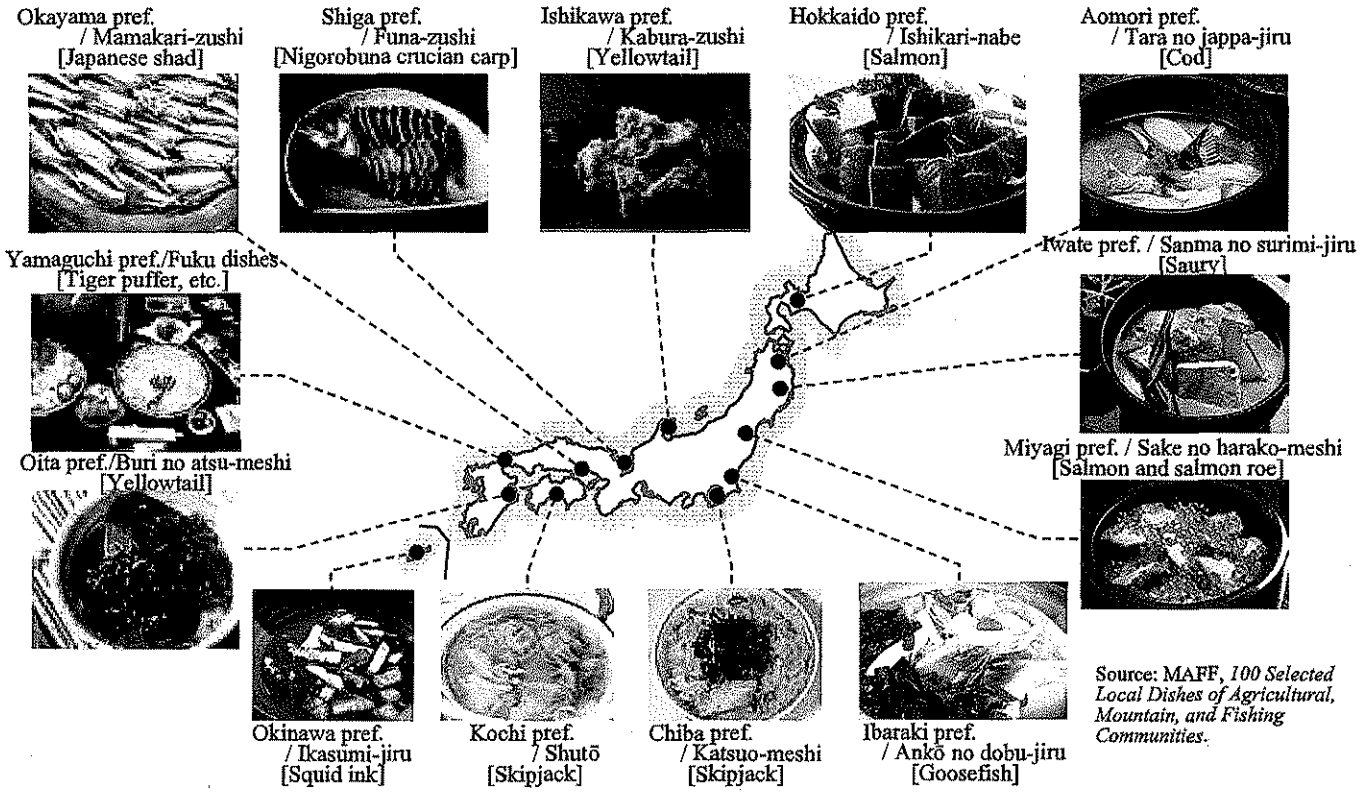
* Per-capita daily supply volume of protein by item: fish products, 15.6 g; meat products, 14.4 g; dairy products, 7.4 g; and chicken eggs 5.6 g. (Source: MAFF, *Food Balance Sheet*)
Supply volume and consumption volume are proximate.

Per-capita annual supply volume of fish products for human consumption (comparison among countries with a population of 1 million or more)

Country	Supply volume (kg)
1. Japan	56.9
2. Portugal	54.8
3. South Korea	52.7
4. Norway	51.4
5. Malaysia	50.1

Source: Compiled by Fisheries Agency based on FAO, *Food Balance Sheets* (2007) and MAFF, *Food Balance Sheet* (2007).

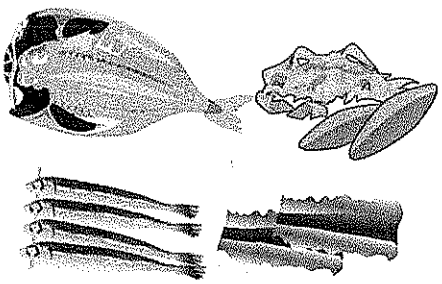
Local dishes using fish products



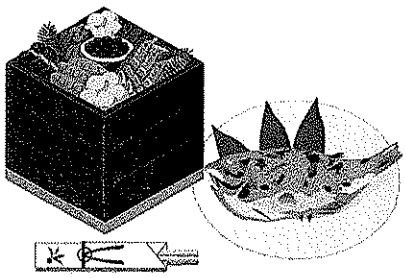
Source: MAFF, *100 Selected Local Dishes of Agricultural, Mountain, and Fishing Communities.*

Fish-rich culinary culture rooted in the Japanese lifestyle

Ebisu, one of the seven lucky gods and known as the god of merchants, has been worshipped by fishers as the god of fishery, who brings fruits of the sea.



Japanese people have developed various ways to use fish products, including ways to preserve fish products longer while keeping them tasty, such as *hiraki* (split and dried fish) and *mezashi* (dried sardines strung through the eyes), or ways to use fish products to make broth, such as *katsuobushi* (dried and shredded skipjack) and dried kelp.



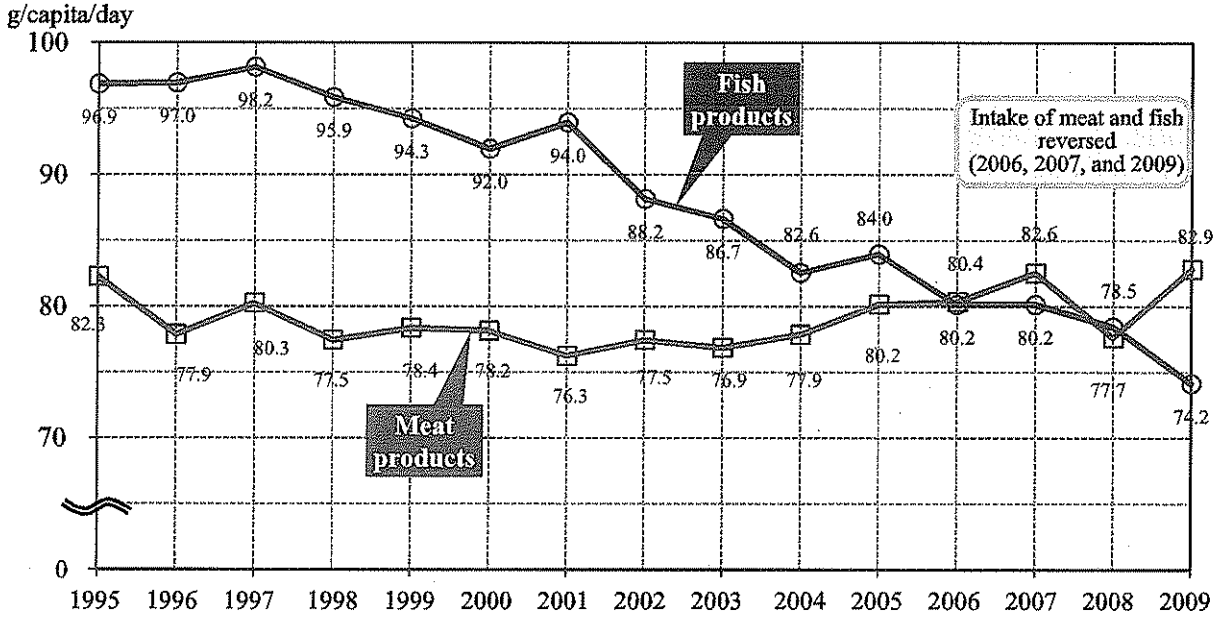
In *osechi*, a set of dishes which Japanese people eat on New Year's Day, fish products are indispensable, such as herring roe, symbolizing a wish for the prosperity of descendants, and sardines stewed in sweet soy sauce, symbolizing a wish for a good harvest, as well as yellowtail, prawns, and kelp.

3. Fish for Today's Dining Table

(1) Decrease in Take of Fish Products

When comparing per-capita daily intake volume of fish products with that of meat products, the intake volume of fish products has been on a decline, while that of meat products has been stable. The intake volume of meat products surpassed that of fish products for the first time in 2006. The difference between the meat and fish intake volumes widened in 2009.

Changes in per-capita daily intake volumes of fish products and meat products

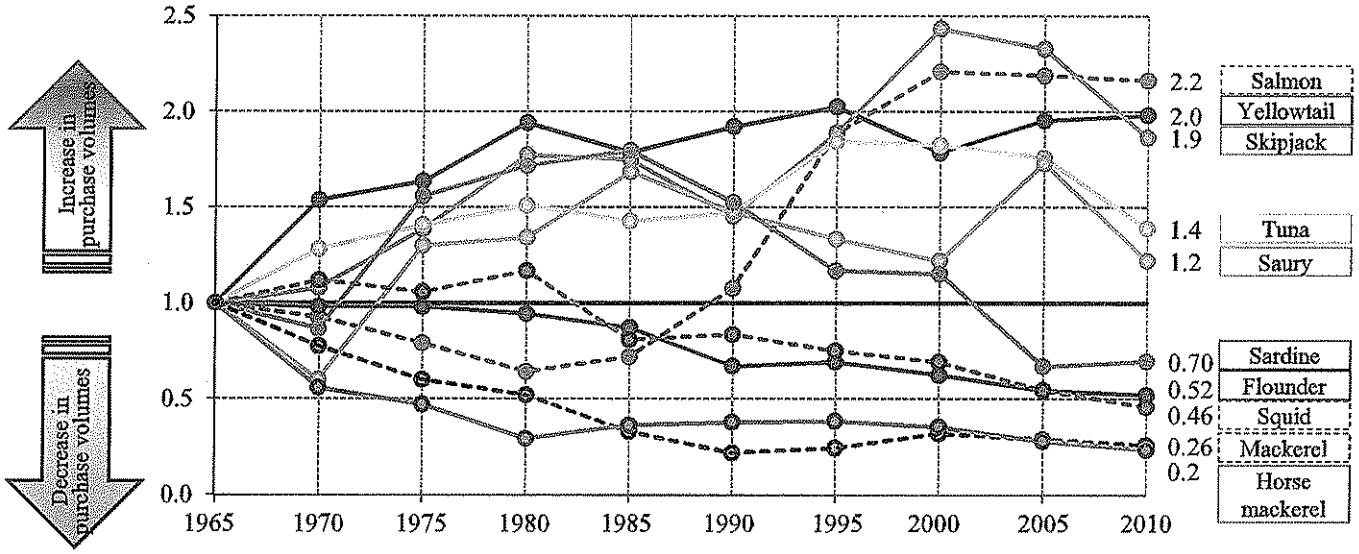


Sources: Ministry of Health, Labour and Welfare, National Nutrition Survey (1995–2002), and National Health and Nutrition Survey (2003–).

(2) Changes in Fish Consumed at Home

Consumption of fish products that need much preparation before cooking such as horse mackerel and mackerel has decreased, while consumption of easy-to-cook salmon and yellowtail fillets has increased.

Changes in household purchase volumes of fresh fish products (volumes for 1965 is shown as 1)

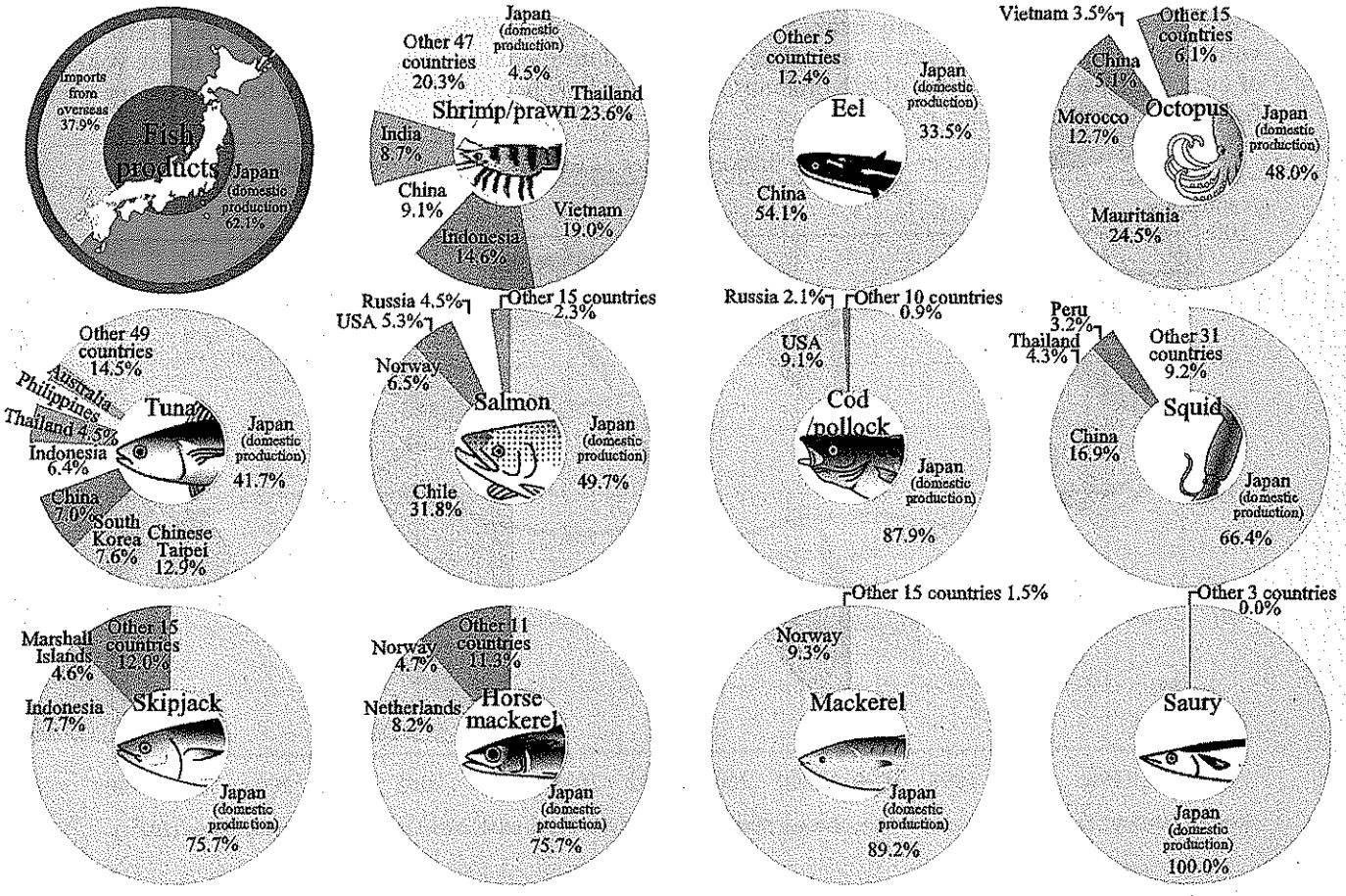


Source: Compiled by Fisheries Agency based on Ministry of Internal Affairs and Communications, *Annual Report on the Family Income and Expenditure Survey.*

(3) Where Do Fish Products that We Eat Everyday Come from?

Fish products are imported from around the world. In the case of some products, imports make up more than half of the total supply volume in Japan.

Shares of Japan's production and import volumes in the total supply of Japan (2009)

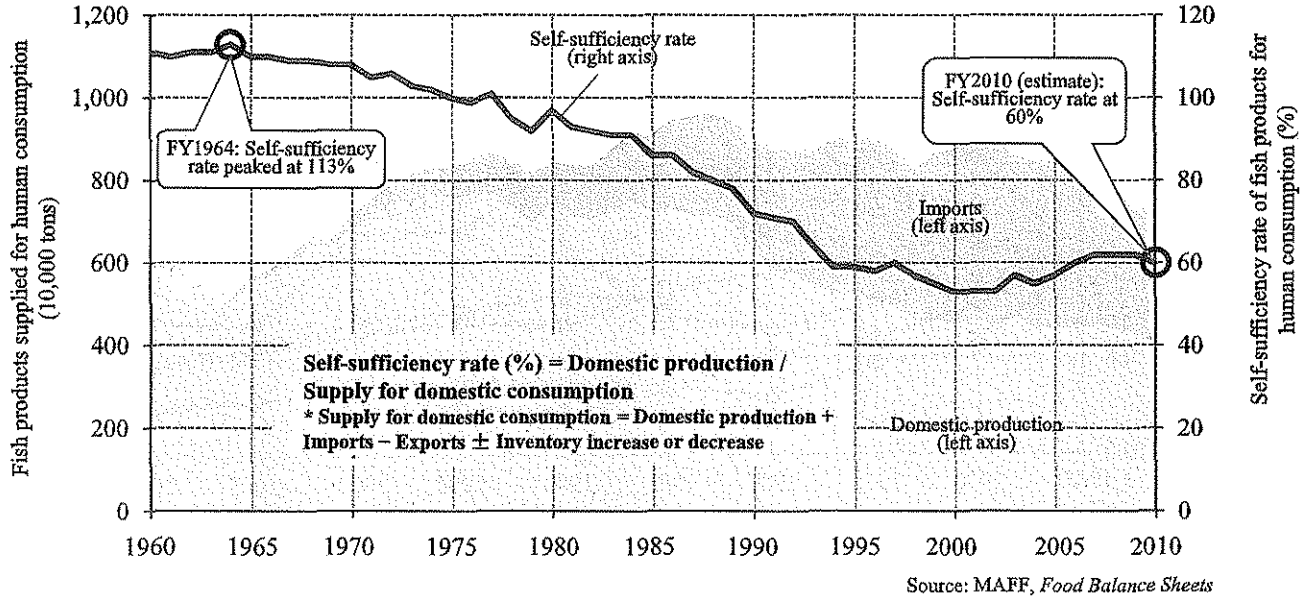


Source: MAFF, *Annual Statistics on Fishery and Aquaculture Production (2009)* and Ministry of Finance, *Trade Statistics (2009)*.

(4) Japan's Self-sufficiency Rate for Fish Products for Human Consumption Stands at 60%

Japan's self-sufficiency rate for fish products for human consumption had declined after peaking at 113% in 1964. In recent years, the rate has been on a slight increase since the domestic production volume ceased to fall and imports of fish products decreased. However, the self-sufficiency rate in 2010 stood at 60%, falling 2% from the previous year.

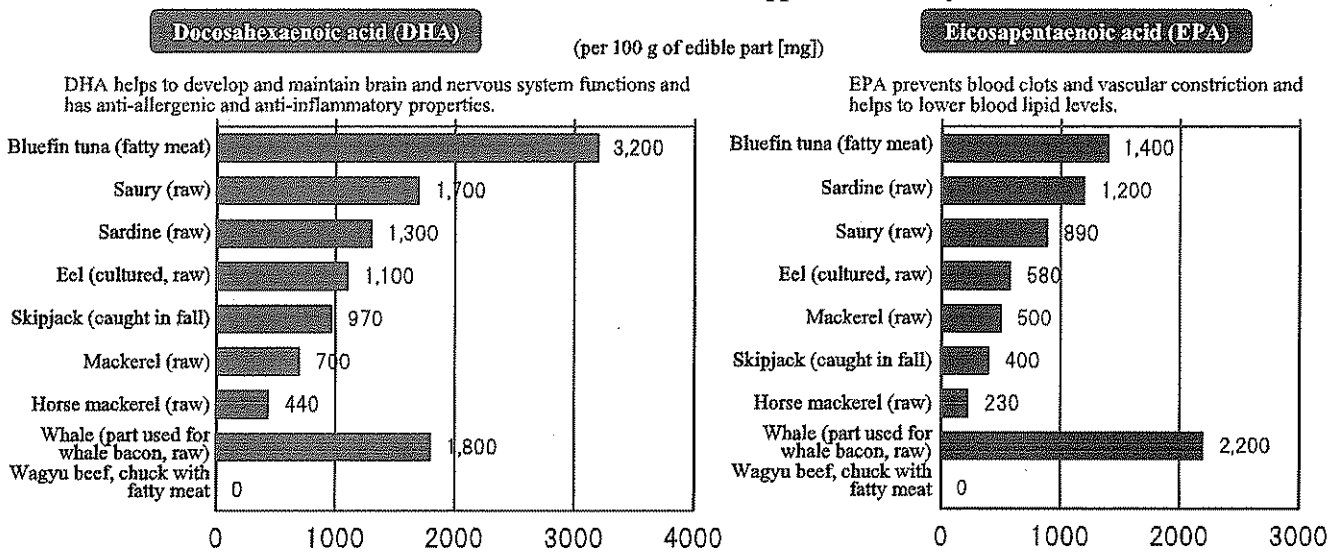
Changes in the self-sufficiency rate of fish products for human consumption (on a weight basis)



Source: MAFF, *Food Balance Sheets*

(5) Fish Products Are Good for the Brain and Body

It has been proven that saturated fatty acids such as DHA and EPA, which are contained in large amounts in fish oil, play an important role in fetal and juvenile brain development as well as prevention of blood clots. Fish products and seaweeds also contain various other functional elements that support our healthy lives.



Other major functional elements contained in fish products and seaweeds

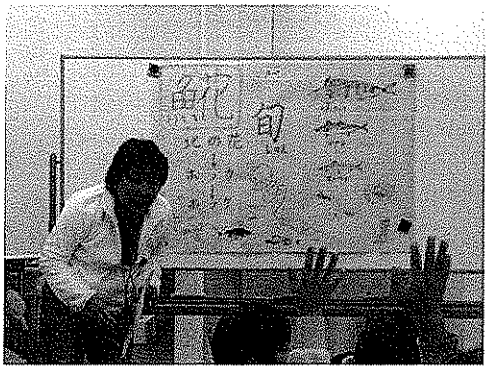
Functional components	Major functions	Major fishery products containing the components in large amounts
Taurine	Adjusts blood pressure, eliminates cholesterol, improves liver function, maintains eyesight	Squid, Oyster, Octopus, Abalone, Scallop, Tiger shrimp, Salmon
Calcium	Forms bone, regulates blood pressure and nervous system function	Small fish (Sardine, Anchovy, etc.)
Iron	A main component of blood erythrocytes (hemoglobin), helps to maintain human body functions	Nori seaweed (laver), Hijiki seaweed, Clam

Source: *Standard Tables of Food Composition in Japan* (Fifth Revised and Enlarged Edition).

Activities to Introduce the Taste of Fish Products

While conducting community-based sales activities, fish retailers also play the role of providing consumers with information regarding tasty ways to prepare fish products, as well as which products are in season. A private accreditation system was established to train people to convey the appeal and merits of fish, and people who have been accredited as "Osakana (Fish) Meisters" are carrying out dietary education activities.

Fresh fish corner in a Tokyo supermarket
This fresh fish corner is staffed with personnel who provide such services as giving customers advice on food preparation and products in season, and cutting fish on request for such uses as sashimi.

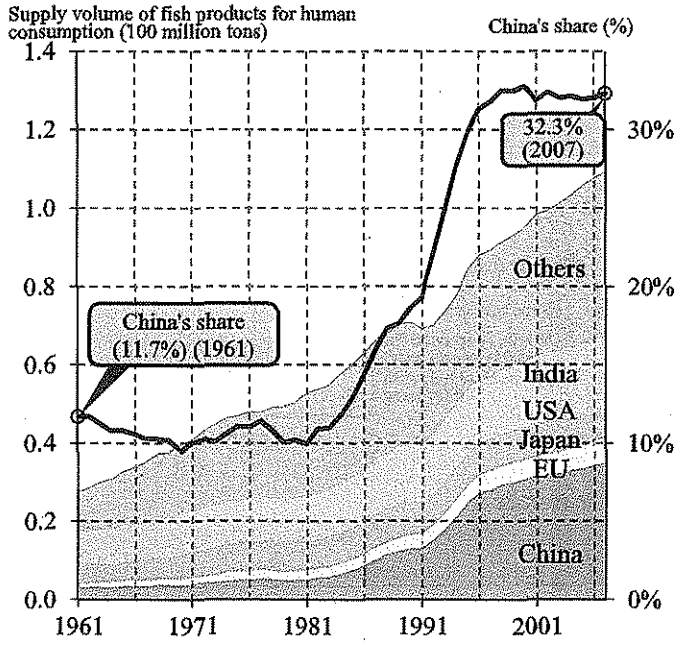


A private accreditation system "Osakana (Fish) Meister" was launched in October 2007 to train people to teach others about fish and spread fish-related information. The related organization also distributes a free magazine focusing on the merits of fish in season.

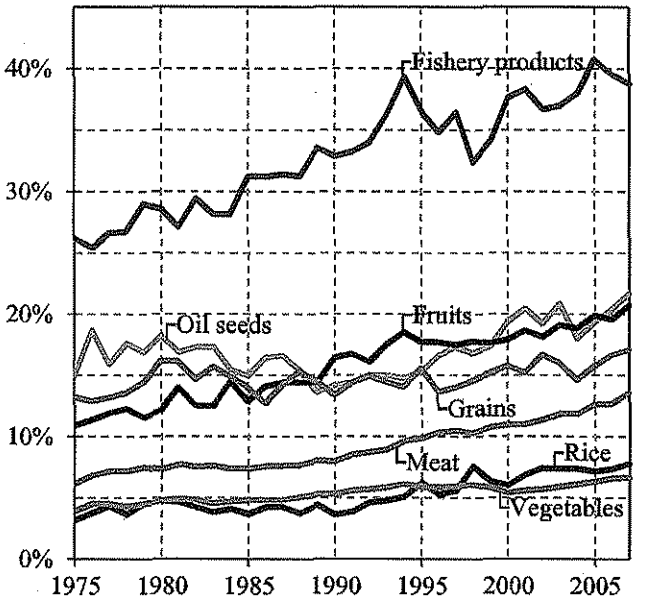
(6) Demand for Fish Products Are Increasing around the World

The world's consumption volume of fish products for human consumption has been increasing every year, due to the growing health-conscious trend in Europe and the United States and the economic development in countries such as China and India.
The consumption increase is particularly notable in China, with the country commanding a one-third share of the world's total consumption volume in 2007.

Changes in the supply volumes of fish products for human consumption around the world



Changes in the proportion of world production volume that is exported by item

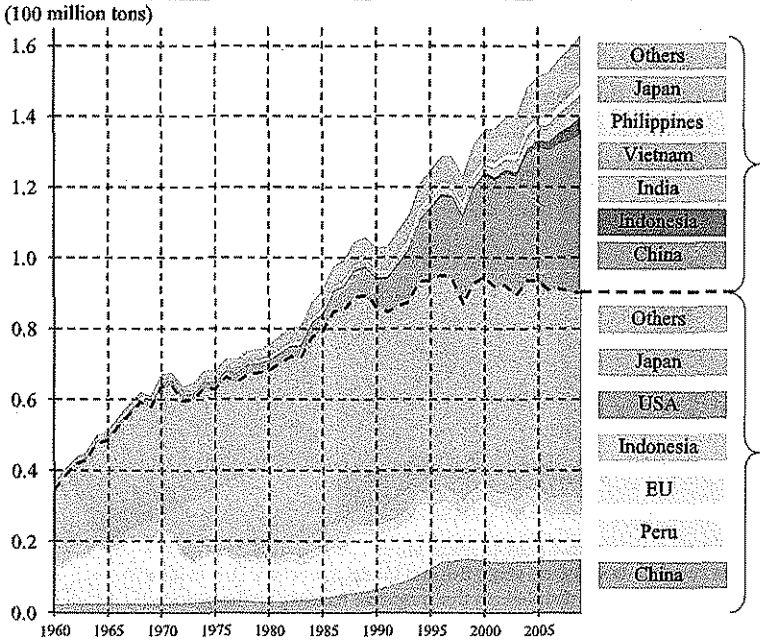


Source: FAO, *Food Balance Sheets* and MAFF, *Food Balance Sheet.*

The World's Capture Fishery Production has Leveled Off, Indicating a Possible Tight Supply in the Future

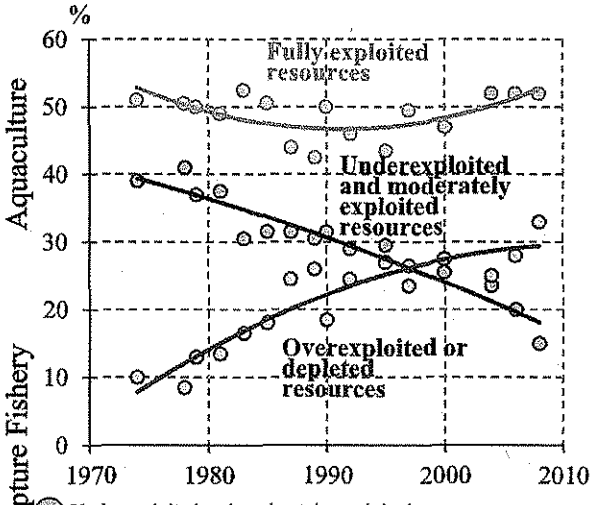
According to the Food and Agriculture Organization of the United Nations (FAO), the proportions of "fully exploited resources" and "overexploited or depleted resources" have increased in the world's marine fishery resources. The production volume of capture fisheries that exploit marine living resources has leveled off since the latter half of the 1990s, and there is a risk that the supply will not be able to meet the world's demand for fish products, which is expected to increase in the future. On the other hand, the world's aquaculture production volume continues to increase, but since there are restricting factors such as limits to locations that are suitable for aquaculture, there is a possibility that the aquaculture production volume will also level off in the medium to long term.

Changes in the capture fishery and aquaculture production volumes around the world



Source: Compiled by Fisheries Agency based on FAO, *Fishstat (Capture Production 1950–2009 and Aquaculture Production 1950–2009)* (for countries other than Japan) and MAFF, *Annual Report on Fishing and Aquaculture Production Statistics* (for Japan).

Status of exploitation of marine living resources around the world



Underexploited and moderately exploited resources
The catch volume is less than the adequate level, and there is room for a production increase.

Fully exploited resources
The catch volume is near the upper limit of the adequate level, and there is no room for any further production increase.

Overexploited or depleted resources
The catch volume exceeds the adequate level, or the resources have already depleted.

Source: Compiled by Fisheries Agency based on FAO, The State of World Fisheries and Aquaculture (SOFIA) 2010.

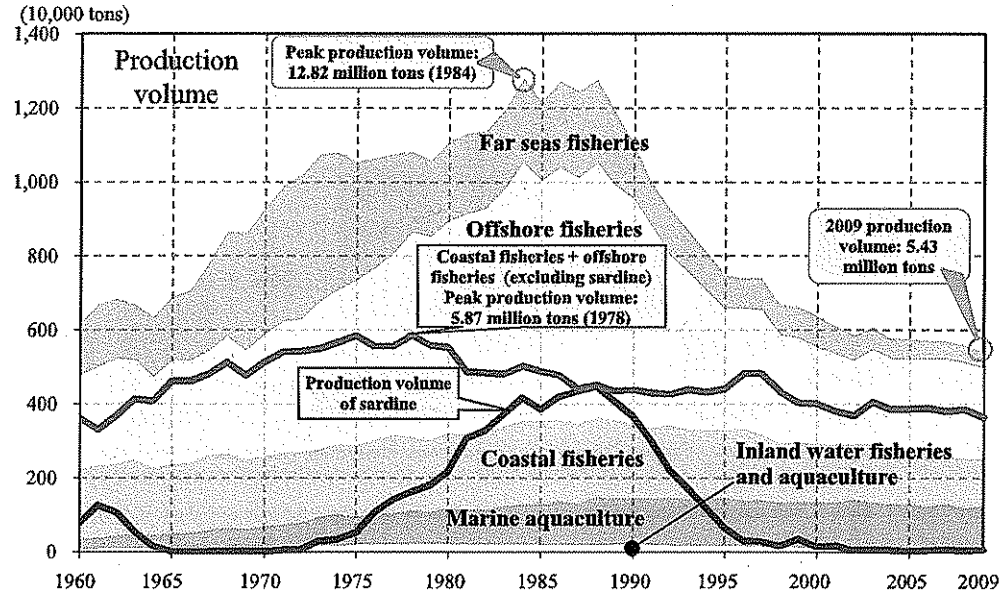
4. Situation of Japan's Fishing Industry

(1) Japan's Fishery and Aquaculture Industries

Japan's fishery production volume has declined to about half of the peak volume, due to the increased withdrawal of operators from far seas fisheries in line with the establishment of the 200 nautical mile zone by many countries, and the drastic fall in the sardine resource level, which is known to fluctuate wildly on a repeated basis. Fishery and aquaculture production volume for 2009 was 5.43 million tons, dropping 163,000 tons from the previous year (a 2.9% decline).

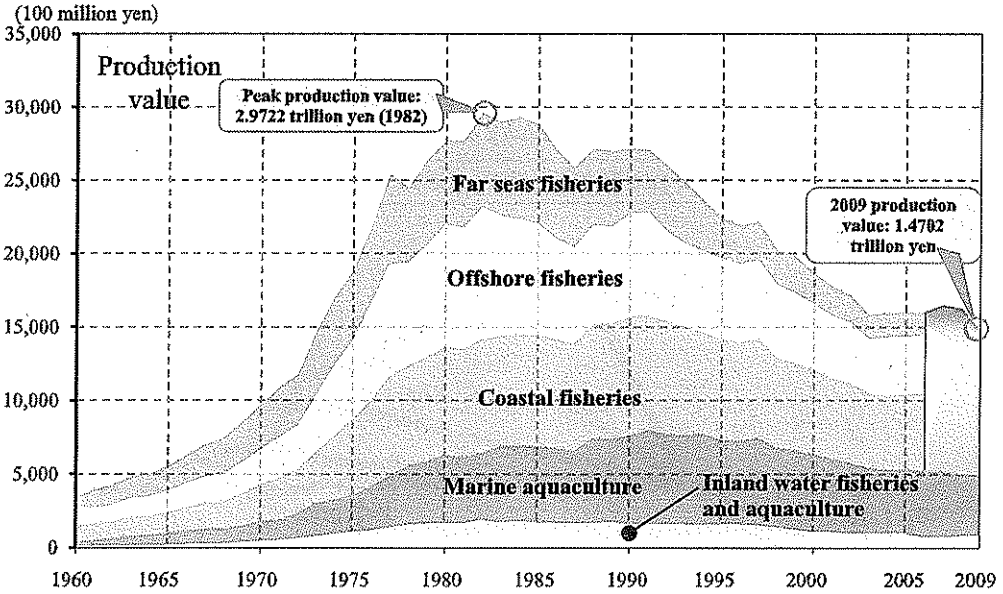
Fishery and aquaculture production value for 2009 stood at 1.4702 trillion yen, falling 157.7 billion yen from the previous year (a 9.7% decline), as a result of an overall decrease in yields of species including skipjack, bluefin tuna, and mackerel.

Changes in production volume and value by fishery type



Production volume	2009 (10,000 tons)
Total	543.2
[Marine]	534.9
Fisheries	414.7
Far seas fisheries	44.3
Offshore fisheries	241.1
Coastal fisheries	129.3
Aquaculture	120.2
[Inland water]	8.3
Fisheries	4.2
Aquaculture	4.1

Figures for offshore fisheries and coastal fisheries are estimates.



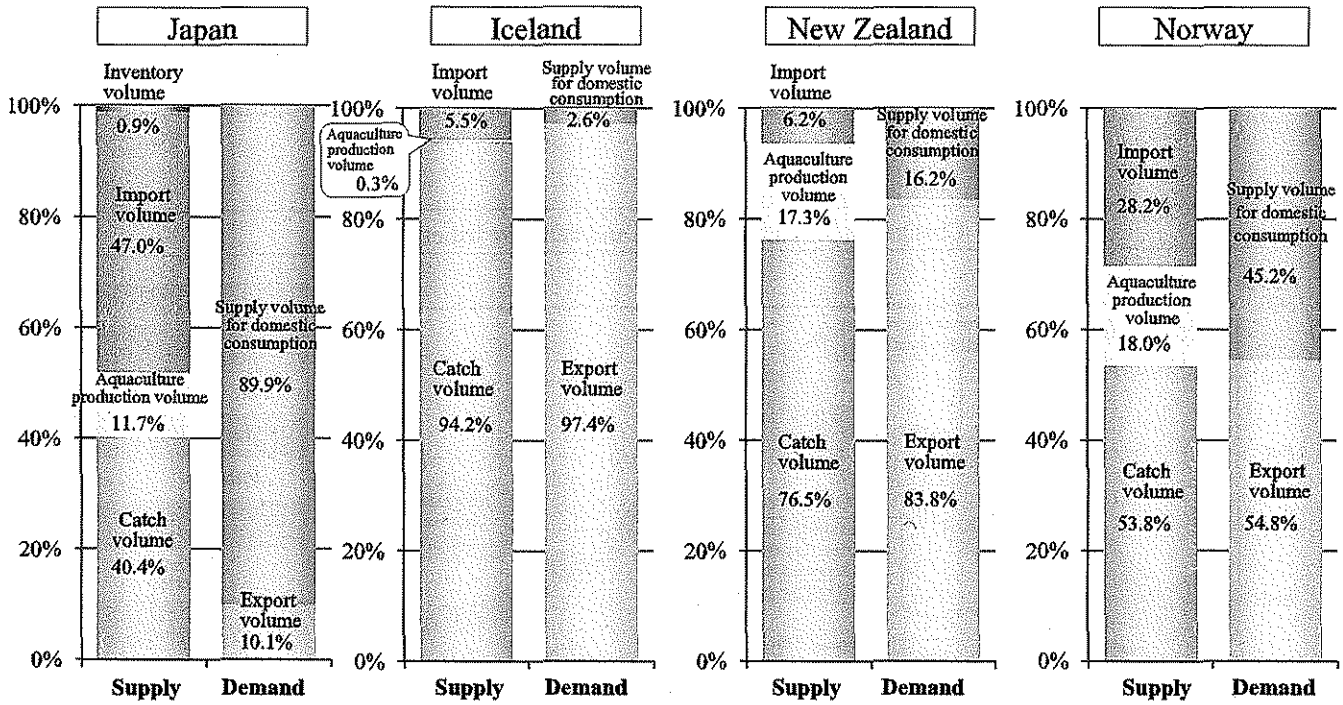
Production value	2009 (100 million yen)
Total	14,702
[Marine]	13,814
Fisheries	9,719
Far seas fisheries	…
Offshore fisheries	…
Coastal fisheries	…
Aquaculture	4,095
[Inland water]	887
Fisheries	264
Aquaculture	623

Notes:
1. The inland water fishery/aquaculture production volumes from 1960 to 2000 are values for all rivers and lakes, those for 2001 to 2003 are values for 148 major rivers and 28 major lakes, and those for 2004 onward are values for 106 major rivers and 24 major lakes. The inland water aquaculture for 2001 onward indicates the harvest volume of trout, sweetfish, carp, and eel. The harvest volume for 2007 includes those of other species that were cultured in Lake Biwa, Lake Kasumigaura, and Lake Kitaura.
2. The fishery production values are estimated by multiplying the fishery/aquaculture production volume by the landing area market wholesale price, etc.
3. The inland water fishery catch volumes and production values for 2006 onward do not include those of catches by recreational fishers (those who catch or collect aquatic animals and plants mainly for recreational purposes).

Japan's Fisheries Are Strongly Oriented toward Domestic Demand

Compared with other fishing countries, Japan's fishery and aquaculture products are mostly supplied for domestic consumption, indicating their strong orientation toward domestic demand.

Comparison of production and consumption structures by fishing countries (2007)

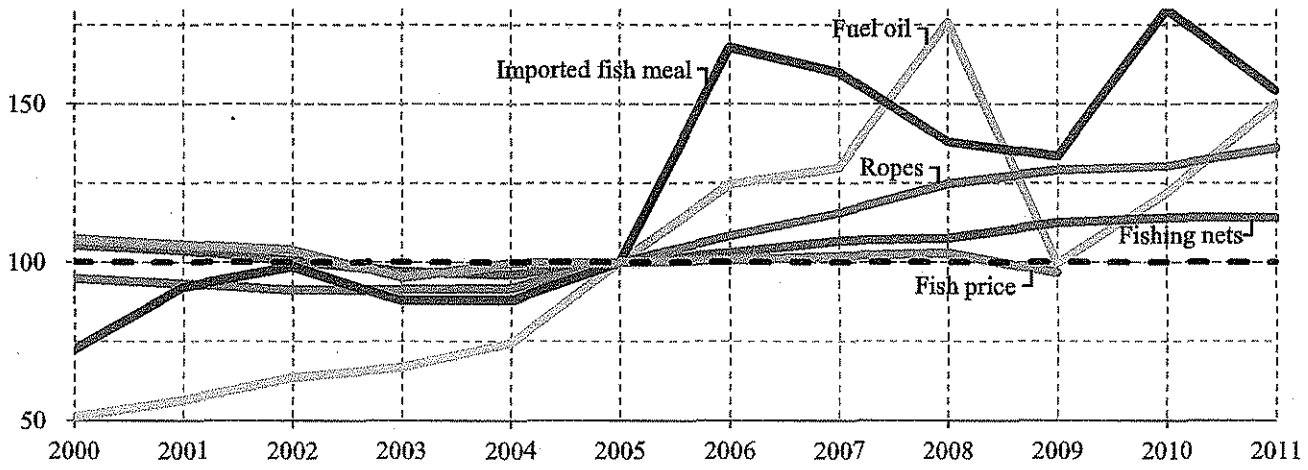


Sources: Compiled by Fisheries Agency based on FAO, *Fishstat (Capture Production), (Aquaculture Production)* (for countries other than Japan) and *Food Balance Sheets* (for countries other than Japan), and MAFF, *Annual Statistics on Fishery and Aquaculture Production* (only Japan) and *Food Balance Sheet* (only Japan).
Note: Japan's catch volume, import/export volumes, and supply volume for domestic consumption include those for seaweed (the weight of raw seaweed).

Price Hike of Fishery Production Materials Affecting Fishery Business Management

In recent years, despite the sluggish growth of fish prices, prices of materials necessary for fisheries, such as fuel oil, fishing nets, and ropes, have risen, deteriorating fishery earnings. In particular, prices of fuel oil and imported fish meal (ingredient for compound feed for aquaculture) have come to surge drastically over a short period of time due to the effects of speculative funds and other factors, and weigh on fishery and aquaculture business management.

Changes in prices of fishery and aquaculture production materials (year 2005 = 100)

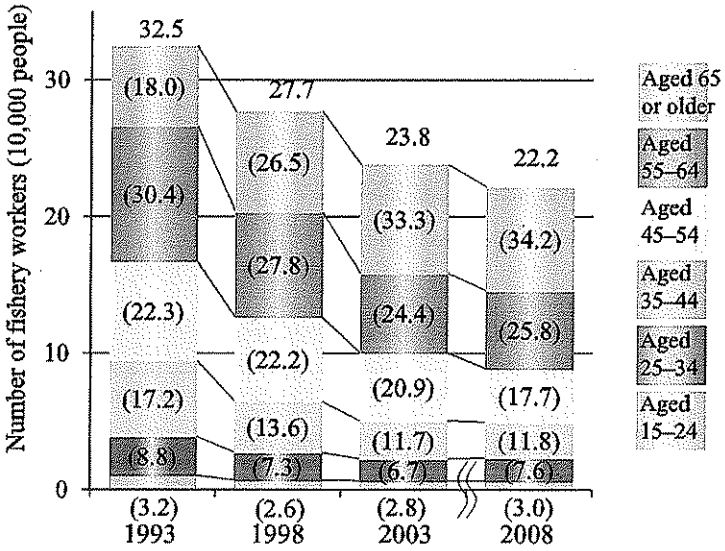


Source: Bank of Japan, Corporate Goods Price Index, MAFF, Annual Statistics on Fishery and Aquaculture Production.
Note: Values of fuel oil, ropes, fishing nets, and imported fish meal for 2011 are average values for the period from January to August. Fish price is calculated by the formula, fish price = fishery production value / fishery production volume, based on Survey on Marine Fishery Production.

Fishery Workers and Fishing Vessels (Issues Concerning Fishery Production Capacity)

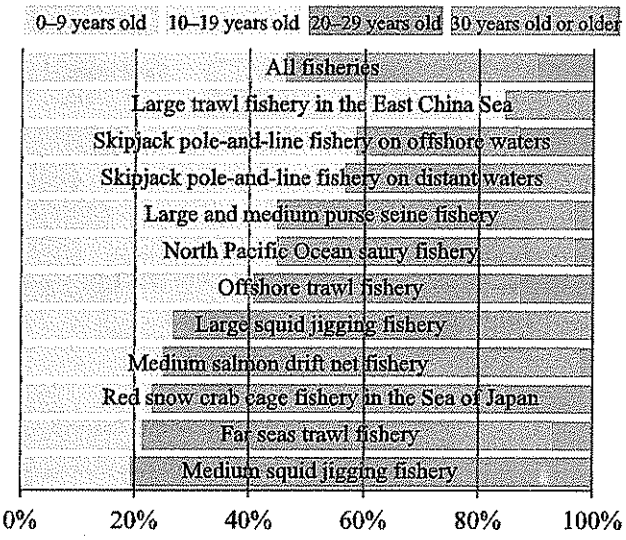
Fishery resources do not have any value as resources as long as they remain in the sea. For effective utilization of fishery resources, it is necessary to secure fishery production capacity (the ability to catch fish from the sea). However, Japan's fishery workers are decreasing and aging. Fishing vessels are aging as well. Among fishing vessels that have received permission for major types of fisheries, 53.8% are 20 years old or older. One of the reasons for this is that fishers' incomes have decreased, and they are unable to replace their old vessels.

Changes in the number of fishery workers



Source: MAFF, *Fisheries Census*.

Distribution of the ages of fishing vessels

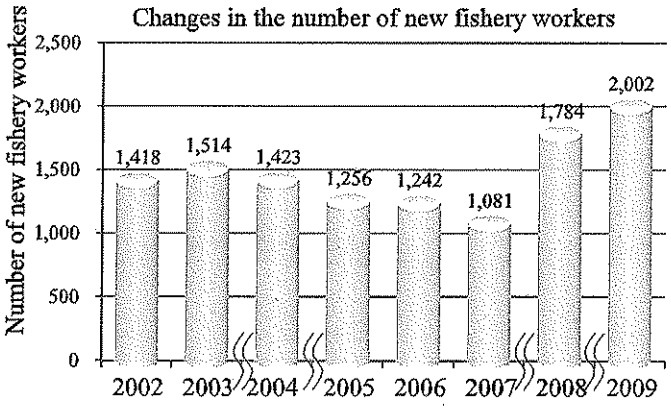


Source: Fisheries Agency survey (vessels under designated fishery permission).

"Fishery Employment Support Fairs" for matching fishers (employers) seeking workers and people seeking fishery employment are held at various locations, in order to promote the recruitment of new fishery workers. Although the number of new fishery workers has remained low, it has been on an increasing trend since 2008. In addition, a project of comprehensive measures for fisheries structural reform is implemented for fisheries using fishing vessels in order to promote a shift to profitability-focused operation systems that pursue energy saving and personnel cuts.

Scene from a Fishery Employment Support Fair

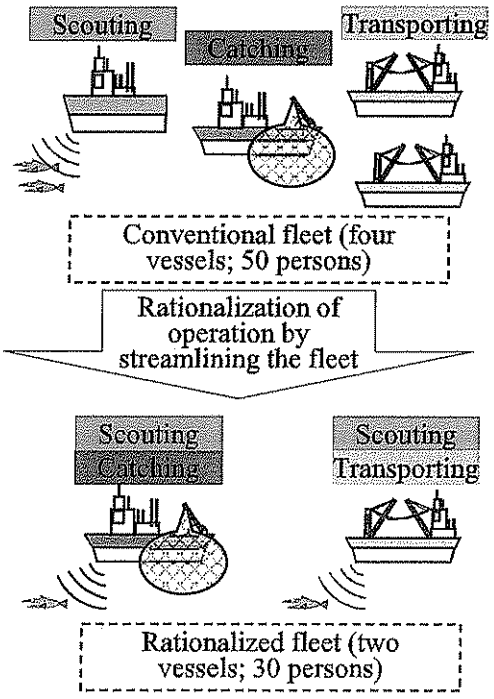
Changes in the number of new fishery workers



Source: Compiled based on MAFF, *Survey on Newcomers in Agriculture, Forestry and Fisheries* (2002, 2003) and *Fisheries Census* (2008). Figures for 2004 and 2009 were estimated from surveys on new recruits conducted by prefectures. Figures for 2005 to 2007 are based on a questionnaire survey of fisheries cooperatives conducted by the Japan Fisheries Association.
Note: Due to the different survey results used, the results for 2001 and 2002–2003, those for 2003 and 2004, those for 2004 and 2005–2007, and those for 2007 and 2008 are not continuous.

Case example of a project of comprehensive measures for fisheries structural reform

Purse seine fishery

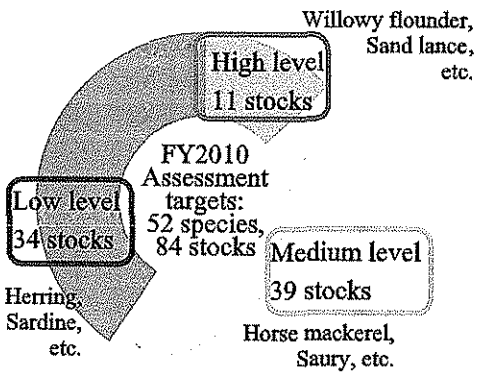


(2) Management and Sustainable Use of Fishery Resources

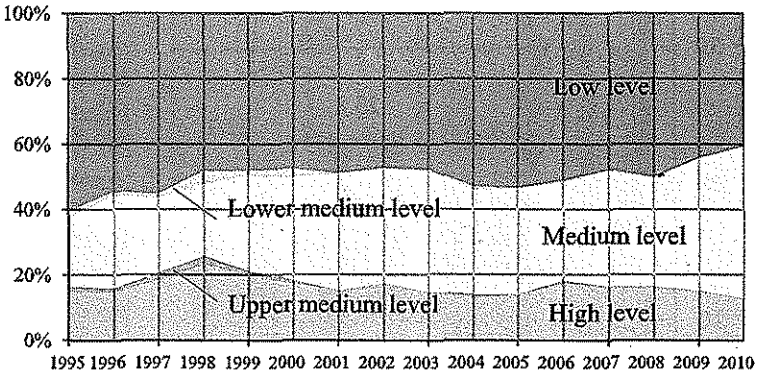
Status of Fishery Resources in Waters around Japan

Looking at the status of resources in waters around Japan, the resource levels are low for about 40% (34 stocks) of the resource assessment targets (52 species/84 stocks). The reported factors behind the low resource levels are the effect of changes in the marine environment, as well as a decrease in seaweed beds and tidal flats, which serve as spawning and nursery grounds, due to the development of coastal areas, and the fact that some resources were caught beyond their recovering ability. However, the percentage of species with low resource levels has slightly decreased in recent years.

Current resource levels (2010) in waters around Japan



Past changes in resource levels



Source: Fisheries Agency and Fisheries Research Agency, *Assessment of Fishery Resources in Waters around Japan, etc.*
Note: Since resource levels of saury have been surveyed since 2003 and those of snow crabs have been surveyed since 2004, these two species are excluded from the data showing past changes in resource levels.

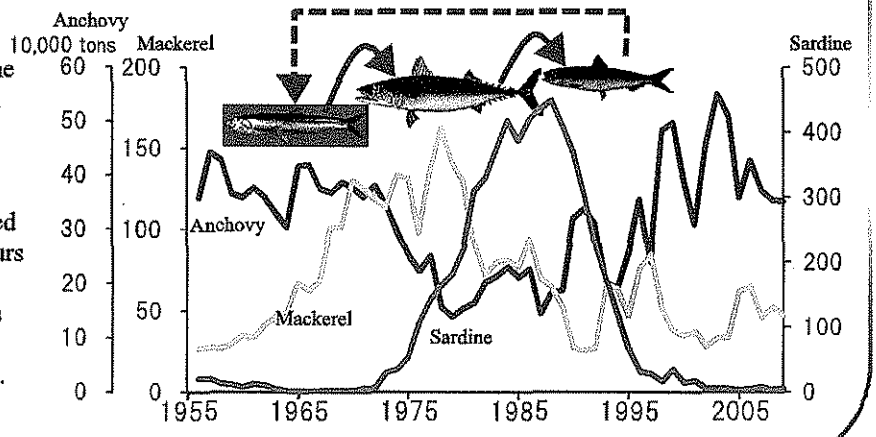
Column

Species replacement: a phenomenon where the fish species that can be caught change in turns

It has been empirically known from the past that, among pelagic fish that repeat good catch and poor catch, the catch volumes of anchovy, mackerel, and sardine change in turns. However, the mechanism of such changes has been unknown.

Recently, it has been suggested that this phenomenon (species replacement) is a regime shift of the ecosystem that is caused by a global-scale climate change that occurs in a cycle of several tens of years.

Elucidation of the mechanism of species replacement is expected to make more appropriate resource exploitation possible.



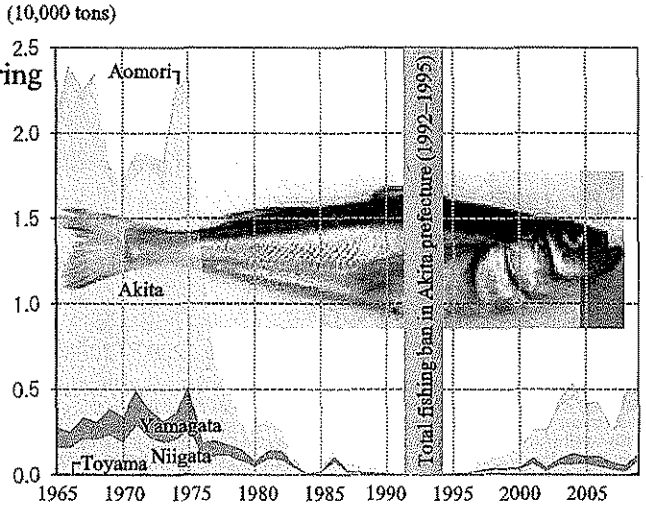
Case example

Resource level of sandfish recovering due to fishers' efforts

The catch volume of sandfish, which had been around 20,000 tons in the late 1960s to early 1970s, has dropped sharply since 1975, falling to 158 tons by 1991.

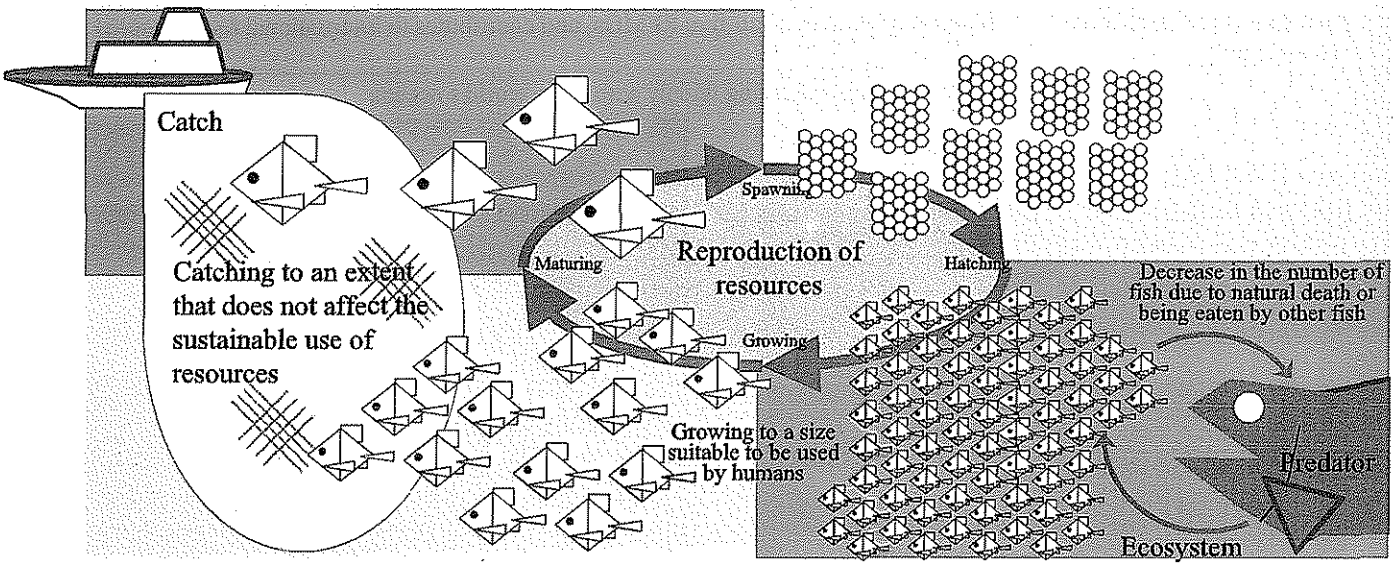
Therefore, fishers in Akita prefecture, which is the major landing area, implemented a total fishing ban for three years from September 1992. Even after the ban was lifted, they continued efforts to recover the resource level, such as establishing a no-fishing period and releasing juvenile fish.

As a result, the resource level recovered to a level that allows for a catch of about 5,000 tons by 2008.



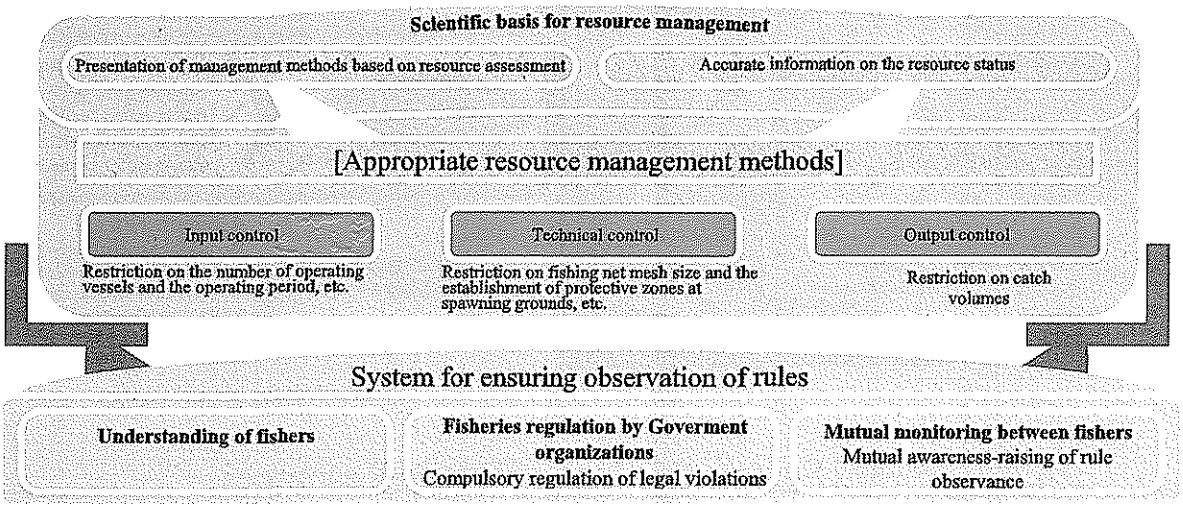
Characteristics of Fishery Resources

Unlike energy resources such as oil and coal, fishery resources are reproducible, with the ability to lay eggs and produce offspring by themselves. In order to achieve sustainable use of fishery resources, it is important to carry out "resource management," such as preventing overexploitation and protecting immature fish and spawning biomass.



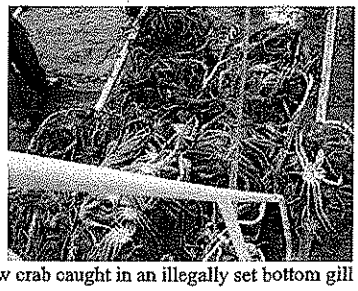
Resource Management Methods and Elements Supporting those Methods

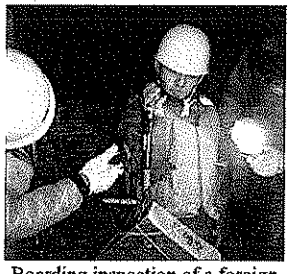
There are three resource management methods: (1) input control; (2) technical control; and (3) output control.
In order to ensure appropriate implementation of resource management, it is important that fishing rules which incorporate these control methods be established based on scientific grounds and that fishers themselves observe these rules.

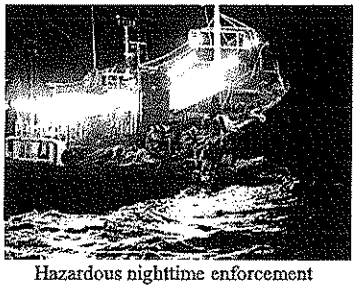


Intensifying Monitoring and Enforcement of Foreign Fishing Vessels

In recent years, unauthorized fishing operations, underreporting of catches, and other malicious violations have been frequently observed in Japan's exclusive economic zone (EEZ). Because of this, the Fisheries Agency has strengthened the monitoring and enforcement in cooperation with relevant organizations, including the Japan Coast Guard.


Snow crab caught in an illegally set bottom gill net


Boarding inspection of a foreign fishing vessel (weighing)


Hazardous nighttime enforcement

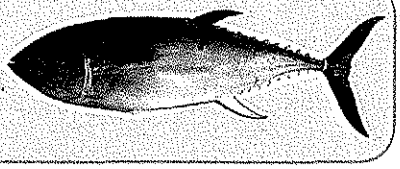
International Resource Management of Tunas

Since tunas are highly migratory species that move a vast distance across the ocean, they need to be managed by relevant countries in a cooperative manner.

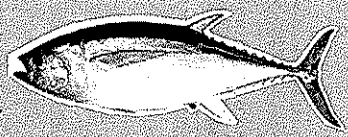
Accordingly, five regional fisheries management organizations (RFMOs) have been established for the conservation and management of these resources. Japan is a member of all five RFMOs, and contributes to international tuna resource management.

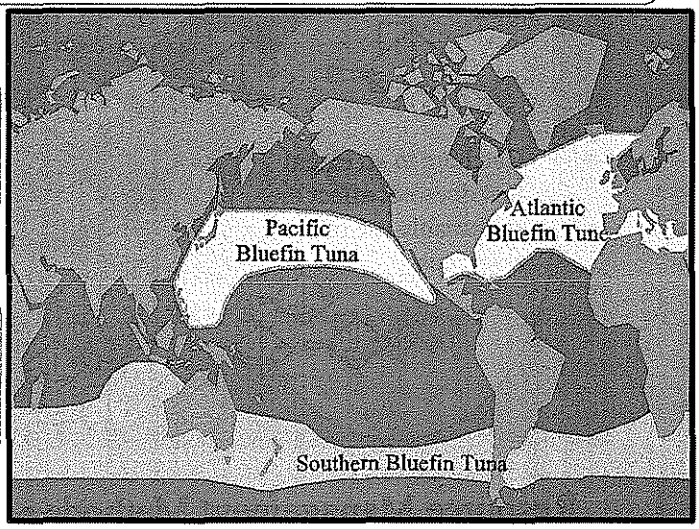
Tuna species migrating widely across the world's oceans

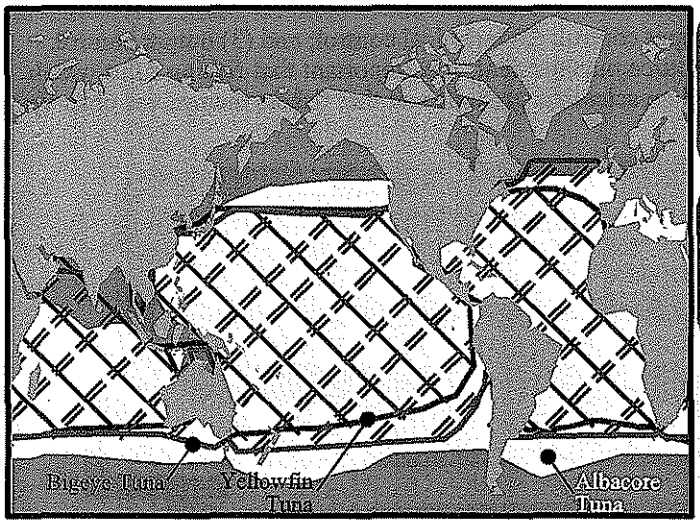
Bluefin Tuna:
Bluefin tuna is the highest quality out of all tuna species. The fish is served mostly as sashimi.

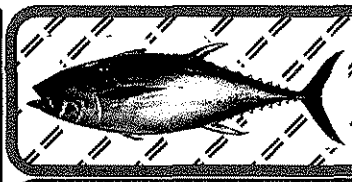


Southern Bluefin Tuna:
Southern bluefin tuna is also known as "Indian tuna." The fish is high-quality and served mostly as sashimi.

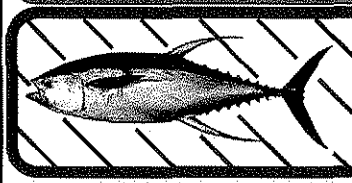








Bigeye Tuna:
Because of its wide-open eyes, the fish is called "bigeye tuna." This fish is served mostly as sashimi.



Yellowfin Tuna:
Because of its yellowish skin, the fish is called "yellowfin tuna." This fish is served as sashimi and also used for canned tuna.

Albacore Tuna:
The fish is characterized by a long pectoral fin that looks like a knife. Albacore tuna is the type of fish used for canned tuna in oil. It has also recently started being served as sashimi. The fish is also well-known as "Bincho" and "Tombo."

Source: Fisheries Research Agency.

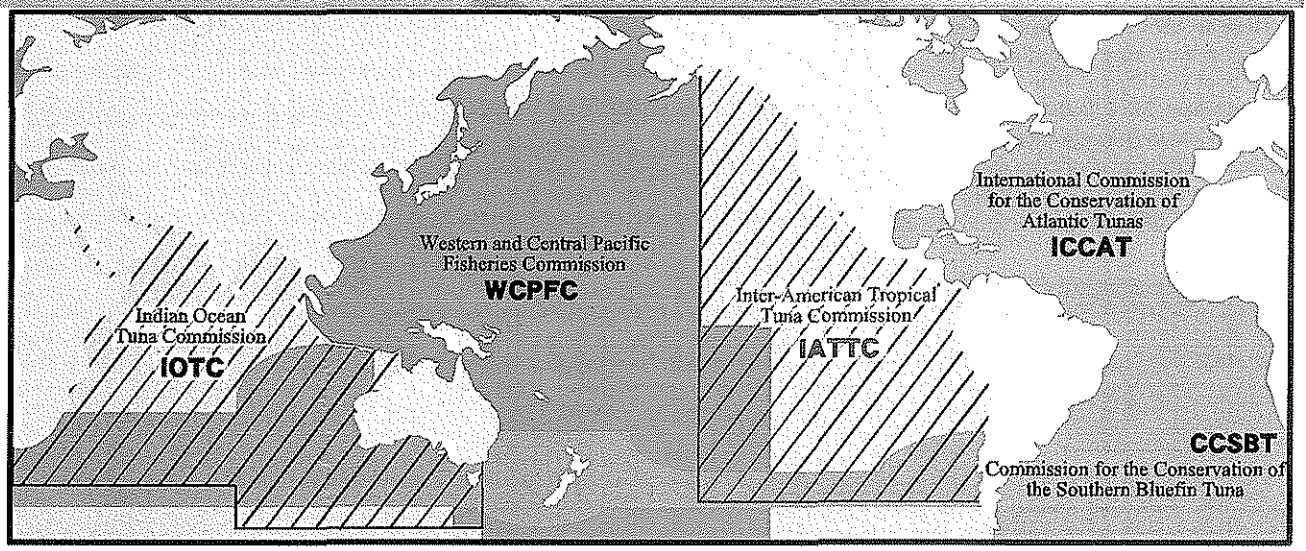
Efforts toward Sustainable Use of Whale Resources

The International Whaling Commission (IWC) adopted a moratorium on a commercial whaling in 1982. According to this moratorium, Japan suspended its commercial whaling of whale species under management by the IWC (minke whale, fin whale, sperm whale, etc.) in 1988.

The moratorium was adopted on the basis that scientific knowledge on the resource status of whales was insufficient. Accordingly, Japan has implemented whale research programs under special permits issued by the Japanese Government based on Article VIII of the International Convention for the Regulation of Whaling, and has proved that the numbers of whales have been increasing, except for certain species.

At annual meetings of the IWC, Japan has advocated that commercial whaling should be resumed for whale resources with favorable stock status and that such resources should be sustainably utilized as food.

Tuna Regional Fisheries Management Organizations and Resource Status



	IOTC Indian Ocean Tuna Commission	WCPFC Western and Central Pacific Fisheries Commission	IATTC Inter-American Tropical Tuna Commission	ICCAT International Commission for the Conservation of Atlantic Tunas	CCSBT Commission for the Conservation of Southern Bluefin Tuna
Bluefin tuna		Medium / decreasing		East: low / stable West: low / slightly increasing	
Southern bluefin tuna					Low / stable
Bigeye tuna	Medium / stable	Medium / decreasing	Low / stable	Low / stable	
Yellowfin tuna	Medium / decreasing	Medium / stable	Medium / stable	Medium / stable	
Albacore	Medium / stable	North: high / stable South: high / decreasing		North: low / increasing South: medium / decreasing	

Source: Fisheries Agency, *The Status of International Fishery Resources for 2010.*
Note: Data denote "resource level / Trends of resource level."
"Resource level" compares the current resource level with the resource levels over approximately the past 20 years, and grades the level into "high," "medium," or "low."
"Trend of resource level" grades the changes in the resource levels over the past five years into "increasing," "stable," or "decreasing."

Whales with favorable stock status

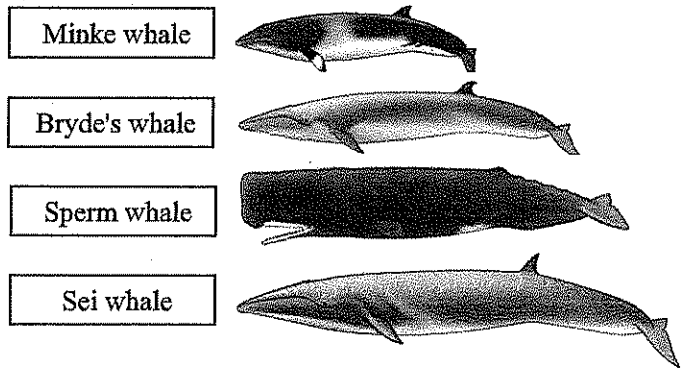
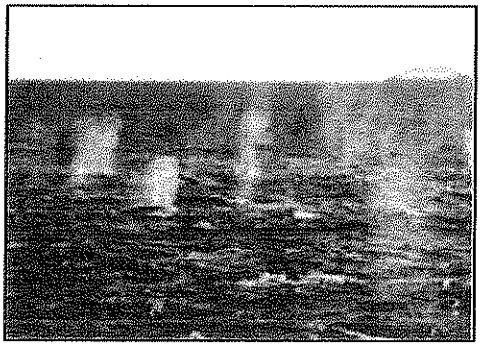


Illustration courtesy of The Institute of Cetacean Research



School of minke whales in the Antarctic Ocean
As a result of the whale research program in the Antarctic Ocean, it was found that young whales of about two to ten years old are large in number, and that minke whales have soundly increased.

(3) Stock Enhancement for Supporting Stock Reproduction

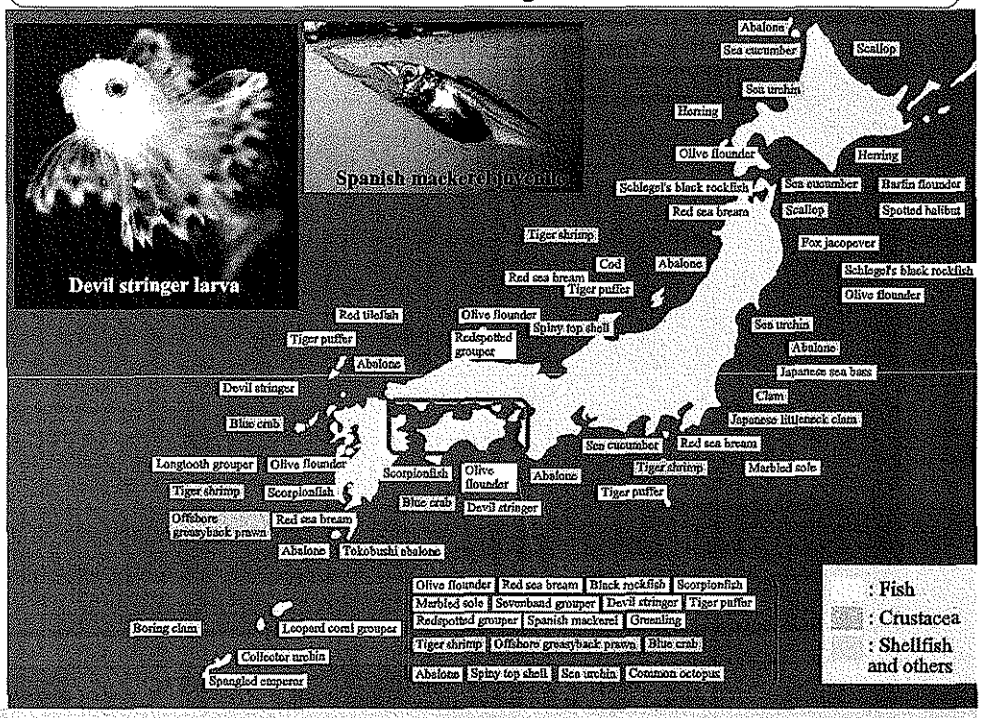
Release of Cultured Juveniles that Support Stock Enhancement

In order to increase fishery resources actively, seedlings of high-valued fishery resources are released in various locations nationwide.

There are about 80 fish species that are subject to the release of seedlings. The number of seedlings of chum salmon, red sea bream, olive flounder, and tiger shrimp released annually exceeds 10 million. Prefectures cooperate with each other in order to increase the efficiency of the release of seedlings.

(Photo courtesy of the Fisheries Research Agency)

Status of seedling releases

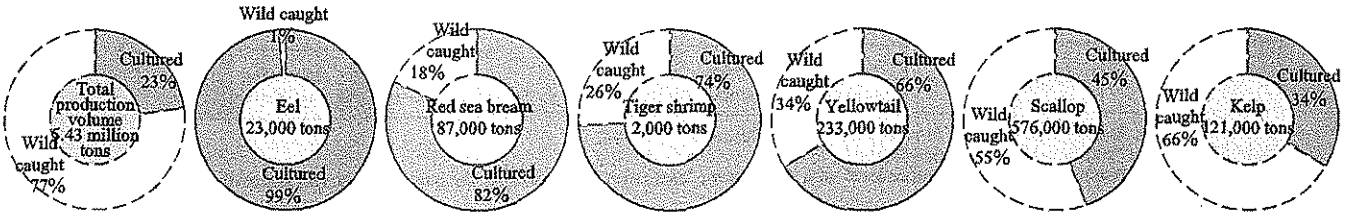


(4) Aquaculture Holds an Important Position in Japan's Fishery

Promotion of Sustainable Aquaculture Production

Aquaculture, which allows for more planned production than fishery, contributes to the stable supply of fish products. For many fish species, aquaculture holds a large share of domestic production. With regard to aquaculture, it is important to achieve sustainable production by preventing deterioration of the culture grounds and the spread of infectious diseases.

Proportion of cultured products in Japan's production volume (2009)



Source: Compiled by Fisheries Agency based on MAFF, *Annual Statistics of Fishery and Aquaculture Production.*

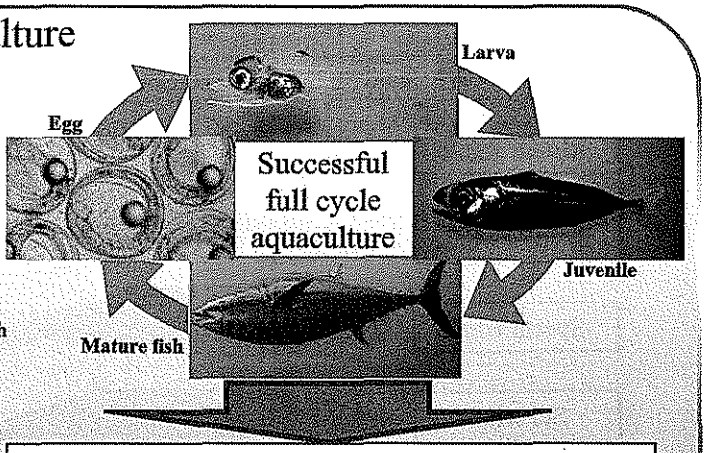
Column

Full cycle aquaculture of bluefin tuna

Bluefin tuna, which is known as high-end fish, must keep swimming in order to maintain their supply of oxygen and stay alive. They are delicate fish; their scales are frail, and even a small amount of light or noise can cause them to panic and swim into barriers, resulting in death. Furthermore, they do not necessarily spawn each year, and most juveniles do not survive. Therefore, it has been said that raising tuna through full cycle aquaculture* is a difficult challenge. Consequently, aquaculture of bluefin tuna has been carried out by catching wild fish and raising them in a pen.

The Kinki University Fisheries Laboratory has been conducting research in tuna cultivation for the past 32 years. In 2002, the laboratory succeeded in full cycle aquaculture of bluefin tuna for the first time in the world, and marked a step forward in the realization of aquaculture that does not impose a burden on natural resources.

* Aquaculture in which adult fish are raised from eggs, and then eggs are further taken from those adult fish to be raised.

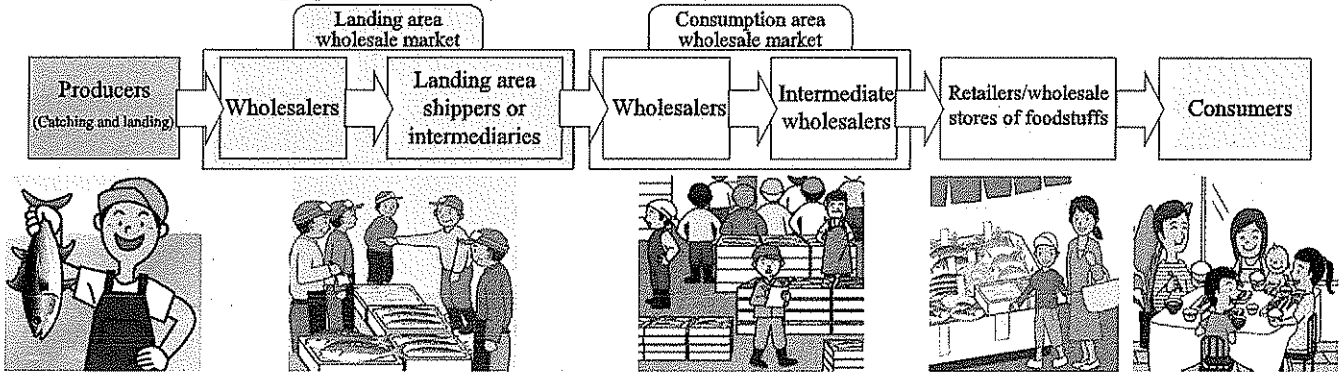


Protection of natural resources, stability of aquaculture, and stable supply of bluefin tuna

(5) Distribution and Processing of Fish Products

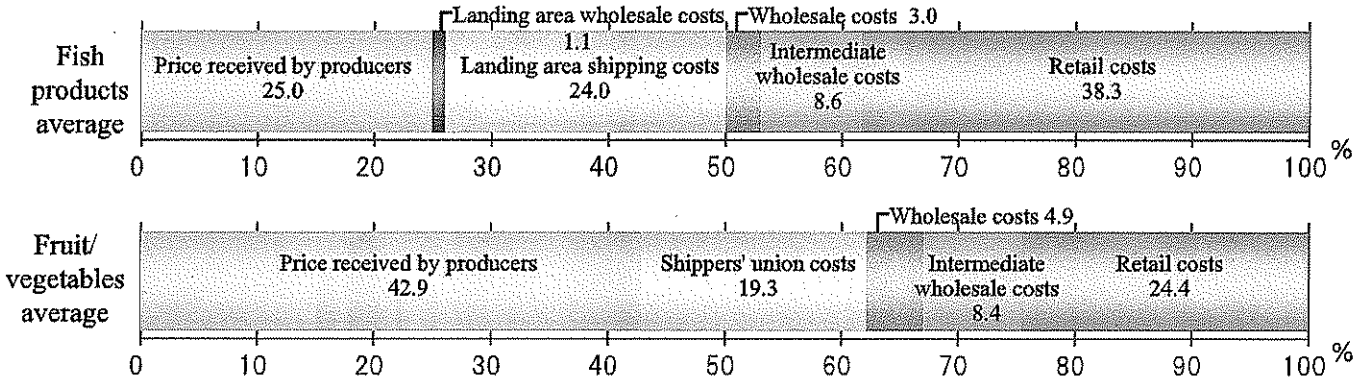
Fish Product Distribution that Has Two-tier Wholesale Markets

Fish products are characterized by the large fluctuations in their production volumes since landing is affected by weather and fishing conditions, and by the fact that a large variety of species are caught in small volumes. Therefore, fish products are distributed by first being sorted and divided into cargos in the landing area market (the wholesale market close to the fish's landing port), and then shipped to a consumption area market (the wholesale market close to an urban consumption area), and finally delivered to consumers through general retailers (fresh fish stores, etc.).



Many of the landing area markets of fish products have small transaction sizes and face problems including having little leeway for price-setting. Accordingly, they face the challenge of revitalizing transactions and increasing fishers' earnings through such measures as consolidating markets and facilities, enhancing market functions, and promoting the entry of new buyers.

Distribution of costs among distribution phases (comparison between fish products and fruit and vegetables)

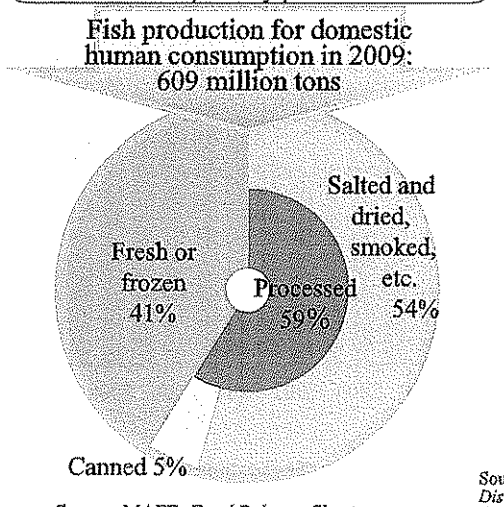


Source: MAFF, *Survey of Food Prices at Various Stages of Distribution (Survey on Fishery Product Costs)* and *Survey of Food Prices at Various Stages of Distribution (Survey on Fruit and Vegetable Costs)* (June 2010).

More than Half of Fish Distributed to the Japanese Domestic Market Is for Processing Industry

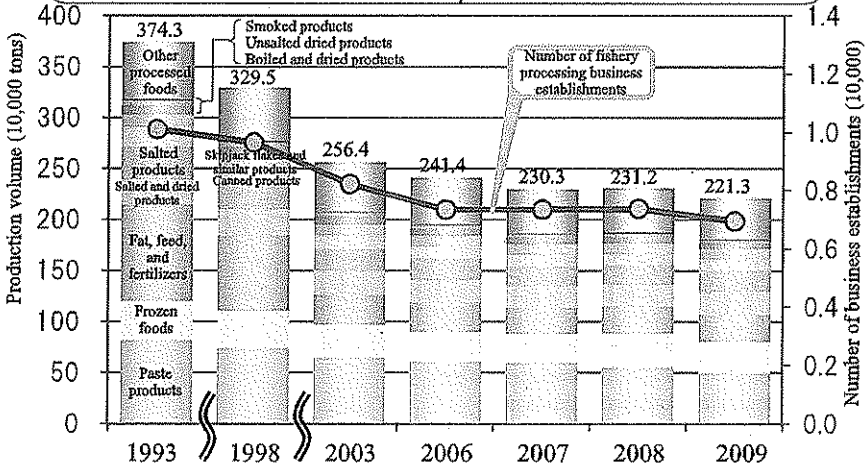
Indeed, 60% of fish and seafood for Japan's domestic human consumption was used by fishery processing industry as raw materials. While the fishery processing industry plays an important role as a key industry in fishing communities, the production volume of processed fish products has been declining, reflecting the sluggish consumption of fish products, a decrease in the number of business establishments concerned, and the destabilization of raw material supplies.

Breakdown of supply for domestic consumption by product form



Source: MAFF, *Food Balance Sheet.*

Changes in the number of fishery processing business establishments and the production volume



Sources: MAFF, *Annual Statistics on Fishery and Aquaculture Production* and *Annual Fishery Product Distribution Statistics*; Japan Canners Association, *The Canners Journal*; Japan Aquatic Oil Association, *Yearbook of Aquatic Oil Statistics*; and Ministry of Economy, Trade and Industry, *Census of Manufacturers.*

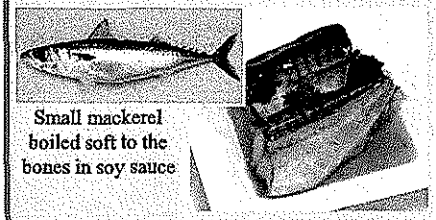
Effective Use of "Unused / Underused Fish" and Increase of Fish Products with Added Value

Efforts are made in various locations to use "unused / underused fish," which are used for non-human consumption or are sold only at low prices due to uneven fish sizes or due to a small product volume owing to a small catch, as well as to increase fish products with added value by introducing new preservation and processing technology.

These efforts are hoped to contribute to increasing Japan's food self-sufficiency ratio through raising workers' earnings in the landing area, revitalizing the local communities, and expanding consumption of fish products.

Development of processing technology

Use of small/unused fish for school meals



Small mackerel boiled soft to the bones in soy sauce

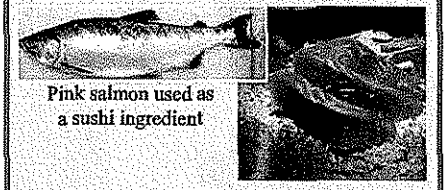
Development of serving ideas

Suggestion of new recipes

Yellowtail eaten shabu-shabu style

Making use of freezing technology

Use as food products

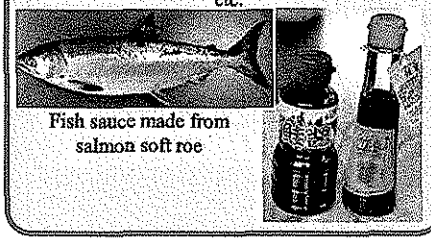


Pink salmon used as a sushi ingredient

Also chika (Japanese surf smelt) and sandfish

Broth/condiments

Processing and spreading the use of unused parts, etc.



Fish sauce made from salmon soft roe

Challenges

- Small product volume
- Difficult-to-process shape
- Large volume only available during a specific period
- Fixed serving methods
- Low recognition level

Use of unused resources — Innovative ideas — New technology

Effective use — Limited sales

Review — Rediscovery of appeal — Extracting of components

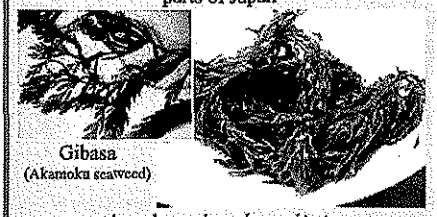
"Limited" products

Sale of products in limited regions or in limited quantities

Rice balls using dried laver collected in Tokyo Bay

Traditional dishes

Spreading of local traditional dishes to other parts of Japan



Gibasa (Akamoku seaweed)

Also salmon *chan-chan-yaki*, etc.

Use as tourism resources

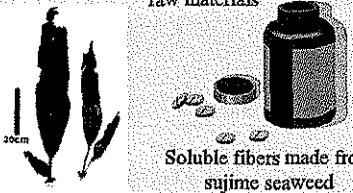
Making use of fish as tourism resources that are caught in limited areas.

Japanese grenadier in sashimi

Also red snow crab, etc.

Use as chemical raw materials

Extracting of components and use as chemical raw materials



Soluble fibers made from sujime seaweed

Also use of alginic acid from seaweed for cosmetics, etc.

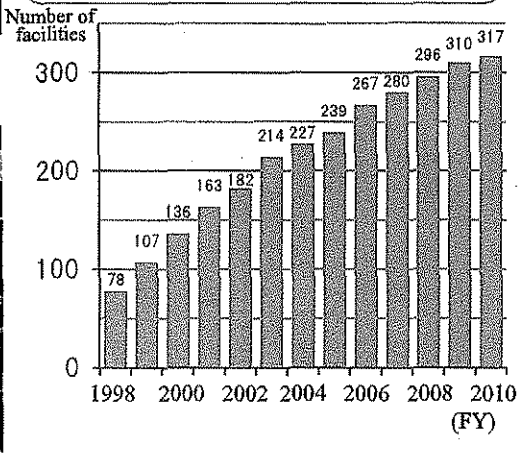
Promoting Supply of Safe and Reliable Fish Products

In order to supply safe and reliable fish products to consumers, efforts are made to strengthen hygiene management at fishing ports where fish products are landed and to introduce a quality and hygiene management system based on the HACCP* (Hazard Analysis and Critical Control Point) at fishery processing facilities.

* HACCP is a method to carry out hygiene and quality management by analyzing potential hazards and reducing or eliminating such hazards in advance in each process from raw materials to end products.

Promoting improvement of landing spaces (piers) at fishing ports and landing area wholesale markets that are shielded from outside

Changes in the number of HACCP-certified seafood processing facilities



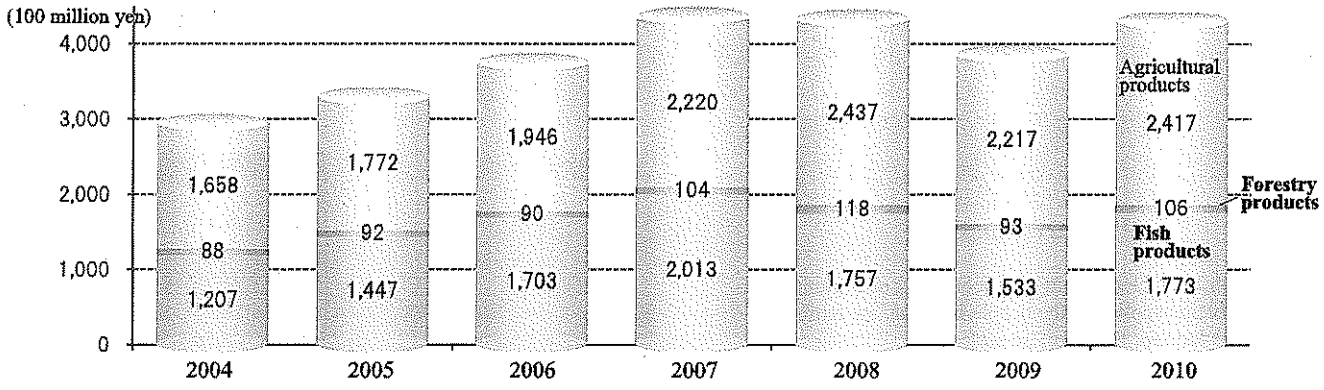
Source: Fisheries Agency survey.

Delivering Japan's High Quality Fish Products to People around the World

In recent years, exports of Japan's fish products have been increasing on the back of expansion of global demand for fish products. In 2010, the export volume of fish products was 570,000 tons, and their export value was 177.3 billion yen, accounting for about 40% of Japan's export value of agricultural, forestry, and fish products and foods.

However, export became difficult after the accident of TEPCO's Fukushima Dai-ichi NPP, since export destination countries tightened their restrictions on imports. In response to this situation, Japan is making efforts to convey accurate information on safety of Japan's fish products.

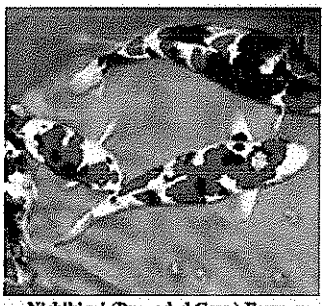
Changes in the export values of agricultural, forestry, and fish products, etc.



Source: Compiled by MAFF based on Ministry of Finance, *Trade Statistics*.

JF Hokkaido (Hokkaido Federation of Japan Fisheries Cooperative Association)
Chum salmon is exported to China and scallops are exported to the United States, EU, etc. These overseas sales channels prevent fish prices from plunging at the time of heavy catch (poor economic yield resulting from a good catch).

Azuma-cho Fishery Cooperative Association (Kagoshima prefecture)
Cultured yellowtail is exported to the United States, Chinese Taipei, Hong Kong, etc. as a sushi ingredient or sashimi product for Japanese restaurants.



Nishikigoi (Brocaded Carp) Farmers in Niigata prefecture
Brocaded carp, known as "swimming jewels," is exported throughout the world. Exports were badly affected by the 2004 Chuetsu Earthquake, but the production system has been recovered, and exports have been expanded.

Website: Measures for the Promotion of Exports of Agriculture, Forestry and Fishery Products (http://www.maff.go.jp/j/export/index.html)

Marine eco-labels

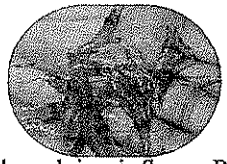
Marine eco-labels are labels attached to fish products to indicate that they have been caught by a method that gives consideration to sustainability of ecosystems and resources, with an aim to promote consumer understanding of resource management. The Marine Stewardship Council (MSC), headquartered in the United Kingdom, commenced certification in 1997. In Japan as well, the Marine Eco-Label Japan (MEL Japan) introduced the marine eco-label in 2007.

○Marine Stewardship Council (MSC)

Kyoto Danish Seine Fishery Federation snow crab and flathead flounder, and Tosakatsuo Suisan pole and line skipjack tuna are certified (as of September 2011).

○Marine Eco-Label Japan (MEL Japan)

Thirteen types of fisheries are certified, including the red snow crab fishery in the Sea of Japan, the sakura shrimp two-boat trawl fishery, the Jusanko freshwater clam fishery, and the sand lance seine fishery (as of September 2011).



Sakura shrimp in Suruga Bay caught by resource management-type fisheries

5. Our Relationship with Fishing Industry and Fishing Communities

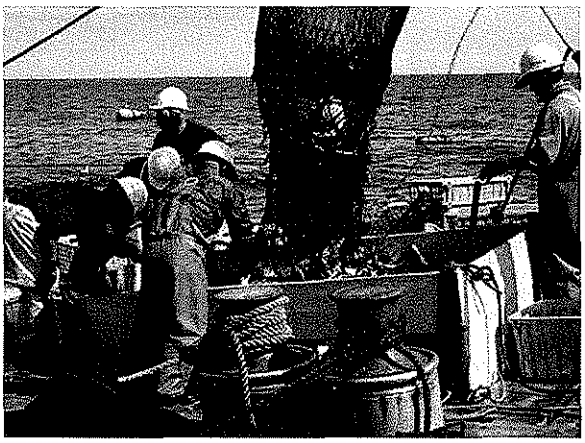
(1) Diverse Roles Played by the Fishing Industry and Fishing Communities

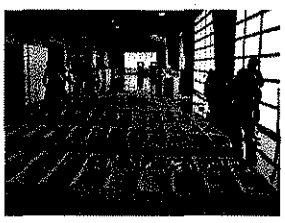
The fishing industry plays the role of harvesting fish and seaweed that grow in the sea, putting them on the processing/distribution routes, and delivering them to our dining tables. Apart from such primary function to supply fish products, the fishing industry and fishing communities have many functions (multi functions), as shown below.

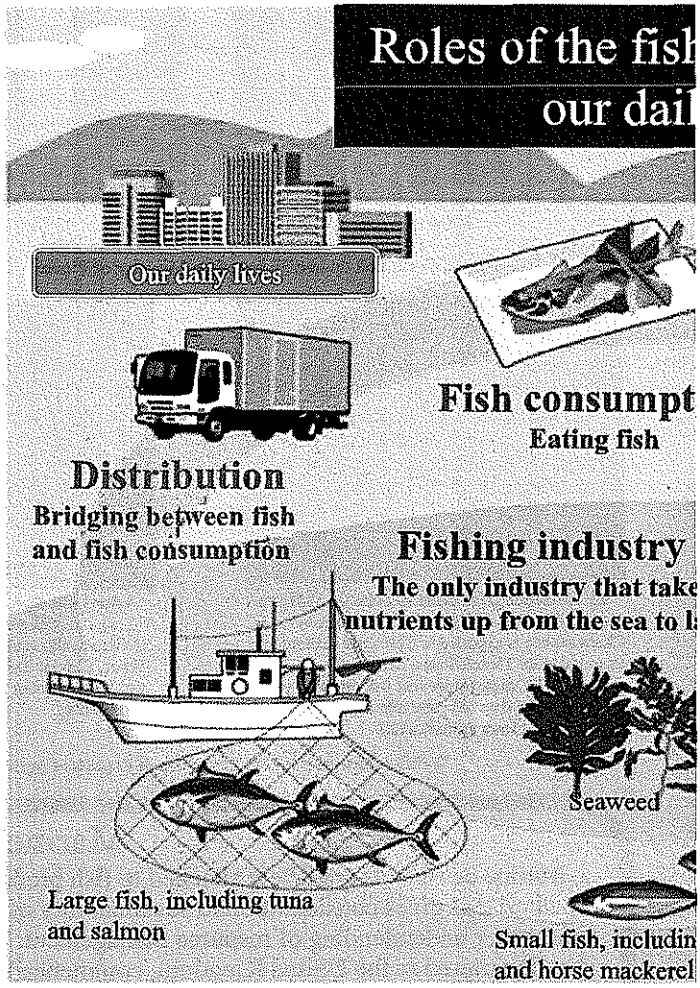
Providing a stable supply of fish products
(Primary function)

Fish products, which account for about 40% of the animal-based protein supplied to the people in Japan, are extremely important food for the Japanese-style diet.

The primary role of the fishing industry is to provide a stable supply of fresh and safe fish products to people.



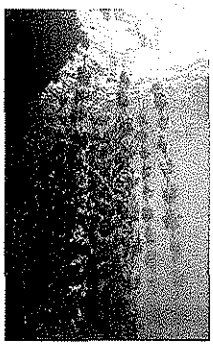


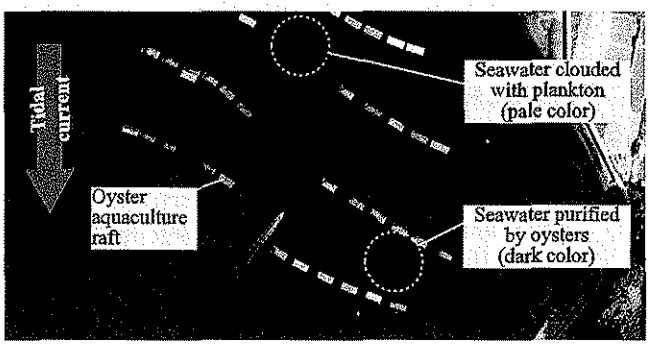


Purifying water

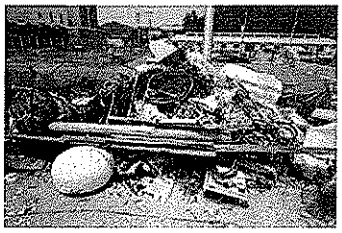
Bivalve mollusks, such as clams and oysters, help to purify seawater by feeding on plankton.
It is reported that a single oyster filters about 400 liters of seawater a day.

Photo on the left:
Cultured oysters that are being hung from a raft like a curtain
Photo on the right:
Seawater being purified after passing through oyster rafts

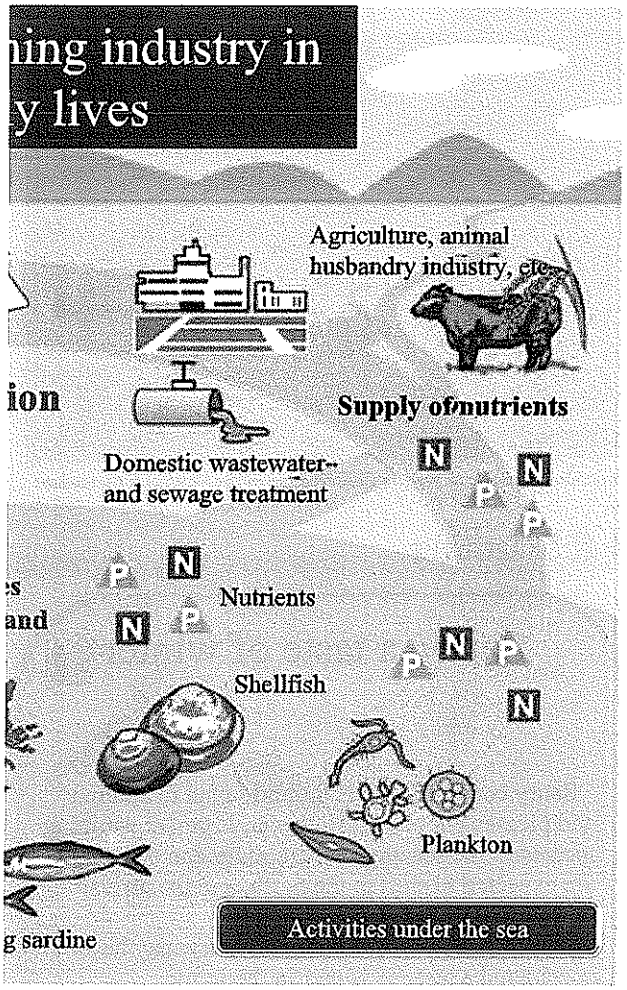




Conserving marine environment



The fishing industry has a role to collect nutrients (nitrogen and phosphorus) ingested by sea organisms through the food chain up onto land, and to prevent the eutrophication of the oceans.
In addition, the fishing industry has a role to contribute to the improvement and conservation of the environment in coastal areas through efforts such as the collection of sea-bottom debris that have been caught in fishing nets.
Photo: Sea-bottom debris collected by fishers



Preserving traditional culture

Photo: Dynamic local ritual conducted on the sea by fishing vessels [Kanmai festival in Iwaishima, Yamaguchi prefecture]

Photo: Sacred music and dance offered while crossing the sea [Kanmai festival in Iwaishima, Yamaguchi prefecture]

In the times when land transportation infrastructure was insufficient, fishing communities served as the core of marine transportation, and developed unique cultures that still remain today in various locations.

Providing opportunities for cultural and rural exchange

Photo: Set net fishing learning program for elementary school students [Iwate prefecture]

Photo: Expedition to the Tokyo Bay tidal flats [Chiba prefecture]

The fishing industry and fishing communities also provide opportunities for urban visitors to enjoy ocean recreation activities and where children can learn about the roles of the sea, and about the local fishery and culture through experiencing nature.

Sea rescue, marine environment, and border patrol

If an accident occurs at sea, nearby fishers stop their work, and come to the rescue above anything else.

Fishers also perform voluntary patrols at fishing grounds in order to protect fishery resources from fish poaching. These kinds of activities contribute to the discovery of illegal immigrants and suspicious unidentified vessels.

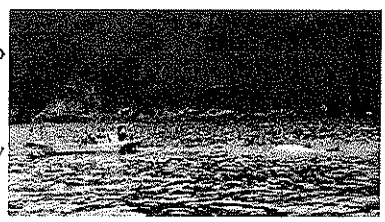
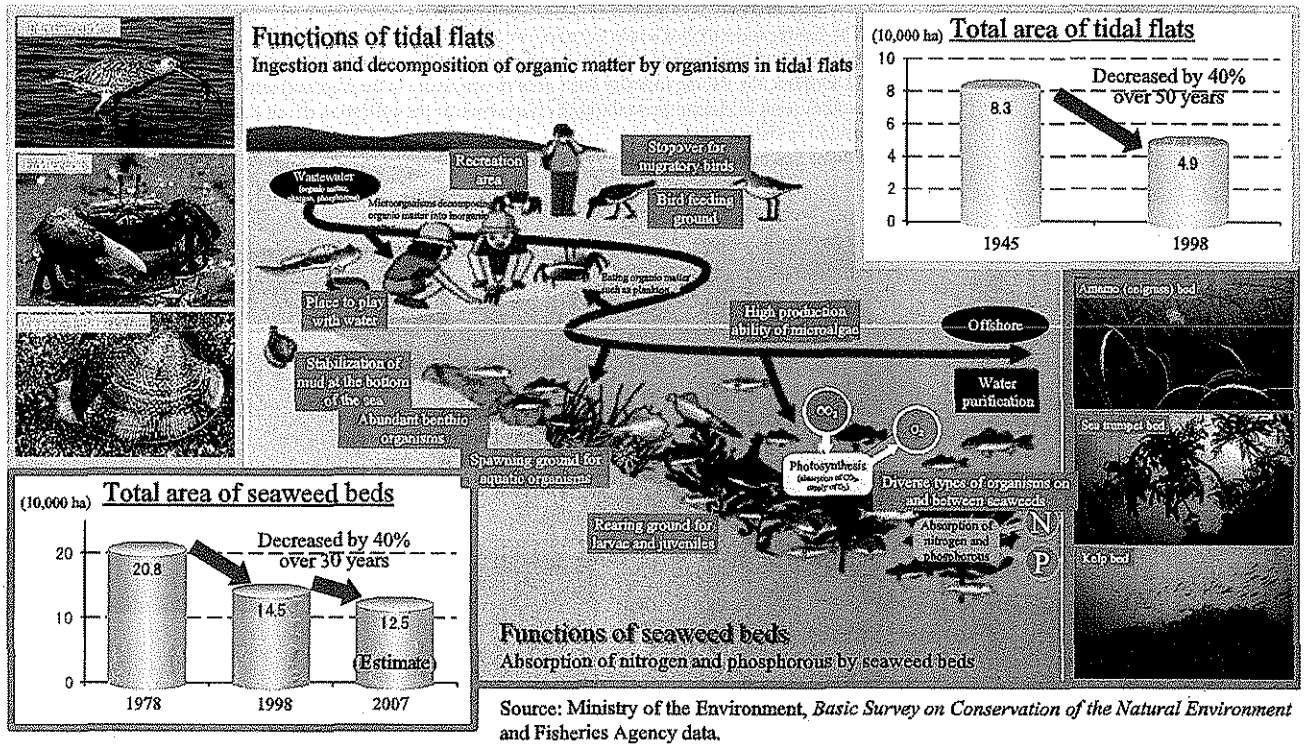


Photo: Fishing boat towing a capsized boat (right)

(2) Environmental Problems of the Sea

Decrease of Seaweed Beds and Tidal Flats

The areas of seaweed beds and tidal flats, which are grounds for fish spawning and growth as well as places that have water purification capabilities, have decreased substantially due to such reasons as development of coastal areas.

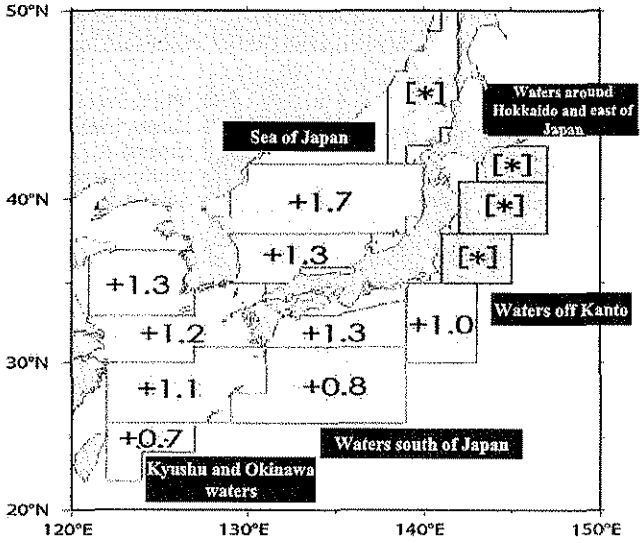


Source: Ministry of the Environment, *Basic Survey on Conservation of the Natural Environment* and Fisheries Agency data.

Concerns about the Effects of Global Warming

In waters around Japan, a rise in sea surface temperature has been reported. Consequently, there have been concerns about how changes in the marine environment caused by global warming will affect fisheries.

Long-term changing trend of average seawater temperature (annual average) of waters around Japan (°C/100 years)



Source: Japan Meteorological Agency, *2008 Examination of Marine Health—Long-Term Trends in Sea Surface Temperatures.*

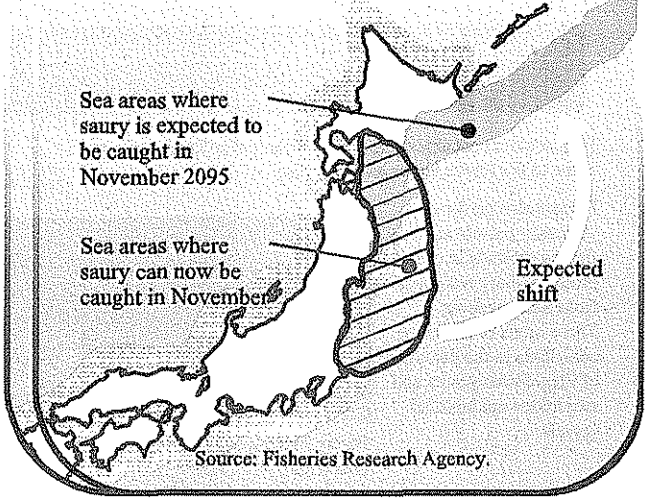
Notes:
1) The values denote the rates of increase per 100 years (°C/100 years) in the annual average sea surface temperatures.
2) For the regions indicated with an asterisk mark [*], no statistically significant long-term changing trends were observed in the annual average seawater surface temperatures.
3) The Sea of Okhotsk is excluded from this analysis because data in and before the 1960s are insufficient.

Saury, a taste of winter

autumn

Saury comes to waters around Japan in autumn and pleases our palate. However, if global warming increases, the sea areas where saury can be caught are expected to shift to the north, and the arrival season will be delayed.

Rather than a taste of autumn, Saury may be considered a taste of winter in the future.



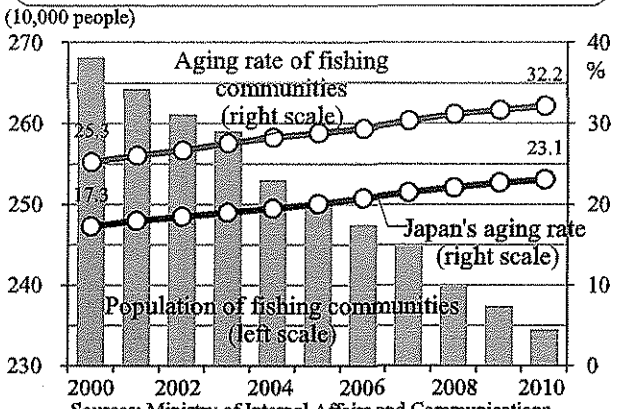
Source: Fisheries Research Agency.

(3) Current Status of Fishing Communities in Japan

Many Fishing Communities being Located in Geographically Disadvantaged Areas

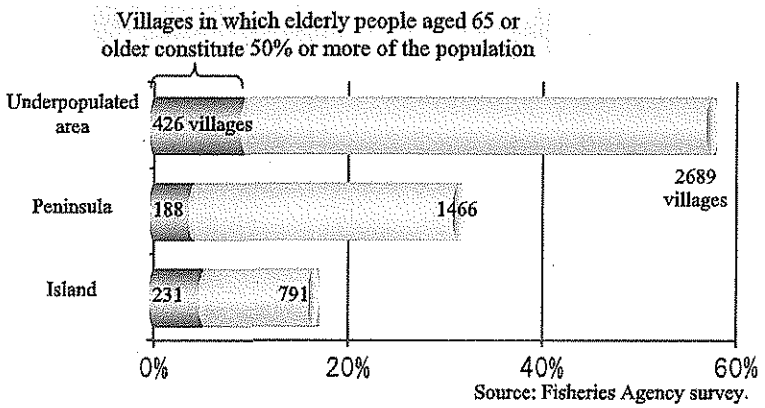
Looking at the location of fishing communities in Japan, many were located in geographically disadvantaged areas, with 20% of fishing port villages being located on islands, 30% located on peninsulas, and 60% located in underpopulated areas. In addition, the proportion of elderly people aged 65 or older (aging rate) in fishing communities is higher than that of the national average. On islands, 30% of the fishing port villages have an aging rate of 50% or more.

Changes in the aging rate of fishing communities and Japan



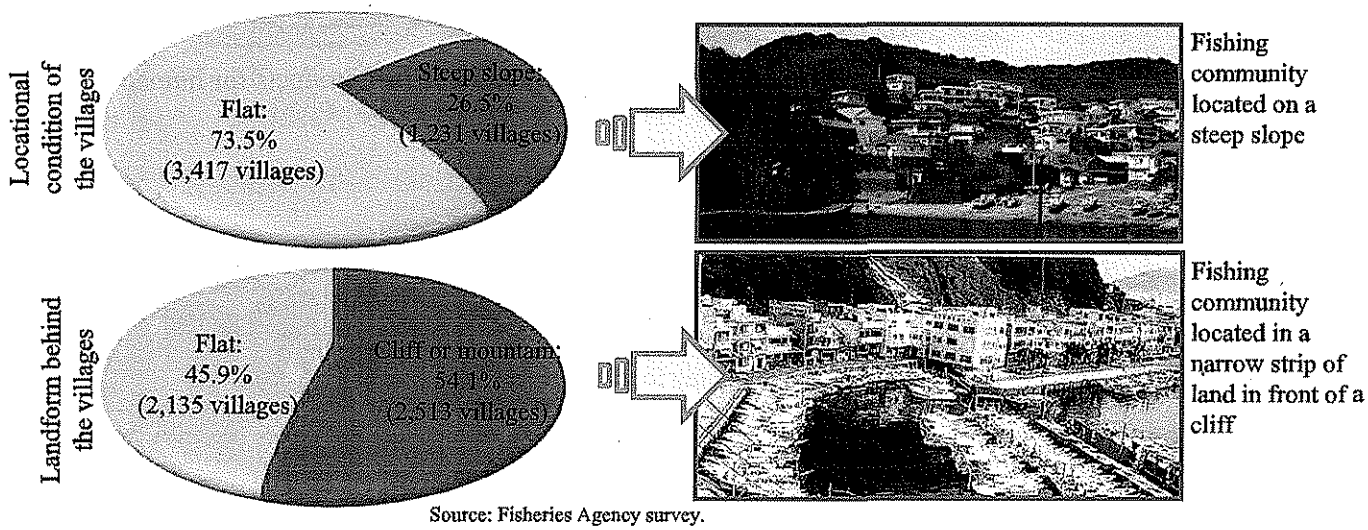
Sources: Ministry of Internal Affairs and Communications, *Population Census* and Fisheries Agency survey.

Aging rate of fishing port villages by type of area



Source: Fisheries Agency survey.

Locational condition of the fishing port villages

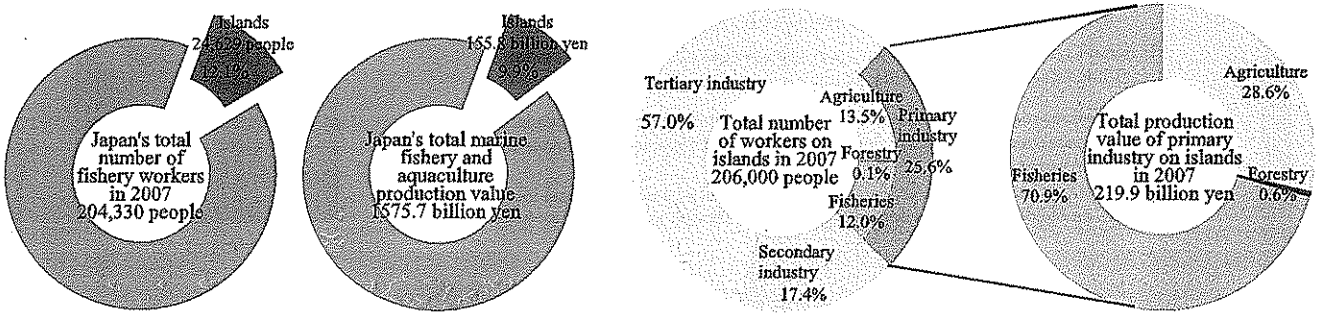


Source: Fisheries Agency survey.

Fishing Industry Serving as a Key Industry Supporting Geographically Disadvantaged Areas

Islands account for 12.1% of Japan's total number of fishery workers, and 9.9% of Japan's total marine fishery and aquaculture production value. The fishing industry plays the role to support geographically disadvantaged areas, such as islands and peninsulas, as a key industry. For example, the fishing industry accounts for 70% of the primary industry production value on islands.

Positioning of the fishing industry on islands



Sources: Compiled by Fisheries Agency based on National Institute for Japanese Islands, *Annual Statistics on Remote Islands* (2007) and MAFF, *Annual Statistics on Fishery and Aquaculture Production* (2007).
Note: Data are those surveyed for the 261 islands of which areas are designated under the Remote Islands Development Act.

(4) In Order to Support the Fishing Industry and Fishing Communities (Efforts by Individual People in Japan)

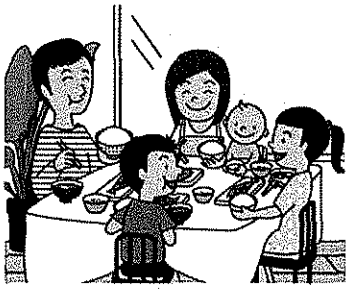
Eating Fish with High Resource Levels

Such fish species as saury and skipjack in waters around Japan are currently high in resource levels as well as relatively low-priced and full of seasonal flavor. Eating fish in season also leads to increasing Japan's self-sufficiency ratio.

If individual people in Japan eat more quantities of the fish species below in the respective seasons, Japan's self-sufficiency ratio will rise!

If all of these quantities are achieved, the self-sufficiency ratio of fish products for human consumption will rise by 4%!

Consuming Domestic /Local Fish



Eating domestic/local fish leads to supporting Japan's fishing industry, which plays many roles, including food supply and environmental conservation.

Being Conscious of Our Connection with the Sea: Participation in Environmental Conservation Activities

Urban residents are taking part in efforts to revive a rich sea together with local residents in various locations. Why not participate in such activities and make it a chance to think about how we are linked with the sea?

Case

Restoring the abundance of the Inland Sea of Japan through the regeneration of Amamo (eelgrass) beds

Regional Council for the Maintenance and Management of Seagrass Beds in the Iwagi-Ikina Region [Kamijima-cho, Ehime prefecture]

The Iwagi-Ikina region of Kamijima-cho, Ehime prefecture is one of the few places where Amamo (eelgrass) beds remain in the Inland Sea of Japan. Efforts are being made in the region to protect these Amamo beds.

Various sectors, including fishers, fishery research institutes, companies, and local elementary, junior high, and high schools are cooperating with each other to restore Amamo beds.

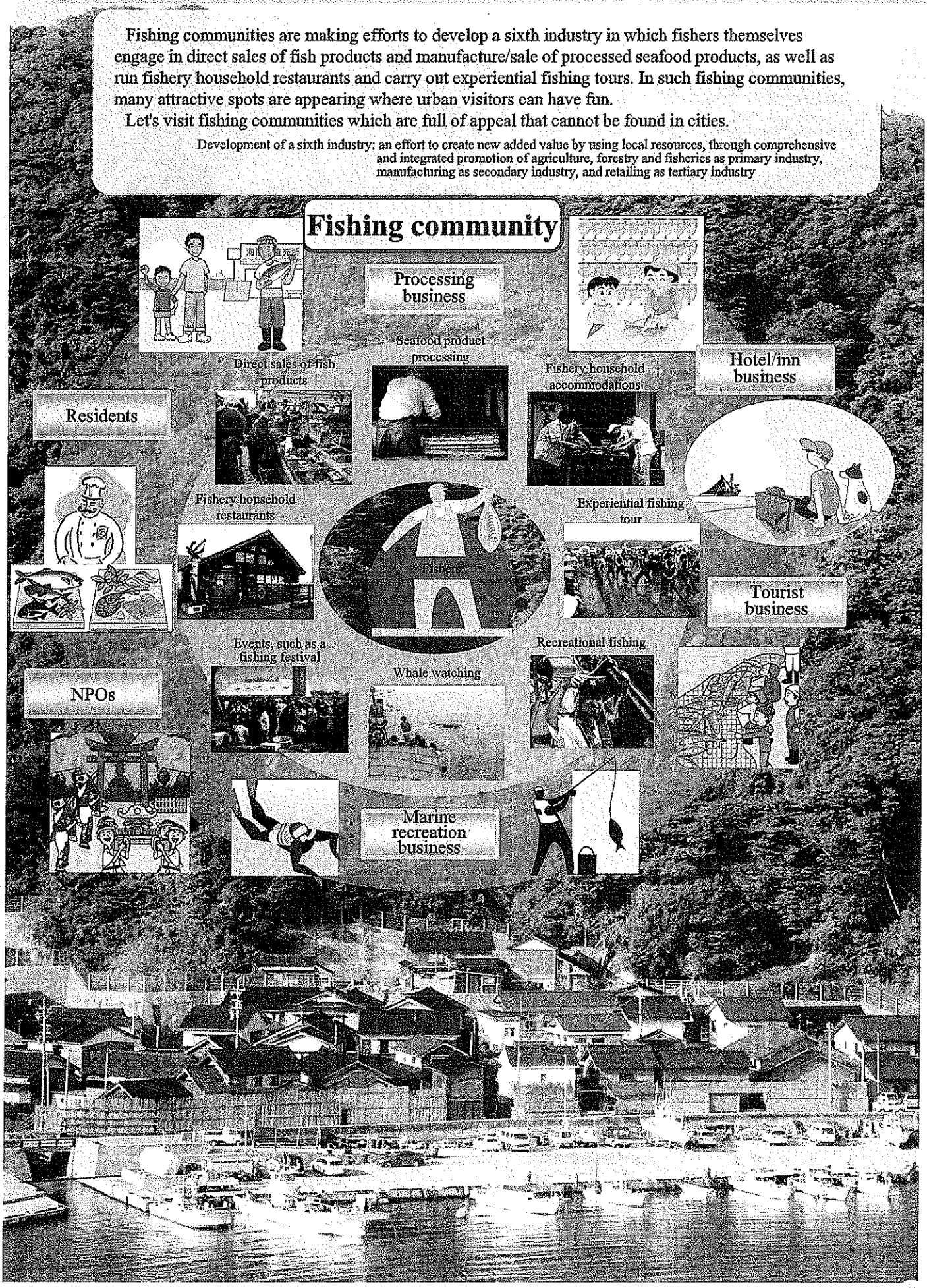
Planting of Amamo

Let's Go and Visit the Sea and Fishing Communities!

Fishing communities are making efforts to develop a sixth industry in which fishers themselves engage in direct sales of fish products and manufacture/sale of processed seafood products, as well as run fishery household restaurants and carry out experiential fishing tours. In such fishing communities, many attractive spots are appearing where urban visitors can have fun.

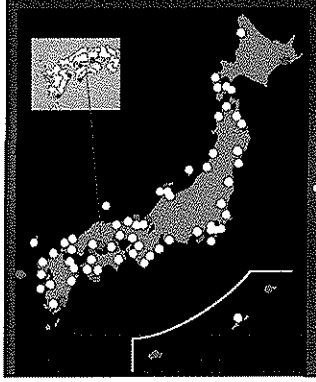
Let's visit fishing communities which are full of appeal that cannot be found in cities.

Development of a sixth industry: an effort to create new added value by using local resources, through comprehensive and integrated promotion of agriculture, forestry and fisheries as primary industry, manufacturing as secondary industry, and retailing as tertiary industry



1-2-1 Kasumigaseki, Chiyoda-ku, Tokyo, Japan 100-8907
TEL. +81-3-3502-8111 (Ext. 6578)
Fisheries Agency Website http://www.jfa.maff.go.jp/e/index.html
(For inquiries regarding this pamphlet, contact: Trend Analysis Section, Policy Planning Division, Fisheries Policy Planning Department, Fisheries Agency)

Facilities of stock enhancement

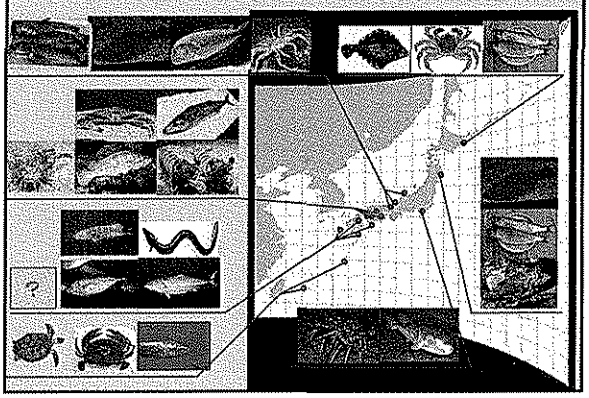


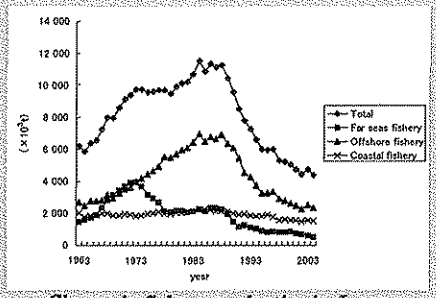
- 16 national centers
- 57 prefectural centers

Numbers of target species for the stock enhancement program

	Primary stage (1960's)	2010
Fish	8	39
Crustacean	2	13
Molluscs	7	29
Echinoderm	1	7

Major objective species of the F.R.A stock enhancement centers





Change in fishery production in Japan

Legislations

Stock enhancement program in Japan is based on the

" Coastal Fishing Ground Improvement and Development Law "(Article 6.1-6.4)

enacted in 1974.

The objectives of the " Coastal Fishing Ground Improvement and evelopment Law " is

to systematically develop and improve coastal fishing ground by construction of artificial reefs and to release juveniles.

The law states

The Minister of Agriculture, Forestry and Fisheries shall stipulate the basic principles concerning the production and release of juveniles of fisheries animals in accordance with the stipulations of government ordinances, after gathering the opinions of the *Coastal Fisheries Promotion Council*, in order to contribute to the increase productivity of coastal fishing ground.

The stock enhancement programs now under way are being carried out according to the *basic principles (the Sixth)* stipulated for the 5-year period from 2010 to 2014.

The prefectural governments shall make the *basic plans* for five years according to the *basic principles*.

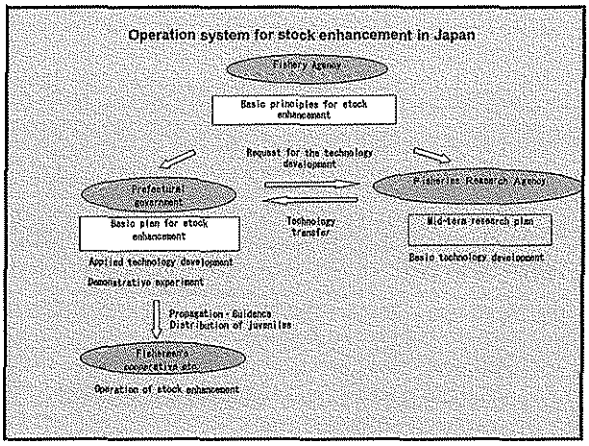
The roles(basic) in the stock enhancement

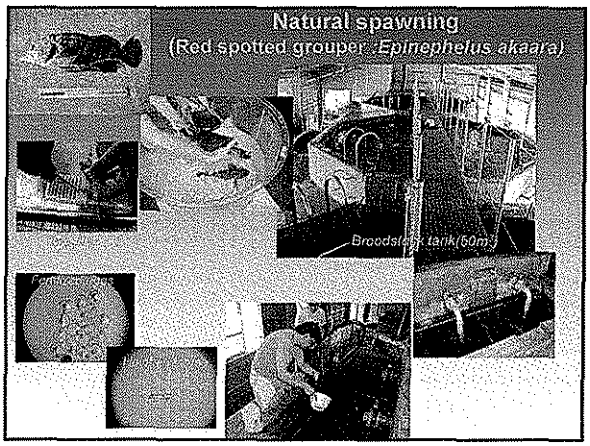
	Technology development	Business level action
Migratory species (fish, crustacean etc)	National centers Prefectural centers	(National centers)・ Prefectural centers・ Public corporations・ Fishermen's cooperatives
Non migratory Species (shellfish, sea urchin, etc)	Prefectural centers (National centers)	(Prefectural centers)・ Public corporations・ Fishermen's cooperatives

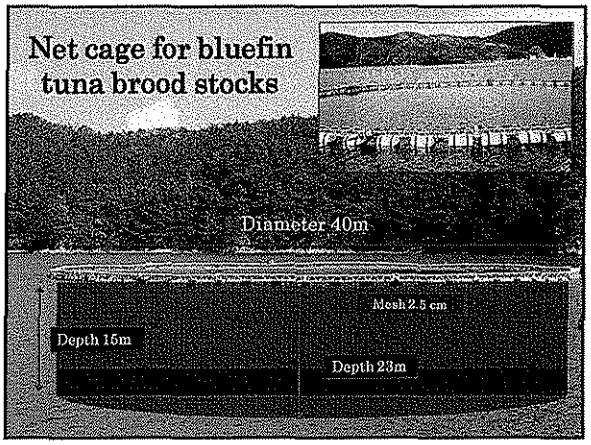
Management of the centers

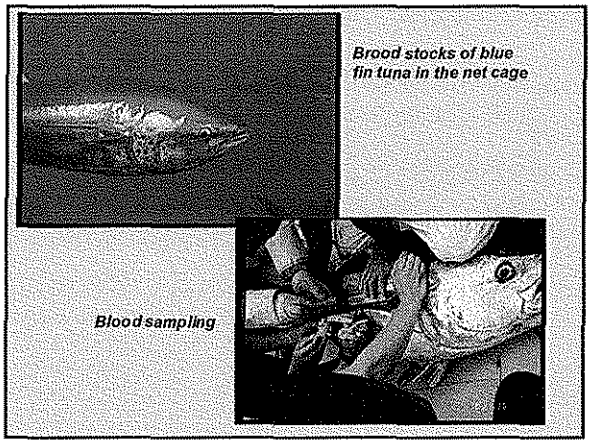
	Facilities	Running expenditure
National centers(F.R.A)	national budget	national budget
Prefectural centers	prefectural budget national subsidy	prefectural budget national subsidy
Public corporative centers*	prefectural budget national subsidy	interest on the fund income prefectural subsidy

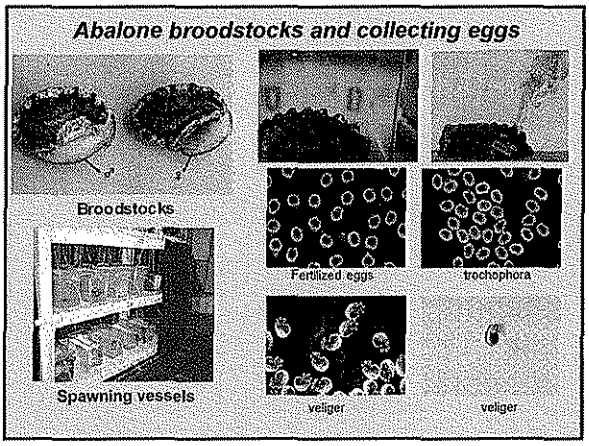
*: tax preferences

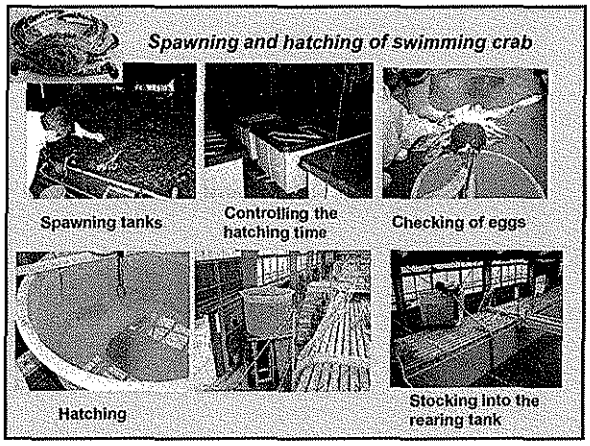


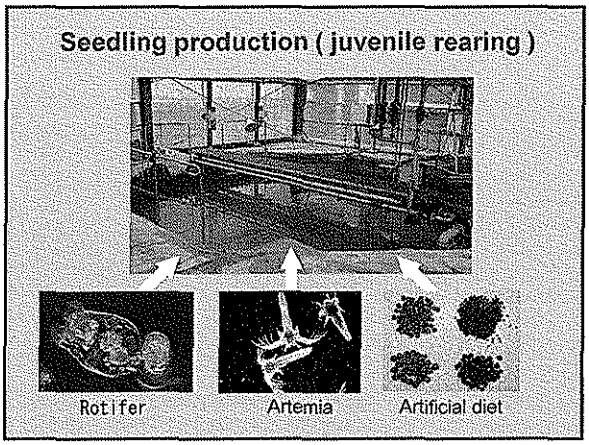


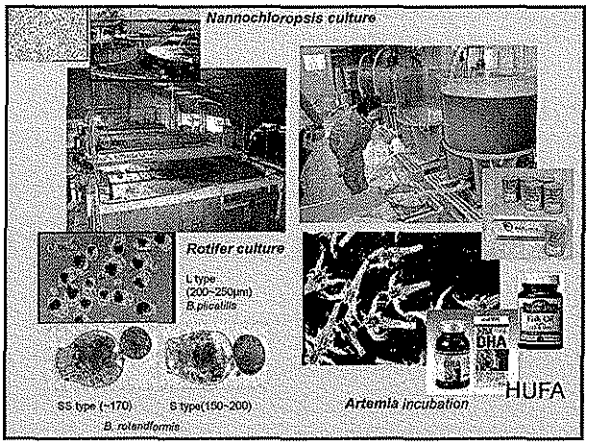

Net cage for bluefin tuna brood stocks
Diameter 40m
Mesh 2.5 cm
Depth 15m
Depth 23m

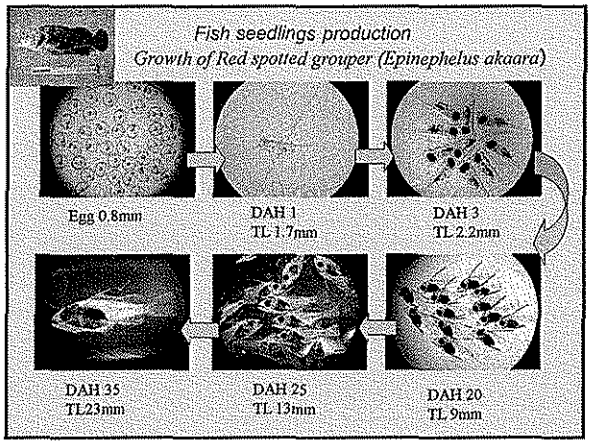

Brood stocks of blue fin tuna in the net cage
Blood sampling

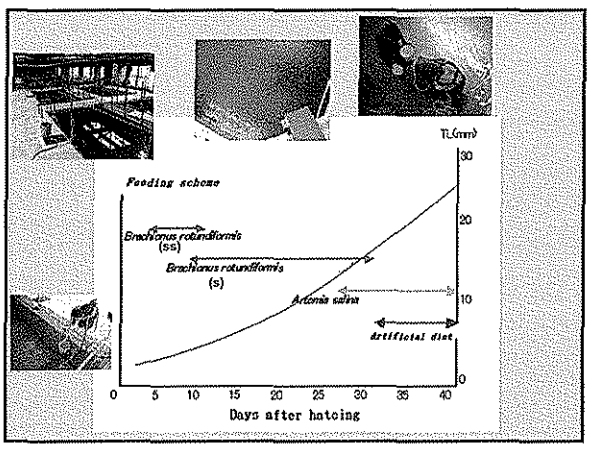

Abalone broodstocks and collecting eggs
Broodstocks
Fertilized eggs
trochophora
Spawning vessels
veliger
veliger

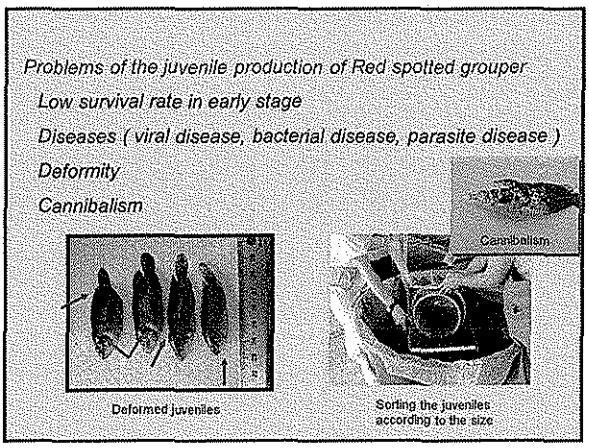

Spawning and hatching of swimming crab
Spawning tanks
Controlling the hatching time
Checking of eggs
Hatching
Stocking into the rearing tank

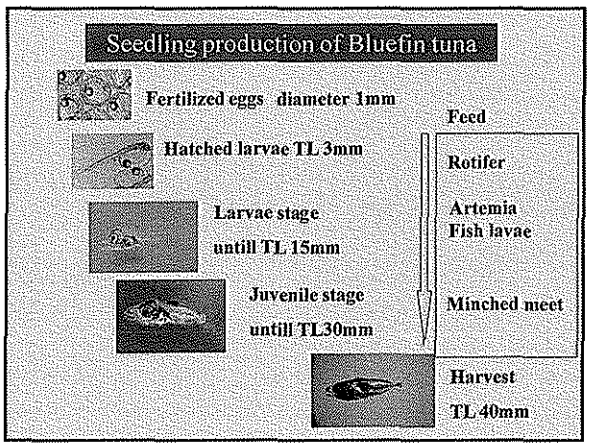

Seedling production (juvenile rearing)
Rotifer
Artemia
Artificial diet

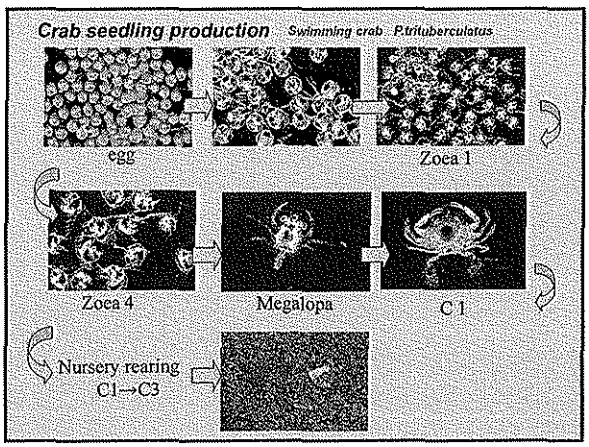

Nannochloropsis culture
Rotifer culture
L type (200~250μm) B.plicatilis
SS type (~170)
S type(150~200)
B. rotendiformis
Artemia incubation
DHA
HUFA

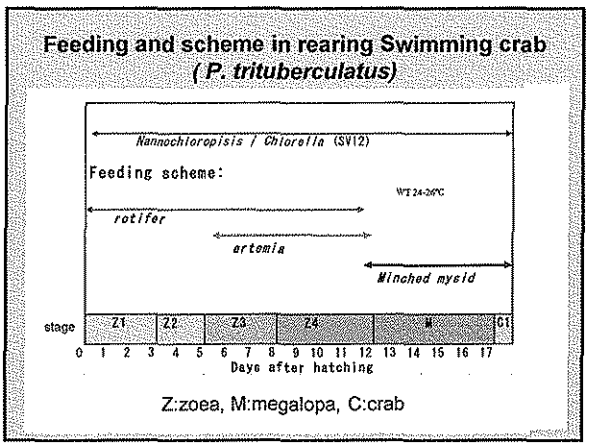

Fish seedlings production
Growth of Red spotted grouper (Epinephelus akaara)
Egg 0.8mm
DAH 1
TL 1.7mm
DAH 3
TL 2.2mm
DAH 35
TL23mm
DAH 25
TL 13mm
DAH 20
TL 9mm

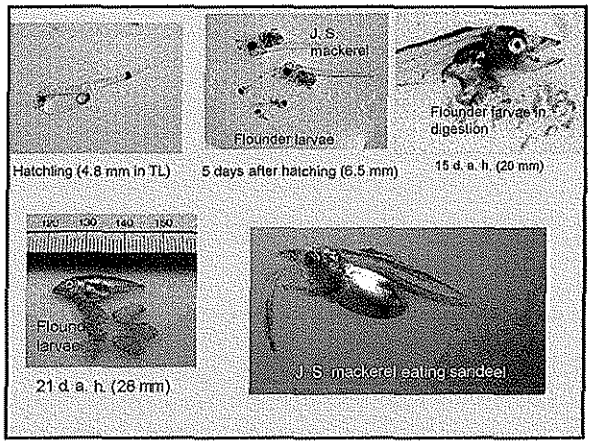

Feeding scheme
Brachionus rotundiformis (ss)
Brachionus rotundiformis (s)
Artemia salina
artificial diet
TL(mm)
Days after hatcing

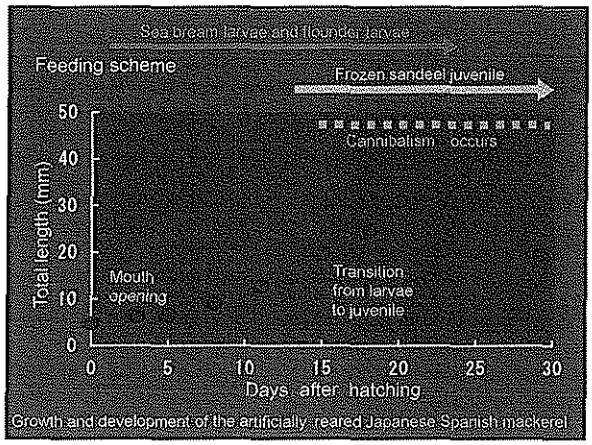

Problems of the juvenile production of Red spotted grouper
Low survival rate in early stage
Diseases (viral disease, bacterial disease, parasite disease)
Deformity
Cannibalism
Cannibalism
Deformed juveniles
Sorting the juveniles according to the size

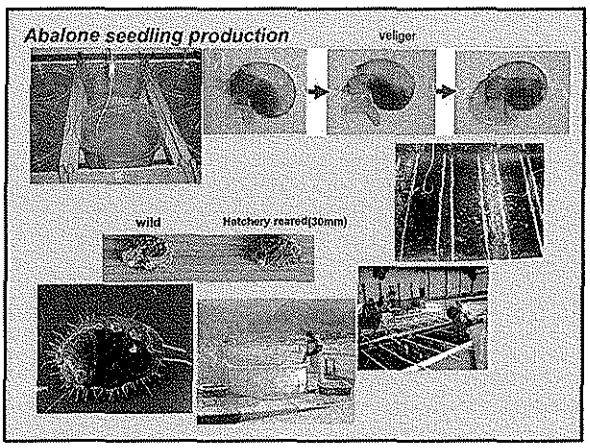

Seedling production of Bluefin tuna
Fertilized eggs diameter 1mm
Hatched larvae TL 3mm
Larvae stage untill TL 15mm
Juvenile stage untill TL30mm
Harvest TL 40mm
Feed
Rotifer
Artemia
Fish lavae
Minched meet

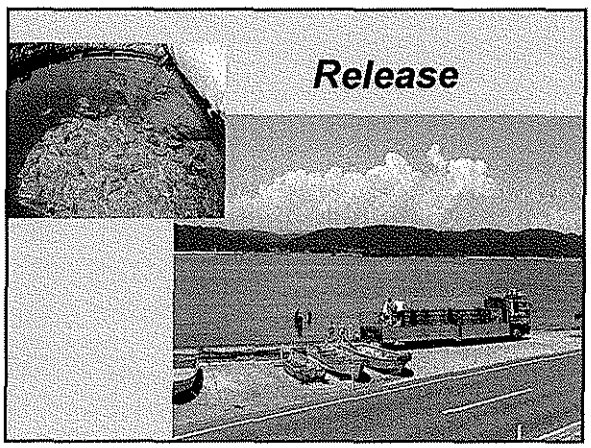

Crab seedling production
Swimming crab P.trituberculatus
egg
Zoea 1
Zoea 4
Megalopa
C 1
Nursery rearing
C1→C3


Feeding and scheme in rearing Swimming crab
(P. trituberculatus)
Nannochloropisis / Chlorella (SV12)
Feeding scheme:
WT 24-26℃
rotifer
artemia
Minched myeid
stage
Z1
Z2
Z3
Z4
M
C1
Days after hatching
Z:zoea, M:megalopa, C:crab





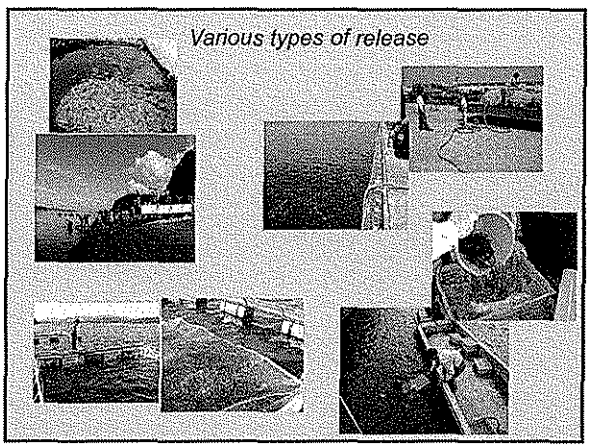




The factors of the release

- ***Size of the juvenile***
- ***Release place***
- ***Release time (season)***
- ***Procedures***

make great difference in the survival rate after release



markings

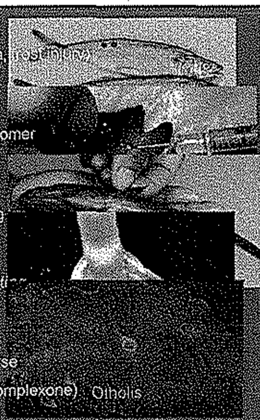
The purpose of the markings

- Investigation of the migration, behavior, growth, etc.
- Research of the landings at the fish market
  distinguish the released juveniles from the wild

Marking methods grouping

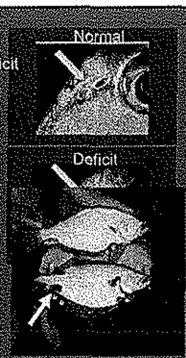
1. Tagging
   - External
     - *Spaghetti tag*
     - Dart tag
     - Ribbon tag
   - Internal — CWT (Coded Wire Tag)

2. Marking
   - External
     - Brand (iron, ...
     - Color elastomer
     - Fin clipping
     - Uropod cutti...
   - Internal — ALC immerse (Alizarin Complexone)



3. Deformity
   - Internostril epidermis deficit
   - Body color in flatfishes

4. Genetic marking
   - Isozyme
   - DNA
     - Mitochondria
     - Micro satellite



The conditions of a good marking

- **Less influence to the juveniles**
- **Easy to mass attach**
- **Low cost**
- **Hard to fall off**
- **Easy to recognize**
- **Identified individually**

No perfect markings to fulfill all of these conditions

Combine them according to the purpose

Table 1 The production and the stocking of the major species in 2004

Species	Scientific name	Number of juveniles produced (×10³)	Number of juveniles stocked (×10³)
Fish			
Pacific herring	*Cluppea pallasi*	5,165	4,534
Pacific cod	*Gadus macrocephalus*	886	722
Japanese tilefish	*Branchiostegus japonicus*	488	41
Striped jack	*Pseudocaranx dentex*	258	184
Bluestreak emperor	*Lethrinus nebulosus*	124	68
Japanese striped knifejaw	*Oplegnathus fasciatus*	46	49
Sea bass	*Lateolabrex japonicus*	288	357
Japanese croaker	*Nibea japonica*	139	131
Red spotted grouper	*Epinephelus akaara*	376	215
Kelp grouper	*Epinephelus briuneus*	110	29
Blue spotted grouper	*Plectropomus leopardus*	16	6
Black sea bream	*Acanthopagrus schlegeli*	4,441	3,331
Red sea bream	*Pagrus major*	23,815	19,594
Sandfish	*Arctoscopus japonicus*	7,107	8,751
Bluefin tuna	*Thunnus thynus*	2	0
Flathead	*Platycephalus*	69	80
Jacopever	*Sebastes shlegeli*	809	934
Marbled rockfish	*Sebastiscus marmoratus*	2,337	2,164
Devil stringer	*Inimicus japonicus*	1,117	1,009
Japanese flounder	*Paralichtys olivaceus*	35,814	24,725
Mud dab	*Limanda yokohamae*	3,203	2,284
Ocellate puffer	*Takifugu rubripes*	7,960	7,398

Table 2 The production and the stocking of the major species in 2004

Species	Scientific name	Number of seedings produced ($\times 10^3$)	Number of seedlings stocked ($\times 10^3$) *
Crustacean			
Kuruma prawn	*Penaeus japonicus*	193,097	142,235
Green tiger prawn	*Penaeus semisulcatus*	9,486	2,422
Speckled shrimp	*Metapenaeus monoceros*	44,336	29,836
Fleshy prawn	*Penaeus chinensis*	1,908	1,908
Japanese spiny lobster	*Panulirus japonicus*	0	4
King crab	*Paralithodes brevipes*	180	16
Snow crab	*Chionoecetes opilio*	2	0
Horsehair crab	*Erimacrus isenbeckii*	0	0
Mangrove crab	*Scylla oceanica*	1,712	410
Swimming crab	*Portunus pribaculatus*	42,184	25,882
Blue crab	*Portunus trituberculatus*	1,782	1,857
Shellfish			
Disk abalone	*Nordotis discus*	8,876	5,471
Yezo abalone	*Nordotis discus hannai*	16,111	14,898
Spiny top shell	*Ttilus cornutus*	5,376	4,240
Ark shell	*Scapharca broughtonii*	1,330	703
Ezo scallop	*Patinopecten yessoensis*	2,991,839	2,991,729
Hard clam	*Meretrix lamarckii*	4,327	4,320
Others			
Common octopus	*Octopus vulgaris*	14	1
Red sea urchin	*Pseudocentrotus depressus*	3,006	2,004
Sea urchin	*Strongylocentrotus intermedius*	52,477	57,276
Sea urchin	*Strongylocentrotus nudus*	9,406	13,747
Sea cucumber	*Stichopus japonicus*	3,351	2,806

*: including natural seed

5. Stocking effects

The methods of evaluation of stoking effects

1. Tag recovery method (~ 1980's)

   Biased estimates

   - low reporting rate
   - high tag-shedding rates

2. Sampling survey at the fish market (1980's~)

The process of the sampling survey at the fish market (fin fish case)

1. Determination of the migration area of target species
2. Selection of the fish markets in the area for the survey
3. Research of the landings, size, price, and the distinction between wild and hatchery reared
4. Year classification of the landings

Evaluation of the stocking effects

Estimated number of fish recaptured in the area / **Number of stocked fish**

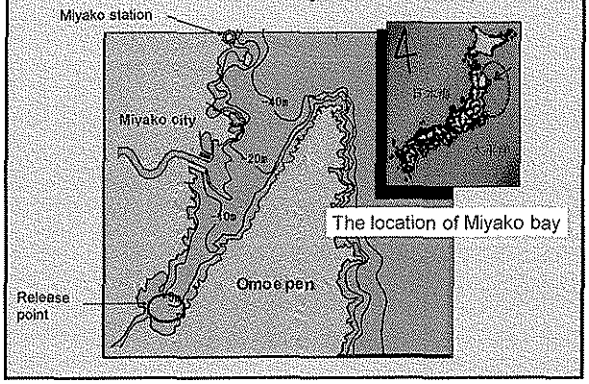
= return rate

Yield of the stocked fish / **Stocking costs**

= economic efficiency

Stocking effects of Japanese flounder released in Miyako bay

(Miyako station, FRA)

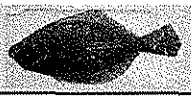


Stocking effects of Japanese flounder released in Miyako bay

The evaluation of the stocking effects of the Japanese flounder (*Paralichthys olivaceus*) in Miyako bay

Release year	Number of fish released A	Stocking cost (10^3 yen) B	Number of fish recaptured C	Return rate C/A	Amount of catch (10^3 yen) D	Profit rate D/B
1987	157,000	9,420	9,293	5.9	4,341	0.46
1988	145,000	8,700	10,071	6.9	7,202	0.83
1989	69,000	4,830	16,110	23.3	9,004	1.86
1990	80,000	5,600	12,750	15.9	7,722	1.38
1991	96,000	5,760	20,783	21.6	11,307	1.96
1992	64,000	3,840	8,734	13.6	5,158	1.34
1993	100,000	6,000	9,128	9.1	8,864	1.48
1994	80,000	4,000	6,810	8.5	10,118	2.53
1995	60,000	5,400	10,155	16.9	13,596	2.52
total/average	851,000			12.2		1.44

Release size 6~11cm TL

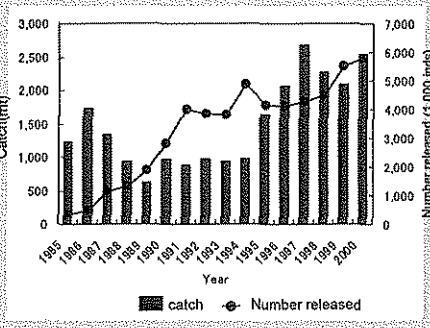


Stock enhancement of flounder in the northern pacific of Japan (business level)

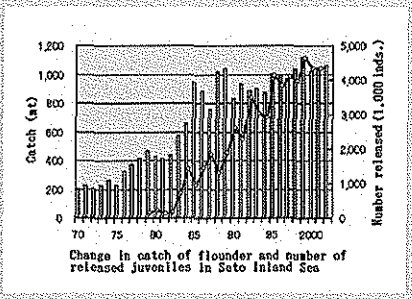
A pref.
B pref.
C pref.
D pref.
E pref.

- Release number 1~2.2 million
- Release size 8~10cm TL
- Fishery regulation
  - prohibit under 30~35cm TL
  - larger mesh of the gill net
- Share the releasing cost
  - 3~5% of the yield of flounder

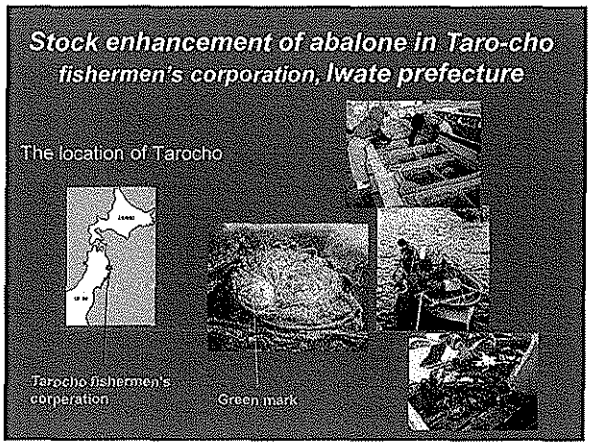
Change in catch of flounder and the number of released flounder in northern pacific area in Japan



The stock enhancement of Japanese flounder in Seto Inland Sea



Stock enhancement of abalone in Taro-cho fishermen's corporation, Iwate prefecture

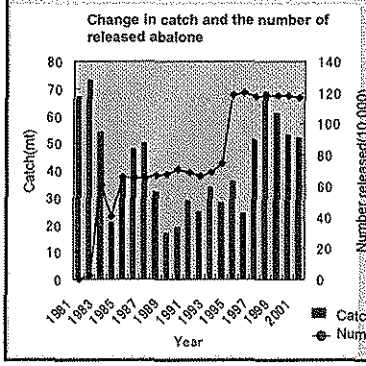


Stocking enhancement of Yezo abalone in Tarocho fishermen's corporation

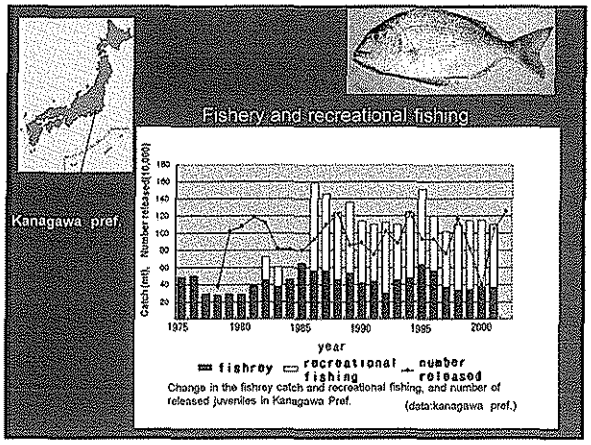
Juvenile release + resource management

- Fishing method・・・hooking
- Fishery season・・・ 5~6days,in November,December
- Fishery time a day・・・3~4hours
- Regulation size・・・smallest 9cm shell length
- Release ・・・3cm SL, 1.2mill./year
- Feeding ・・・sea weed (surplus of the aquaculture)
- predator elimination・・・ starfishes (35,000/year)
- Share the releasing cost・・・2% of the yield

The stocking effects of abalone in Tarocho fishery coop.



- contribution of the hatchery reared abalone 0.32
- economic efficiency 1.83 (average1981~2001)



6. Tasks for the further development of the stock enhancement in the future

- Mass juvenile release and scientific evaluation of the stocking effects
- Reduction of the production costs
- Comprehensive resource management
- Consideration to the natural ecosystem
  - carrying capacity of the sea area
  - prevention of the disease
  - maintenance of genetic diversity

Global effects of the stock enhancement in Japan

Name	Scientific name	Total number of released juveniles (in 2003, ×10⁶)	Reported return rate (%)
Yezo scallop	*Patinopecten yessoensis*	2,989	25.6–46.3
Chum salmon	*Oncorynchus keta*	2,000	2–4
Red sea bream	*Pagrus major*	20	8–12
Japanese flounder	*Paralichthis olivaceus*	25	8–35
Kuruma prawn	*Penaeus japonicus*	153	1–22
Ezo abalone	*Nordotis discus hannai*	16	1–51

(kitada:2001)

Economic return rate

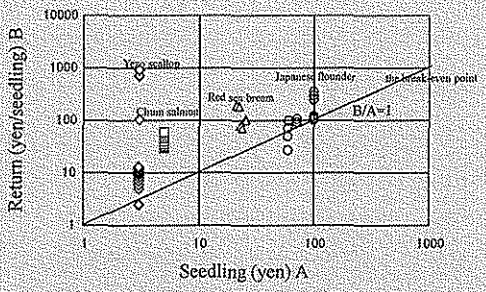
Economic return rate

species (size cm)	Japanese name	Number of sample	seedling price (yen) (A)	fish landing price (yen) (B)	economic return rate B/A
Patinopecten yessoensis (3.5)	Yezo scallop	Hotategai	16	2.9	80.9 (1.4 - 899.7)	27.9
Oncorynchus keta (5)	chum salmon	Shirozake	9	5	48.8 (35.2 - 60.9)	9.8 (7.0 - 11.8)
Pagrus major (7)	Japanese red sea bream	Madai	6	22.6 (21.1 - 25.3)	112.5 (70. - 174.9)	5.0 (3.3 - 8.2)
Paralichthis olivaceus (7 - 10)	Japanese flounder	Hirame	13	83.1 (60 -100)	189.7 (27.7 - 380.0)	2.1 (0.5 - 3.8)

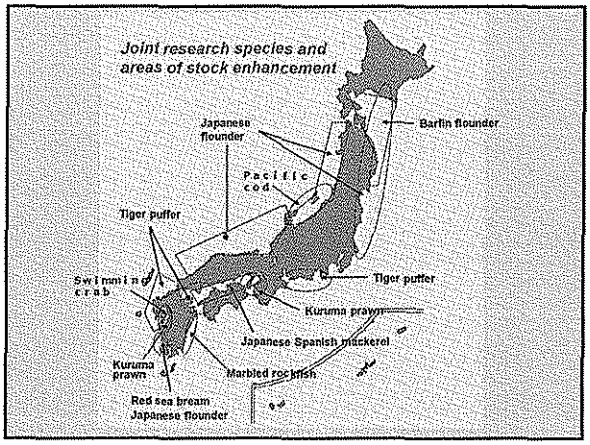
(Kitada 2001)

(The encyclopedia of fish and seafood1999) (JASFA)

Profit and loss



Joint research species and areas of stock enhancement



Stock enhancement and resource management

Former theory of stock enhancement

Stocking effectiveness

⇩

Current theory of stock enhancement

Stocking effectiveness

Comprehensive resource management

Fisheries resources

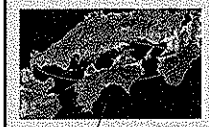
Released stock

Rational catch

Comprehensive resource management

Wild stock

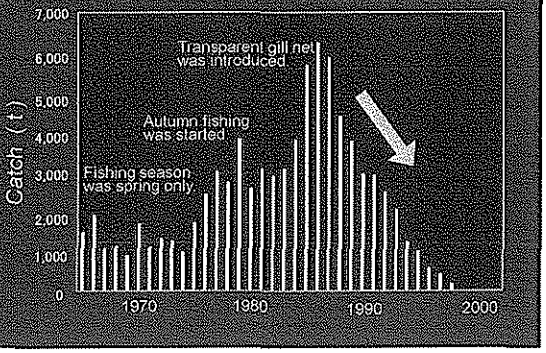
Comprehensive resource management



Yashima station for S.E. FRA

The resource restoration project for Japanese Spanish mackeral in the Seto Inland Sea

Transition of the annual catch of Japanese Spanish mackerel in Seto Inland Sea



The purpose of the project

Increase the wild resources 20% during 5 years starting from 2002

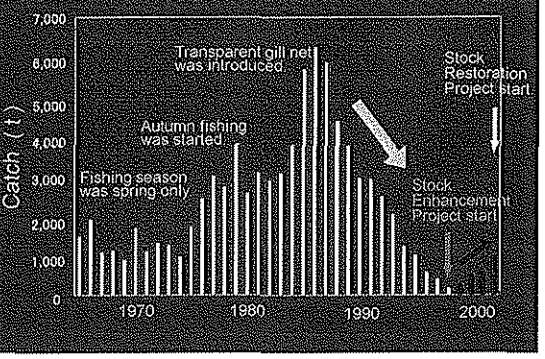
by

reduction of the fishery efforts (10%)

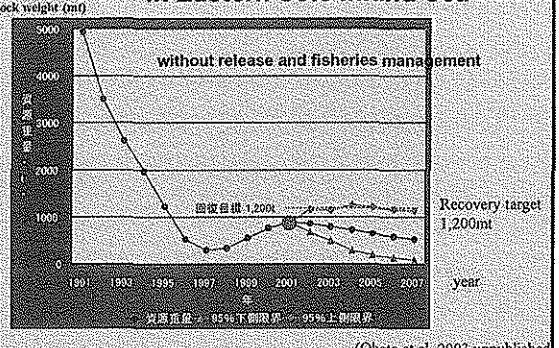
+

juvenile release (100,000 inds./year)

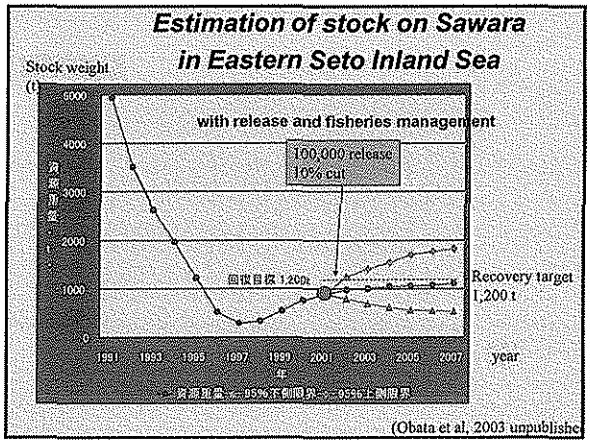
Transition of the annual catch of Japanese Spanish mackerel in Seto Inland Sea

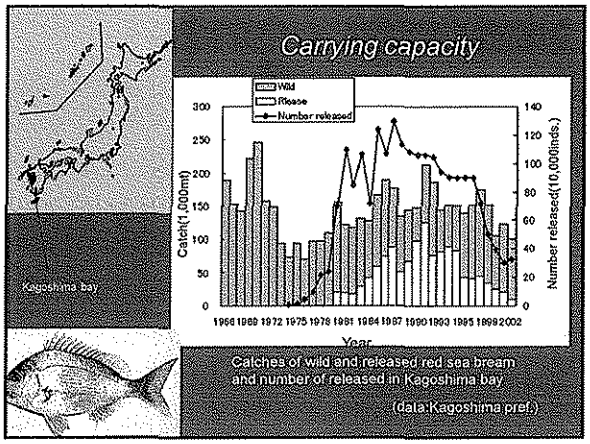


Estimation of stock on Sawara in Eastern Seto Inland Sea



(Obata et al, 2003 unpublished)


Estimation of stock on Sawara
in Eastern Seto Inland Sea
Stock weight
with release and fisheries management
100,000 release
10% cut
回収目標 1,200t
Recovery target
1,200 t
year
(Obata et al. 2003 unpublishe


Carrying capacity
Wild
Release
Number released
Catch(1,000mt)
Number released(10,000inds.)
Kagoshima bay
Year
Catches of wild and released red sea bream
and number of released in Kagoshima bay
(data:Kagoshima pref.)


I hope you will enjoy good taste of sushi here
in Japan. Released fish may be included.