Chapter 2
Healthy Interaction between Human and the Earth

As seen in Chapter 1, we humans depend on underground resources such as fossil fuels and minerals, as well as renewable resources such as food, forest and water. These natural resources provide energy, food, timber, medicine and so on, which are vital for human beings. We also depend on the fundamental roles of ecosystems; healthy forests, for example, regulate damages from heavy rainfall caused by typhoons. These natural resources and ecosystems support various patterns of human life styles, and indigenous cultures which remained until today heavily depend on them (Figure 2-1-1).

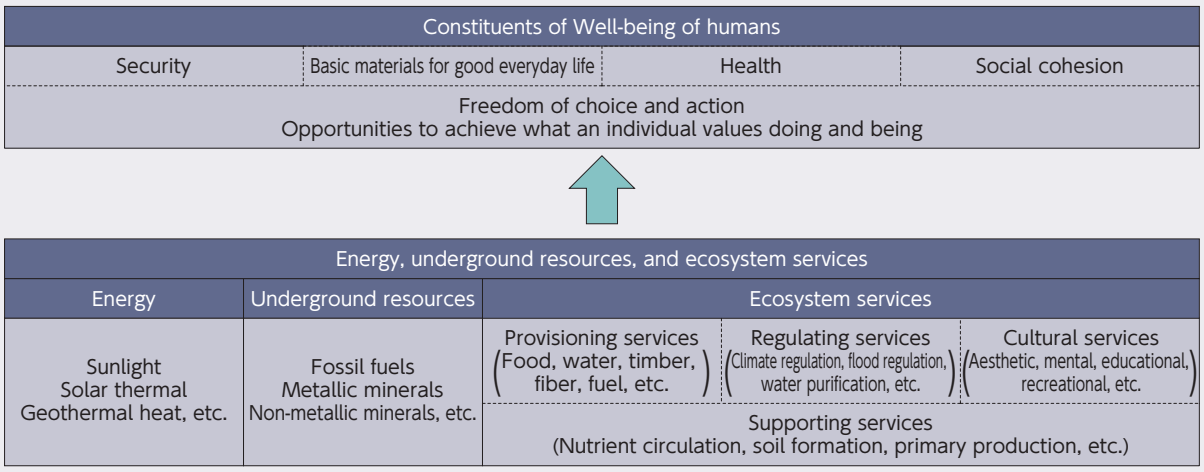
In Chapter 2, we will consider about how to achieve the wisdom in order to assist local everyday lives which based on traditional knowledge, to maintain the relationship in good condition between human beings and the Earth's environment and to share the benefits of ecosystem services with the future generation, focusing on status of renewable resources of biodiversity.

Section 1 Benefits of Ecosystem Services on the Earth for Our Everyday Lives

There are 1.75 million identified species. Including unknown living organisms, it is said that there are 30 million species on the Earth. Humans are nothing more than one of the many species, and it would be impossible for us humans to exist without interrelationship with these innumerable living organisms. That is why maintaining these "relationships" is extremely important.

Here, we will discuss the relationship between our everyday lives and ecosystem services of biodiversity, mainly from the perspective of how ecosystem services provide security in everyday life, timbers for building, food, medicine for our health, and traditional cultures in Japan.

Figure 2-1-1 The Benefits We Receive from natural resources



Source: Created by the Ministry of the Environment, using the Millennium Ecosystem Assessment, etc.

1. Security in Everyday Life Provided by Biodiversity

Biodiversity regulates drastic environmental changes and keeps the environment in a good status. This function is referred to as biodiversity's regulating services, and a well-known example is the water regulating function of forests. Here we will take a look at the example of the *Bekanbeushi River Basin and Obetsu River Basin* in eastern Hokkaido.

The Bekanbeushi River Basin consist of planted forest, natural forest and wetlands. The ratio of area of agricultural land is no more than 7.6 percent. Meanwhile, most part of the Obetsu River Basin, which is a branch river of the Bekanbeushi River, consists of agricultural land. The ratio of agricultural land is two-thirds of the river basin.

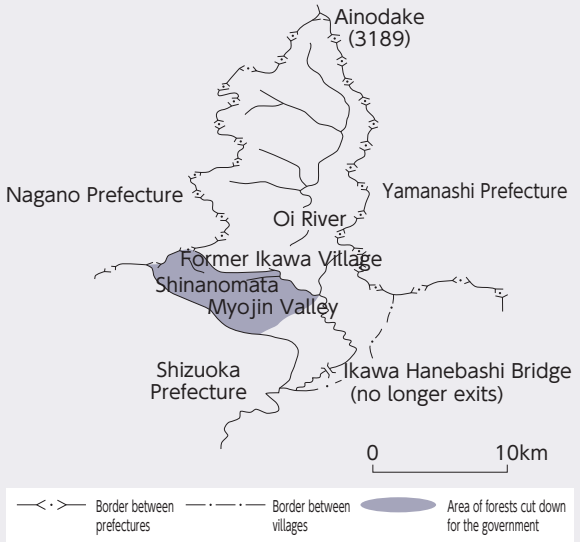
Comparing the amounts of rainwater inflow into these river basins during three days after rainfall, the amount of rainfall in the Bekanbeushi River Basin is only about 10% of the amount of rainfall and the amount of rain fall in the Obetsu River Basin is approximately 70% of the amount of rainfall flows. This shows that the rainfall stays longer within the Bekanbeushi River Basin because forests in Bekanbeushi River Basin remain more than in Obetsu River Basin (Table 2-1-1).

Further, a past event of logging in Japan shows that large-scale logging affected flood regulating functions. There is a report on the relationship between large-scale logging of forests and flood of the Oi River in the northern region of Shizuoka Prefecture during the Edo Period (from 17th to 19th century). In order to obtain timber for the Edo government, approximately 3,600 hectares of forests around the upper course of the Oi River were cut down during the nine years from 1692 to 1700 (Figure 2-1-2). After 1692, large-scale floods began to strike the areas and they washed downstream bridges away.

The state of the floods at that time can be estimated from old records of changes of the length of the Ikawa Hanebashi Bridge (rare type of wooden cantilever bridge) that spanned the Oi River, which flows from the logging area. After the Ikawa Hanebashi Bridge was built in the beginning of the 1600s, even after it was repaired several times, the length of the bridge, approximately 73-meter, did not change until around the end of the 1600s. However, the bridge had become approximately 30 meters longer after the upstream logging from 1700 until 1825 (Figure 2-1-2). This was because the water-retaining capacity of the forests declined and this caused the amount of river flow to increase and the width of the riverbed to expand after large scale logging in the upstream areas of the Oi River.

As seen by these examples, the environment's regulating functions of biodiversity have provided the foundation for our stable everyday life, and still play an important role today.

Figure 2-1-2 Area of Cut-Down Forests and Position of Hanebashi Bridge



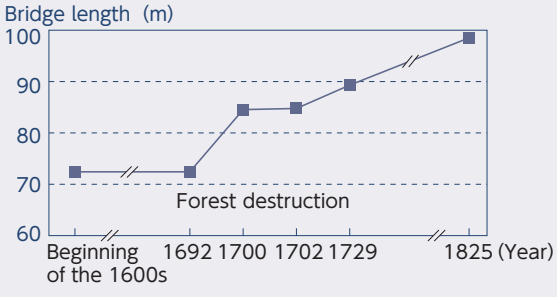
Source: Illustration by the Ministry of the Environment, based on The Relationship between the Length of Hanebashi in the Oi River in the Edo Period and Cut Down Forests, by Kazuhiro Takao and Yutaka Omura (2008), Journal of Forest Research Issue 90: 190-193

Table 2-1-1 Amounts of Rainwater River Flows in Obetsu River and Bekanbeushi River

	Obetsu River	Bekanbeushi River
Area of river basin	38.68km²	378.97km²
Ratio of agricultural land	65.7%	7.6%
Total amount of rain in river basin	2,530,000t	24,830,000t
Amount of flow within 24 hours	23.5%	3.2%
Amount of flow within 48 hours	53.4%	8.2%
Amount of flow within 72 hours	66.0%	12.8%

Source: Study of Associations among Forests, Countryside, and the Sea, edited by Field Science Education and Research Center, Kyoto University, Chief Editor Yo Yamashita

Figure 2-1-3 Extension of the Length of Ikawa Hanebashi Bridge



Source: Illustration by the Ministry of the Environment, based on The Relationship between the Length of Hanebashi Bridge in the Oi River in the Edo Period and Cut Down Forests, by Kazuhiro Takao and Yutaka Omura (2008), Journal of Forest Research Issue 90: 190-193

2. Traditional Wooden Buildings Supported by Forest Resources

As another type of ecosystem service, we will discuss provision service from the perspective of how forest resources provide traditional wooden buildings in Japan. Japan is one of the countries which has oldest wooden buildings. There are more than 4,000 buildings that are national treasures or important cultural properties and 85% of them are made of wood and nearly half of their roofs are thatched with materials made from plants, so regular maintenance is necessary. Japan recognizes the significant value of wooden buildings as cultural properties, and forest resources have been preserved for a long time. At present, more than 300 traditional wooden buildings are annually repaired using well-managed forest resources.

Maintenance of traditional wooden buildings requires large amount of timbers made from large-diameter trees; approximately one third of the timbers were the ones of large diameter and length. In order to supply these materials it is necessary to maintain forests so that they are continuously more than 100 years old. Here we will take a look at the example of a traditional way for maintaining and rebuilding wooden building that the Isejingu Shrine carried out once every 20 years.

The regular rebuilding of Isejingu Shrine, which has long and distinguished history in Japan, began more than 1300 years ago in 690 A.D., as is called 'Shikinen-Sengu'. The 62nd rebuilding is scheduled in 2013. The rebuilding require each time a volume of approximately 8,500m^3 of round Cypress timber, the main of which are long and have a large diameter. For example, when the 58th regular rebuilding was carried out, more than 11,000 round timbers were ordered; approximately 3,000 trees were required to be mid-size with of more than 30 centimeters of diameter, and more than 600 timbers were required to be large-size with of more than 70 centimeters (Figure 2-1-4).

The forest has been supplying large-diameter trees for a long time under the traditional way of management. After World War II, most part of the forest was put under the management of the Forestry Agency, the way of managing the forest were established under the Forestry Agency's plans, and planned and continuous management has been conducted over a long period, with approximately 50 year cycle.

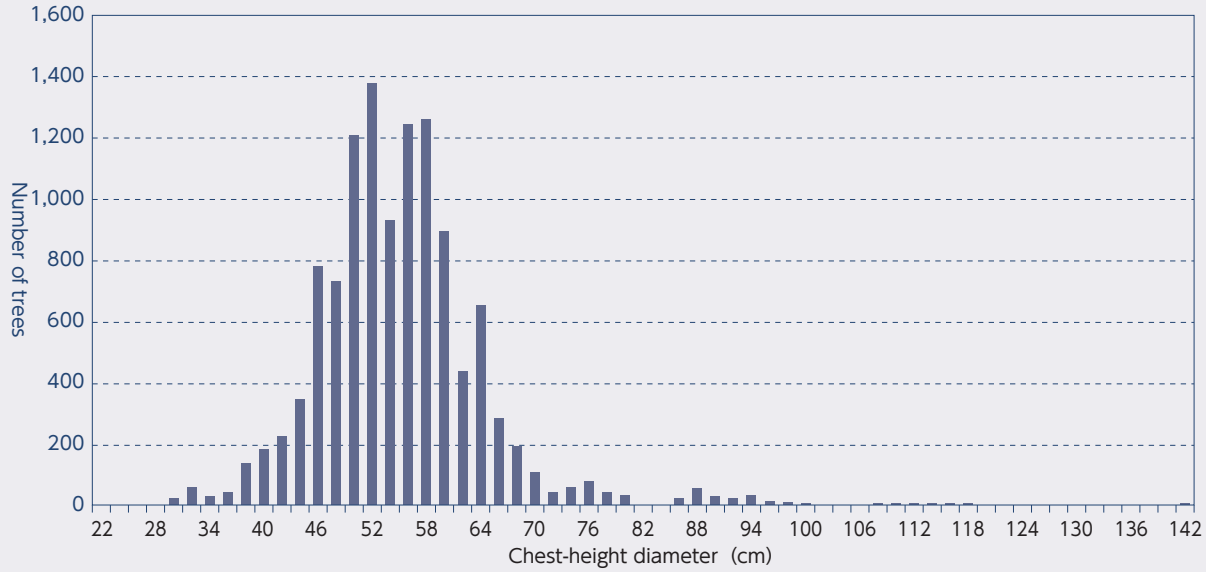
In addition, the Isejingu Shrine has its own forest for supplying the trees, which contains a sanctuary where cutting is prohibited (267ha), Number 1 Precinct Forest comprising natural forest (1,094ha), and Number 2 Precinct Forest where forest operations such as production of timber for building the shrine are conducted. In this Number 2 precinct forest, the Jingu Administration Office has the plan for long-term forest management, with a target of producing approximately 100 large-diameter trees per unit area (ha) every 200 years.

Further, the wood wastes generated after the regular rebuilding of Isejingu Shrine are not disposed of, but instead are thoroughly reused as materials for other shrines across the nation. It can be thought that Japan has traditional knowledge of taking care of its forests and of how to fully use materials without any waste (Figure 2-1-5).

3. Traditional Cuisine Which Reflects the Geographical and Climate Background

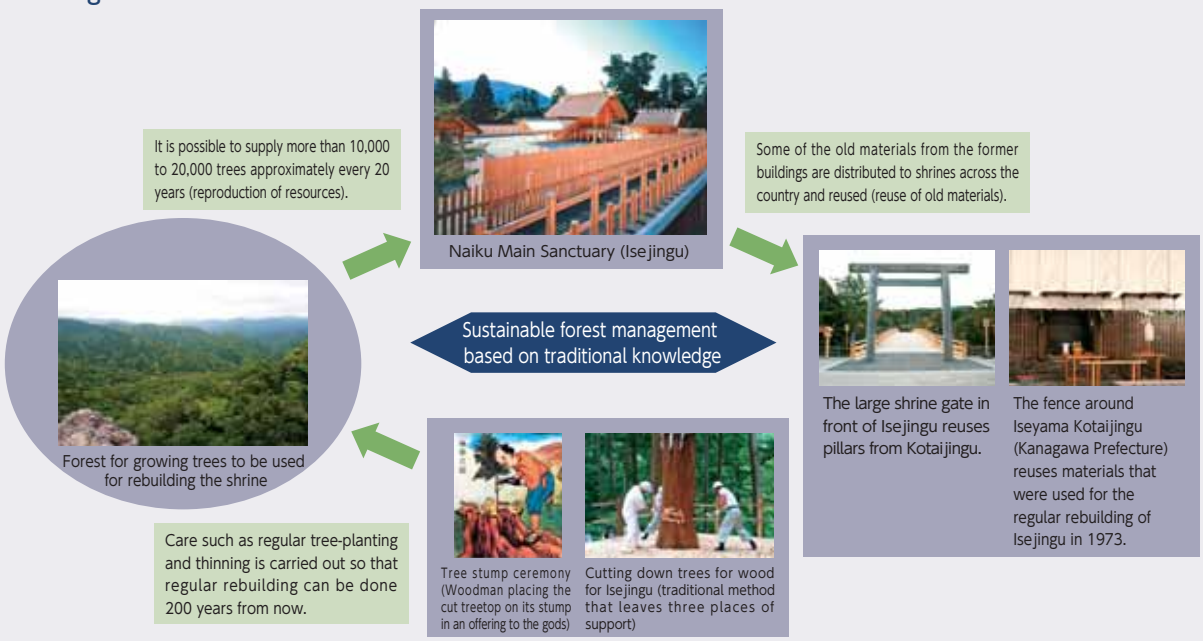
Tetsuro Watsuji (1889-1960), who was a Japanese philosopher and argues that there is essential relationship between climate and other environmental factors and human culture, wrote the following in his book "Climate and Culture: A Philosophical Study." "Climate is the most deeply related to production of food. Our appetites

Figure 2-1-4 Number of Cypress Trees Necessary for Rebuilding Isejingu, by Diameter Level



Source: Research on Securing Materials for Repairing Wooden Building Cultural Properties, by Hirokazu Yamamoto and others (March 2005)

Figure 2-1-5 Sustainable Forest Management of the Former Forest for Growing Trees to be Used for Rebuilding the Shrine



Photos and illustrations provided by Jingu Administration Office, Isejingu, and Nakatsugawa City

do not target whatever can be used for food, but instead choose cuisine that was familiar to them and has been taken over a long time."

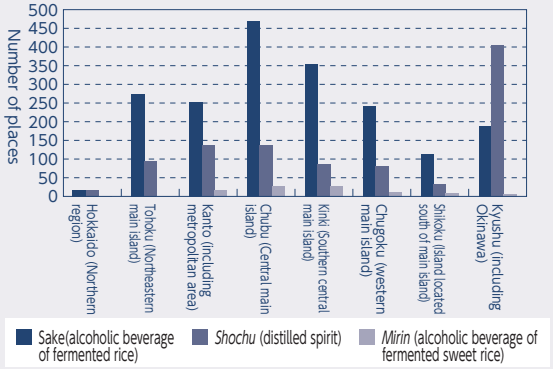
We humans have used the regional and biological resources as ingredients, but we do not choose any biological resources just because they are available. Humans have evolved traditional and unique cuisine that varies from region to region by choosing, cooking and eating the food that reflect geological and climate background.

We not only cook by ourselves, but also we use fermentation technology, the process of microorganisms such as lactic bacteria and yeast. Fermented foods vary to the world, which reflect the regional ingredients of agricultural and marine products by using traditional fermentation technologies. For example, bread is made from fermented flour, Japanese *sake* is a kind of alcoholic beverage made from fermented rice, *miso* and *natto*, which are traditional food familiar to Japanese, are made from fermented soybeans.

Most fermented foods have been made from biological resources that are available in the local region, and people have used traditional fermentation technology which is adjusted to geographical and climate condition. Thus unique fermented foods are evolved by regions. For example, in the case of Japanese alcoholic beverages, various basic ingredients such as rice, potatoes, and sugarcane are used, and regional characteristics can be seen (Figure 2-1-6). As another example, Japanese fermented fish dishes vary to regions, such as fermented fish preserved in salt (*shio-zuke*), a kind of fish sauce that extracts liquid that fermented fish's innards (*gyosho*), fermented seafood dish (*shio-kara*), a kind of traditional sushi made from fermented rice and fish (*nare-zushi*), and preserved mackerel soaked in fermented bran (*heshiko*) (Figure 2-1-7).

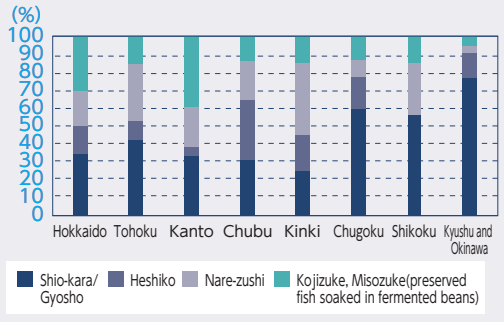
Loss of biodiversity can make it difficult to supply ingredients for these traditional fermented foods, resulting in the loss of regional and unique individualities. Next we will consider this issue using an example of fermented

Figure 2-1-6 Number of Places Licensed to Make Alcoholic Beverages (By Region)



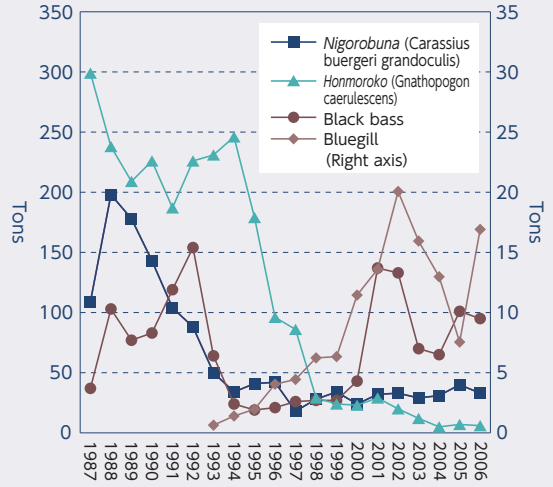
Source: The National Tax Agency's Annual Statistics Report (2009)

Figure 2-1-7 Regional Characteristics of Fermented Fish Dishes



Source: Created by the Ministry of the Environment, using information from Traditional Dietary Habits for Preserved Foods "Shiokara" and "Gyosho," and the Regional Characteristics of the Places They are Consumed (2003) by Setsuko Imada and others

Figure 2-1-8 Trends in Amounts of Catches of Fish in Lake Biwa



Source: Created by the Ministry of the Environment, using Shiga Prefecture statistics on fish processing, etc. Information on bluegill only is from the Otsu Fishing Cooperative (amount caught by one fixed net in the southern portion of Lake Biwa).

Photo: *Funazushi* (indigenous fermented fish dish in Shiga Prefecture)

①*Nigoro-buna* preserved with salt (3 months).

②The fish is dried (about half a day).

③The fish is fermented with rice (summer).

④After fermenting for several months to several years, the *funazushi* is ready to enjoy.

Source: 2010 "Shiga Fishery"
Photos provided by Shiga Prefecture

fish dish in Shiga Prefecture.

In Shiga Prefecture, "*funa-zushi*," a type of traditional fermented fish dish, is familiar to the people living there. It is served on happy occasions such as the New Year. "*Funa-zushi*" is made from "Nigorobuna"(*Carassius buergeri grandoculis*), which is endemic carp in Lake Biwa located in Shiga Prefecture. The unit price for "Nigorobuna" is more expensive than other types of carp. The price is about JPY 3,000 per 1kg for "Nigorobuna", while it is around JPY 400 for other carp. This means that Nigorobuna extremely is important fish product for local fishery in Shiga Prefecture.

However, the important habitats for the fish have been lost after World War II. Reed grass areas have been lost around the lakeshore because of the infrastructural development around Lake Biwa and changes in land use. In addition, the water quality began to worsen in the early 1960s. Alien species such as black bass and bluegill invaded Lake Biwa from the 1960s through the 1980s. These environmental impacts had a noticeably negative effect on the habitat environment for Lake Biwa's fish.

As a result, the maximum capture was approximately 1,100 tons of Lake Biwa carp around 1965, but capture has been hovering around 100 tons in recent years. Capture of *Nigorobuna* also continues to decline and at present has fallen to approximately 40 tons (Figure 2-1-8). For that reason, the *funazushi* that uses *Nigorobuna* as its ingredient has become a dish that is difficult for the residents to enjoy for their dinner. It can be the typical example that the loss of biodiversity has a large impact to the unique cultures of regions.

In Shiga Prefecture, a "Funazushi-Cooking Workshop" has been conducted for the purpose of taking over this traditional cuisine to the next generation since 2010 as part of a "Project for Business Development of Lake Biwa Fisheries."

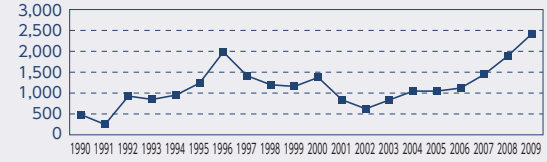
4. Biological Genetic Resources Used in Bio-Technology

In recent years, there has been increased use of bio-technology particularly in developed countries, including research and development on genetic and biochemical resources. Bio-technology is used as an advanced technology that uses genes and materials from living organisms to develop new medicines and high-quality crops. It has been drawing attention in various fields such as medical care, the environment, and food as an important technology that will provide new business opportunities.

As a result, new technological development of bio-technology can be seen in Japan. The number of patent registrations for biochemistry, biogenetics, and other fields has increased from 472 patents (registrations) in 1990 to five times that at 2,412 patents in 2009 (Figure 2-1-9).

Amid this increased attention to bio-technology, international dialogues on Access to genetic resources and Benefit-Sharing (ABS) have been made. These efforts has been made in order to overcome the conflicts between provider countries of genetic resources and user countries which insist that R&D should be promoted to contribute human welfare through smoothly access to genetic resources. With COP10 as a starting point, the framework for access to genetic resources and the fair and equitable sharing of the benefits arising from their utilization are to be made in order to contribute to biodiversity conservation and sustainable use. This will be discussed in more detail in Chapter 3.

Figure 2-1-9 Number of Patent Registrations for Biochemistry, Biogenetics, Etc.



Source: Japan Patent Office Annual Report (2010)

5. Culture which reflects Natural Background

Lastly we will consider Japan's indigenous culture that reflects natural background.

Our cultural activities reflect our lifestyle and the environment in which we live. We exchange the wisdom and techniques through communication with people from other cultural background. Cultural activities are also a means of expression of life satisfaction, passion and happiness of being alive. The nature that surrounds our everyday life has a significant influence on our culture.

In recent years, some natural objects seem to disappear from us, though these are used to be close to us. The Japan Meteorological Agency, which conducts phenological observation, has decided not to observe black-spotted pond frogs and fireflies, which has become difficult to continue to observe in cities, since 2011.

It has also become difficult to watch the stars in the night sky, although in the past millions stars could be seen. In Collection of the Ten Thousand Leaves (edited around 7th to 8th century. Japanese name of "the Man-Yoshu"), which is an important classic and oldest collection of poetry in Japan, poets and common people of the time wrote about a wide variety of subjects in nature. Here is the brilliant poem "High above the Sky, which is the Sea, the Wave of Clouds Rise and I Can See the Moon Ship is Rowed into the Forests of Stars," written by Hitomaro no Kakimoto. This poem supposes that the sky is the sea, clouds are a wave, and the moon is a ship, and he created the poem with a unique and elegant emotion in which that "moon ship" disappears into the "forests of stars."

However, in modern Japan's night sky it has become difficult to feel a situation of such limitless stars as "forests of stars." Ministry of the Environment defines monitoring points of a nationwide starry sky. The ratio of points where Cygnus including Deneb could be seen was approximately 50% of the 318 monitoring points without clouds and other obstacles in August 2009. Cygnus could be seen at over 80% of places in forests and mountain areas, which are thought to have few street lamps, while it could be seen only at approximately 10% of commercial areas (Figure 2-1-10). The scenery of a night sky with many visible stars is one of beautiful sceneries that people who live in city have lost.

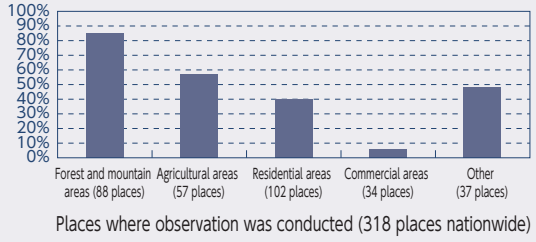
Natural objects and natural sceneries around us are continuing to be lost in recent years. How does it affect on the culture in the future? Here we will take a look at examples of animals and plants mentioned in the poems gathered in Collection of Ten Thousand Leaves.

In the "Collection of Ten Thousand Leaves" including approximately 4,500 poems, it is possible to identify approximately 50 species of wild animals and approximately 140 species of wild plants. As wild mammals, deer, wild boar and whales are included. In the poems, these species give expression of not only poetic feelings but also awareness of wildlife as food resources.

Wild birds appear as symbols of seasons, such as cuckoos and bush warblers for spring symbols. There were also birds as game species such as pheasants and ducks. In addition, in Hinkyu-mondo-ka (meaning of Accusation against Poverty), which was written by Yamanoue Okura, who is known as a social poet of that time, White's Thrush appears as a symbol of loneliness, whose night song inspires loneliness because of its far-carrying voice and high notes.

In modern Japanese poems, the expression of wildlife has changed considerably. For example, in "Modern Collection of Ten Thousand Leaves in Heisei period" (edited by The Yomiuri Shinbun, 2009), which selected modern poems from a general call for submission. In 1,000 poems of this modern "Collection", there are approximately 30 for identified plant species, which was about 30% of the original "Collection". There are trends of an increase in the ratio of pets and garden species in

Figure 2-1-10 Ratios of Times Cygnus Could be Seen (By Place of Observation)



Source: Nationwide starry sky continuous observation study by the Ministry of the Environment

Table 2-1-3 Species of Wildlife and Main Species of Animals That Appear in "Collection of Ten Thousand Leaves"

	Number of species of wildlife (*1)		Main wild animals that appear (number of poems in which they appear (*3))
	Wild animals	Wild plants	
Collection of Ten Thousand Leaves	Approx. 50 species	Approx. 140 species	Deer (approx. 60 poems), whale (12 poems), cuckoo (approx. 150 poems), goose (approx. 100 poems), quail (8 poems), White's Thrush (5 poems), sweetfish (15 poems), others
Heisei Collection of Ten Thousand Leaves (*2)	Approx. 20 species	Approx. 30 species	Duck (4 poems), goose (3 poems), bush warbler (2 poems), deer (1 poem), others

Souece: Created by the Ministry of the Environment, using information from Collection of Ten Thousand Leaves, Heisei Collection of Ten Thousand Leaves, Classical Dictionary of Plants (Shu Matsuda, Kodansha Ltd.), etc.

*1: Except when referring to general names of living organismssuch as bird, turtle, etc. in general the species given allow identification up to the scientific family name.

*2: Heisei Collection of Ten Thousand Leaves refers to the poetry compilation of the same name that was publicized by the Yomiuri Shimbun in 2009.

*3: The number of poems appearing in Collection of Ten Thousand Leaves was tallied based on the Collection of Ten Thousand Leaves Text by Makoto Komura of the Education Department of Yamaguchi University. Except for names that appear as personal nouns, such as place names, the ones that appeared as set epithets were included. There are several different theories about interpretation of the names of animal and plant species that appear in Collection of Ten Thousand Leaves, and the numbers of species and numbers of poems appeared in are reference numbers.

the modern "Collection". Some species no longer appear in the modern "Collection", while they were mentioned in the original "Collection" (Table 2-1-3).

Expression of Japanese poems has been changed, because of development of techniques as literature, changes of awareness and feeling toward natural subjects, and changes in the environment. Environmental changes significantly affect to Japanese poems, because poems reflect environmental factors. For instance, the modern night sky has become so bright that stars become less visible. Environmental noise has become so loud in our everyday life that it has become difficult to enjoy songs of birds such as White's Thrush. Some species become regionally endangered, while they used to be so close to us that they appear in poems.

Traditional culture is the emotional anchor for the people of the region, promotes community cohesion, and plays important roles of forming a regional community in which people feel senses of belonging. Culture has a value that cannot be replaced by a monetary value. In order to protect and take over the culture to the future, it is important to conserve the environment and biodiversity that serves as a background for traditional culture.

Column

Modern "Kagyu-Ko" The Study on the Word of Snail

Japan has an extremely wide variety of regional names referring to snails. Kunio Yanagita's, who is father of folkloristics in Japan, wrote the book "Kagyu-ko" (1930. "Kagyu" means snail, "Ko" means thinking or study). In this book, he points out that the distribution of snail names as dialect words forms concentric circle with the center in Kyoto, the capital of ancient Japan. He inferred that over a long period of time these names referring to snails gradually spread concentrically from the inside to the outside.

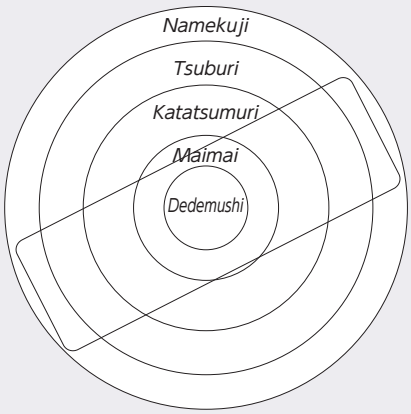
According to the Japanese Linguistics Map (1977. National Institute for Japanese Language and Linguistics), regional names related to snails are sorted into "*name-kuji*", "*mai-mai*", "tsumuri", "*tamakura*", "*katatsumuri*", "*dendenmushi*", "*deero*", "*tsunodashi*", and other isolated word forms. Overall, when variations of these words are included, approximately 470 types of names have been confirmed. Words such as "*name-kuji*" and "*mina*," which refers to shellfish in general, first became popular, and then names such as "*katatsumuri*" and "*mai-mai*" became used, and now it is thought that "*dendenmushi*", which is widely used mainly in the central region of Japan, is one of the newest word forms. This means that on the opening line of the lyrics of "Snails," one of the school songs, "*dendenmushi*" is being sung about in parallel with "katatsumuri".

Snails are species familiar to Japanese and deeply are rooted in our everyday life and culture. In addition, there are recently several reports that are interesting from the perspective of biodiversity.

In relation to Japan's terrestrial molluscan species including snails, 732 species and subspecies have been identified, and the majority of those are endemic to Japan. This diversity is due to the geographical isolation, caused by barriers such as mountainous landscape and many islands. On the Ogasawara Islands, which is an archipelago including over 30 subtropical and tropical islands, geographical isolation drives further speciation of terrestrial molluscan species and causes remarkable diversity.

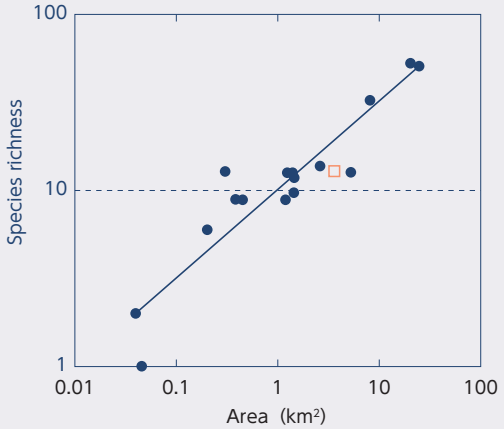
There is another report about snails which points

Diffusion of Names for Snails



Source: "Kagyuko" by Kunio Yanagida (Iwanami Bunko)

Relationship Between Types of Terrestrial Molluscan Species and Island Land Area in the Ogasawara Group of Islands



Relationship between land area and number of species for terrestrial molluscan species in the Ogasawara group of islands
□Indicates Minamiiwojima
Source: Minamiiwojima's Terrestrial Molluscan Species, by Satoshi Chiba

out the relationship between snails and a kind of snake whose predation is specialized to snails. The report shows that the specialized snake predation drives prey (snail) speciation. Snail Eating Snake (*Pareas iwasakii*), which is specialized predator of snails, is distributed broadly from the Yaeyama Islands of Okinawa to southern China, India, and Southeast Asia. This snake has specialized its jaw to eat dextral (clockwise coiled) snails, because many snails are clockwise coiled. This speciation causes sinistral (counterclockwise coiled) snails survive predation by the snake: the snake tends to miss capture of the snails when the snake is given sinistral snails. This works as an advantage to sinistral snails, and as a result, many sinistral snails can be observed in regions where the Snail-Eating Snakes is distributed.

According to the Ministry of the Environment's Red List, approximately 30% of terrestrial Molluscan species, including snails, are endangered due to human activities such as logging forests and developing land in their habitats, as their means of movement is crawling over the ground on their bellies and this is a barrier for their survival.

Pareas Snake Preying on a Snail

Successful predation of a right-coiled shell


Failed predation of a left-coiled shell

The numbers of teeth differ between the left and right sides of the jaw.

Source: Hoso, M., Kameda, Y., Wu, S. P., Asami, T., Kato, M. & Hori, M. (2010)
A speciation gene for left-right reversal in snails results in anti-predator adaptation
Photographs provided by Masaki Hoso

Section 2 Relationship between the Earth's Environment and Living Organisms

In Section1 we looked at the close relationship between our everyday lives and biodiversity. Our everyday lives depends on biodiversity, and the biodiversity is depend on keeping the living organisms and the ecosystems in good health and preserving the interaction between those ecosystems and living organisms.

Here focusing on dynamic migration of birds and fish and dispersal of animals, we will discus the relationship between ecosystems and organisms in order to understand it.

1. The Relationship between Organisms and the Earth

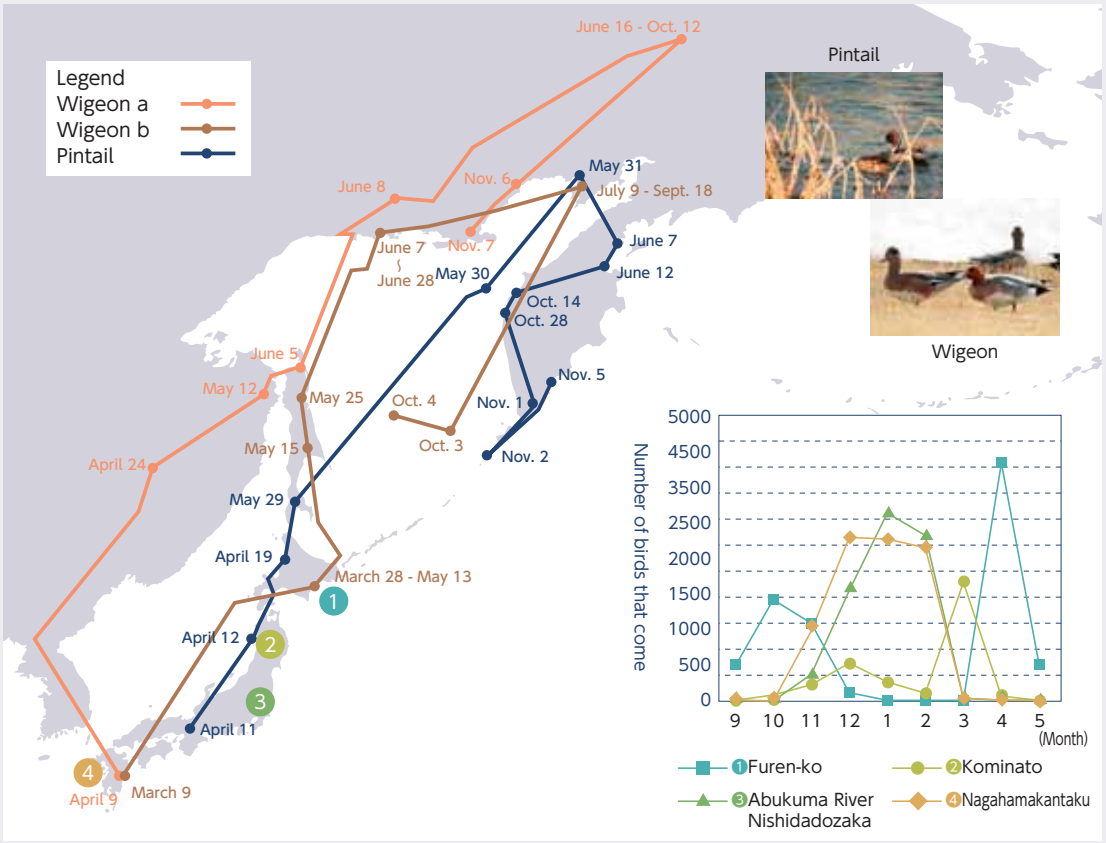
(1) The Flyway - Crossing in the Sky

In the Heian Period (8th to 12th Century), Sei Shonagon, who was a court lady to Empress around year 1000, wrote "The Pillow Book" (in Japanese "Makura no Sōshi"): "In autumn evenings...more charming still is a file of wild geese, like specks in the distant sky." This expresses the sight of aquatic birds migrating over Japan before winter comes, which has an aesthetic of autumn. In recent years, the migrating route of some bird species has been coming clearly due to the development of bird banding surgery, and tracking study technology that uses satellites to ducks and hawks. For example, Wigeon and Pintail, which can be seen in large numbers across Japan from autumn to winter, breed in Russia's Kamchatskaya Peninsula in the summer and then fly to Hokkaido in autumn. These ducks take a rest of their wings in lakes on their way to the south of Japan, feeding themselves. And they pass the winter in south regions of Japan.

Here we will look at this migration through the trend in number of Pintails that fly to wetlands in Japan. The number of Pintails in Hokkaido reaches a peak around December. After that they fly to the south, and there are hardly few Pintails in Hokkaido's Lake Furenko. Large number of Pintails pass the winter in Japan's southern areas. After they leave for the north before spring, they are no longer seen in the places where they passed the winter. In spring, reaching a peak around April for crossing Hokkaido again, almost none remain in Japan around May (Figure 2-2-1).

Aquatic birds thus use wetlands not by staying in a single place but instead use them like stepping stones.

Figure 2-2-1 Migration Routes for Pintails and Anas Penelopes; and Shifts in the Number of Pintails that Come, by Location



Source: Ministry of the Environment's Study on the State of Bird Migration (FY2009) and Report on Study to Clarify Bird Migration Routes (FY2007)

Each of the wetlands plays an important role for aquatic birds to rest their wings. This interaction of wild bird habitats through the flyway is referred to as a "flyway network," meaning an interaction of habitats through their flight path. Because this flyway network can be a borderless interaction on a global-scale, it is an important ecosystem network internationally.

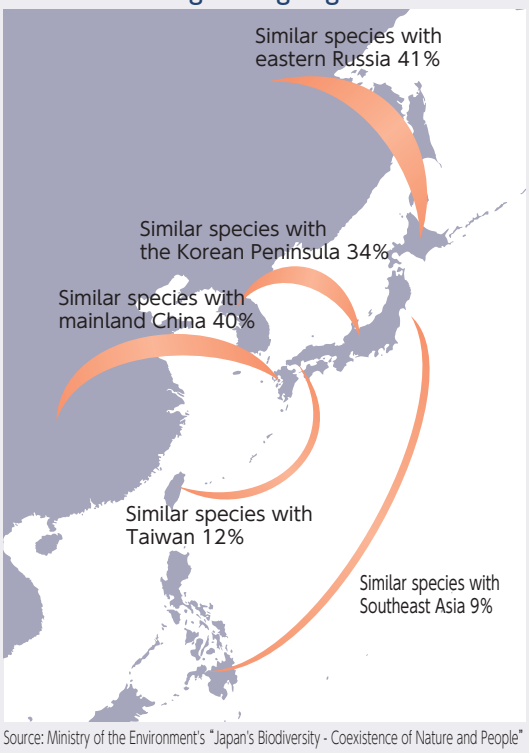
(2) Diversity of Species Due to Dispersal and Geographic Isolation

The Japanese archipelago in the glacial age differed from today, because it geographically connected to the Eurasia. At that time, various living organisms moved into the Japanese archipelago from Taiwan in the south and the Korean Peninsula and Sakhalin in the north. Many of the mammals and other living organisms that can be seen in Japan today are descendents of the living organisms that came to Japan in the glacial age (Figure 2-2-2).

Those living things were distributed widely across the Japanese archipelago, but they were blocked by the deeply cut Tokara Strait. This geographic isolation causes the difference of species distribution between the north and south of that strait.

In the case of Japan, this appears especially in the diversity and distribution of amphibians. 40 species and subspecies of frogs are distributed in Japan. Almost all of them are distributed either south of the Amami Islands or north of the Tokara Archipelago, and only a few species are distributed on both sides of the Tokara Strait. For example, the black-spotted pond frog and the Japanese brown frog, which are distributed north of the

Figure 2-2-2 Commonality Between Japan's Mammals and Neighboring Regions



Source: Ministry of the Environment's "Japan's Biodiversity - Coexistence of Nature and People"

Tokara Archipelago, cannot be seen south of the Amami Islands, and the same species and allied species inhabit the Far East, the Korean Peninsula, and northern China. Meanwhile, species distributed south of the Amami Islands cannot be seen north of the Tokara Archipelago, including in Honshu, and most of their allied species are distributed from the southeast portion of China through Southeast Asia (Figure 2-2-3).

Organisms that have been geographically isolated are separated into other species after many years have passed. The 5 species of Okinawa tip-nosed frog, which are distributed in islands south of the Amami Islands on the Ryukyu Archipelago, were isolated approximately 8.7 million years ago. They were separated from their continental ancestors because the sea level rose after the last glacial age, and then after approximately 7 million years they separated into 5 species such as the Amami tip-nosed frog (*Rana amamiensis*) and Utsunomiya's tip-nosed frog (*Rana utsunomiyaorum*) and so on, which are endemic species of the Ryukyu Archipelag. In addition, in the Ornate narrow-mouthed frog (*Microhyla ornate*), which is an endemic species of the Ryukyu Archipelago, extremely large genetic differences have been identified on each of the islands in the Ryukyu Archipelago. This is thought that the Ornate narrow-mouthed frog is separating into different species on each island in the Ryukyu Archipelago.

A characteristic of the amphibians in Japan is that many of them are endemic species. This is because amphibians, which inhabit wetland areas, have become geographically isolated on individual islands or separated due to Japan's mountainous landscape. Of the 64 species and subspecies of amphibians that inhabit Japan, approximately 80% are endemic to Japan. This is the eleventh highest ratio in the world (Figure 2-2-4).

(3) The Vast Interaction between Forests and the Sea

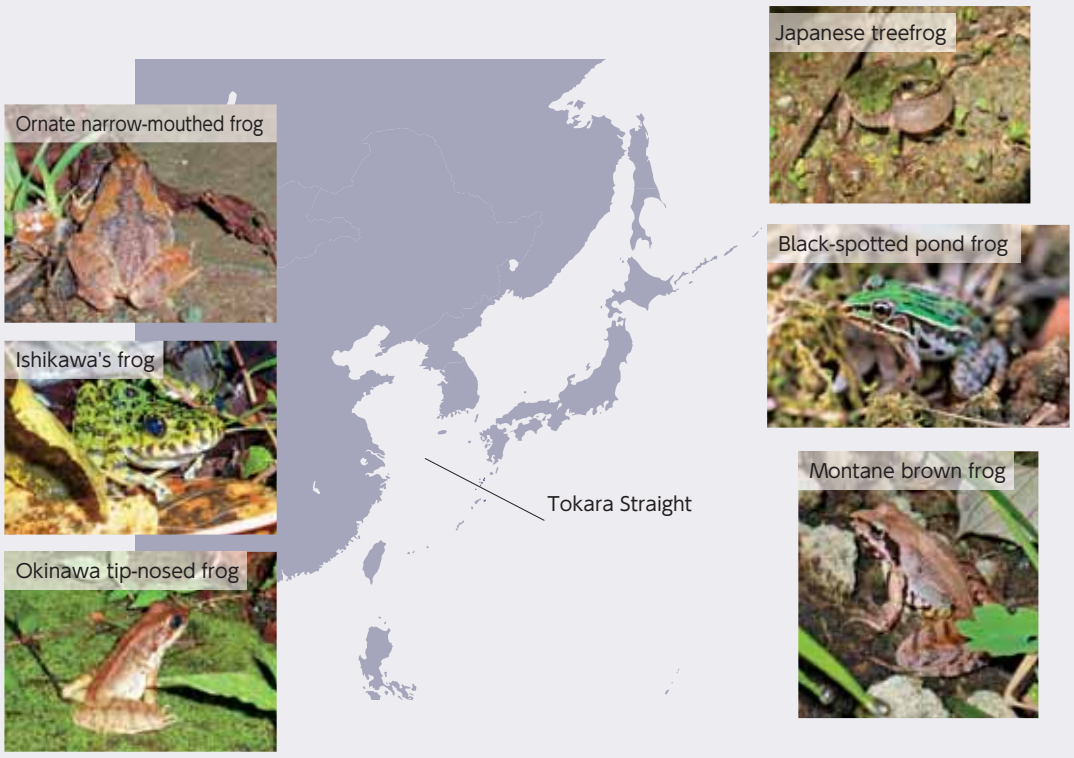
Nutrients flow from forests into the sea through rivers. In the sea, phytoplankton and seaweed grow by using those nutrients. This phytoplankton and seaweed becomes food for zooplankton, small fish and shellfish, and these small living organisms are consumed by bigger fish. The fish and shellfish are used as food by birds and humans. In this way, it is possible to think that ocean and land are connected ecosystems. This ocean-land interaction is sometimes expressed by the phrase "the forest is the ocean's sweetheart."

This kind of interaction is not only the forests and the sea, but also at the borders of ocean and land there are sandy beaches and rocky shores, and a wide variety of organisms inhabit the area. Tidal flats and seaweed beds are particularly rich in organisms and have high water purification capacity. The amount of production of organisms in such coastal areas is extremely abundant, and the juvenile fish are grown in these areas.

A large-scale example of the ocean-land interaction is Amur River and the ocean. Nutrients flow out of the Amur River into Sea of Okhotsk and are carried by the dense and cold flow of seawater that occurs when the sea ice is formed in the northern area of the Sea of Okhotsk. This nutrients nurture rich offshore fishery in the southern area of the Sea of Okhotsk and in the Pacific Ocean.

The Amur River (Chinese name is *Hēilóng Jiāng River*)

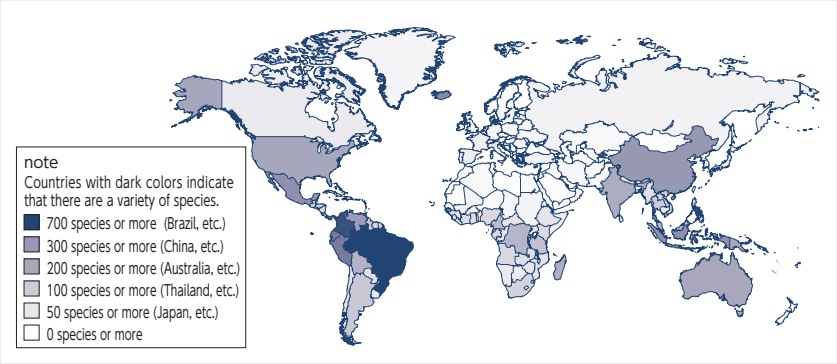
Figure 2-2-3 Distribution of Frogs in Regions on Both Sides of the Tokara Strait



Photographs: Japanese tree frog photograph provided by Tomohiko Shimada. All others by the Ministry of the Environment

Figure 2-2-4 World Distribution of Amphibian Species

Approximately 6,400 species of amphibians have been confirmed in the world, and many of them are distributed mainly in tropical areas (figure on the left). Although the number of species of amphibians that inhabit Japan is less than in countries in such areas, Japan is characterized by having many endemic species (table on the right).



Rank	Country	Endemic species/ Inhabiting species (%)
1	Jamaica	100
2	Seychelles	100
3	Sao Tome and Principe	100
4	New Zealand	100
5	Fiji	100
6	Palau	100
7	Madagascar	99
8	Cuba	96
9	Australia	93
10	Sri Lanka	84
11	Japan	80
12	Philippines	79
13	Puerto Rico	78
14	Chile	70
15	Papua New Guinea	70

Source: Created by the Ministry of the Environment, using information from the IUCN Global Amphibian Assessment (GAA)

is a large river that flows in the northeast area of the Eurasian continent. Its length is approximately 4,400 km, and the land area of its basin is approximately 2.05 million km^2. Sea ice in the Sea of Okhotsk is formed when the Amur River pours into Amur Bay. In the northern area of the Sea of Okhotsk, freshwater from the Amur

Column

"The Forest is the Ocean's Sweetheart Movement" and Damage from Earthquakes

The phrase "the forest is the ocean's sweetheart" became known throughout Japan from a book of the same name written by Shigeatsu Hatakeyama, who works in the fishery in Karakuwa Town, Miyagi Prefecture. Here we will refer to "The Forest is the Ocean's Sweetheart (by Shigeatsu Hatakeyama)".

"Miyagi Prefecture's Kesennuma Bay is an unparalleled good port with deep water and calm waves, which is unique to the deeply indented coastline. It is one of the nation's leading fishing ports and at the same time aquaculture industry is vigorous, with oysters, scallops, and kelp being produced. What increases the value of the fishing grounds of this bay is the Ogawa River, which originates in Murone Village, Iwate Prefecture and pours into Kesennuma Bay, carrying nutrients of the forest all the way to the distant Karakuwa Peninsula. In the past, the delta at the mouth of the Ogawa River was famous as a seed home for premium-quality Nori (*Porphyra tenera*), and the ocean downstream at Matsuiwa and Hashikami were famous as fishing grounds where good-quality seaweed could be harvested. Kesennuma Bay's seaweed cultivation boasted of such outstanding quality and amounts, but the situation changed around 1961, and it turned seaweed cultivation there into a shambles."

Mr. Hatakeyama came to recognize that changes in the watershed as a whole including the sequence of forests, rivers, and the sea, are having major effects on Kesennuma's fishing industry. Such changes included reclaiming land in the tidal flats of the mouth of the Ogawa River that pours into Kesennuma Bay, filling the rivers that feed into the Ogawa River with concrete blocks, reduction of the water level of rivers, and a change of broadleaf tree forests upstream into forest plantations of coniferous trees.

Based on the belief that we cannot protect the rich resources of the sea without the interaction between forests, rivers, and the sea, Mr. Hatakeyama continued to talk with people who live near rivers and in forests, and began to interact with the people of fishery that cultivate oysters and the people who live along the Ogawa River.

After that he expanded his interactions to people in various positions who live in the basin from upstream to the river mouth area, which developed into forestation activities in the upstream area by local fishing people. As a result of those efforts, the forest of Oak (*Quercus crispula*), Beech, and other trees in upstream Muroneyama was named "Oyster Forest" and it has been carefully preserved. This movement has also spread across the nation, and in each region people have become aware of the necessity for management that connects forests, rivers, and the sea.

Due to the massive magnitude 9.0 earthquake centered off the Sanriku coast that struck on March 11, 2011 and the resulting tsunami, fishing industries across a wide area, mainly in areas along the Pacific Coast in the Tohoku region, suffered catastrophic damage. The fishing industry in Kesennuma also had enormous damage; fishing industry facilities such as offices, fishing boats, and cultivation floats were washed away by the tsunami. A ring of support by NPOs and others has begun to spread, and steps are being made in the direction of recovery of the sea.

River mixes with the seawater, and in winter the low-salt content water freezes and turns into sea ice, caused by extremely cold seasonal winds from the northwest. As the sea ice is formed, cold and high salinity seawater, which is heavy, sinks and flows out from the continental shelf. In that process iron supplied by the Amur River is carried to the southern area of the Sea of Okhotsk and the North Pacific Ocean. In the Sea of Okhotsk, these nutrients are used by large amounts of phytoplankton, which becomes food as salmon, trout, cod, herring, saury, crabs, pink shrimp, Hokkai shrimp, scallops, kelp, and oysters, which nurtures the rich offshore fishery of the Sea of Okhotsk.

Seawater that includes nutritional elements has a heavy specific gravity and sinks as far as a depth of 200–500 meters, and it is blocked by the Kuril Islands and changes course. However, because there is a deep trench more than 2,000 meters deep in the Bussol' Strait to the northeast of Iturup Island, it passes through this strait while still containing the nutritional elements, and it is churned by merging with the Oyashio Current on the Pacific Ocean side.

This iron is again supplied to the surface layer by the seawater cycle system that is caused by the cooling of the ocean surface in winter. This supply of the iron causes an increase of growth of phytoplankton. It is known to support the marine and terrestrial ecosystems of the North Pacific. The rich nutrients flowed out of the Amur River nurture phytoplankton and form rich offshore fishery in the seas near Japan (Figure 2-2-5).

Next we will take a look at living organisms in the ocean. There are various patterns in breeding of marine animals and migrating fish and patterns in the processes of growth and development of young fish. For example, there are some fish like salmon, which hatch in inland water areas, swim to the ocean as young fish, grow up in the ocean, and then return again to rivers. There are some fish like eels, which hatch in the ocean, make their way up to rivers as young eels, grow up in inland water areas, and then return again to the ocean. In addition to these migration patterns, there are fish which do something in between, such as sweetfish, that hatch in inland water areas and swim to the ocean as young fish, but return to inland water areas before they grow up, and grow into adult fish there. Japanese perch, which hatch in the ocean, swim to rivers as young fish, and then return again as young fish to the ocean, where they grow up.

For fish that migrate between the two different water areas of ocean and inland water, it is extremely important for their process of growth and development to preserve both environments.

Tracking studies on these migration routes are difficult, and their actual model of life has been a mystery. But

Figure 2-2-6 Eel Migration Route

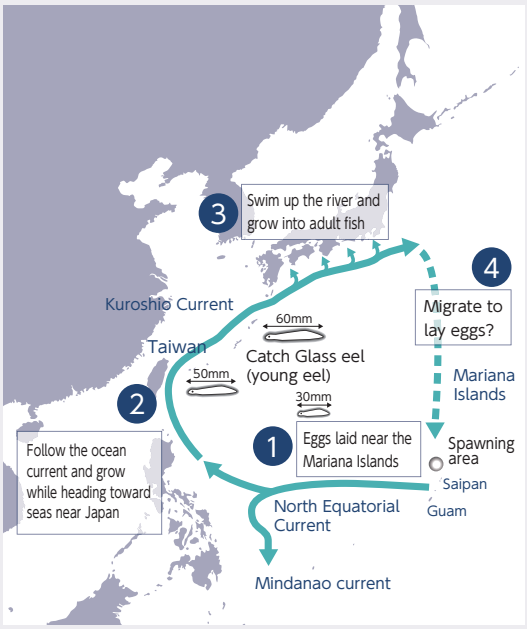
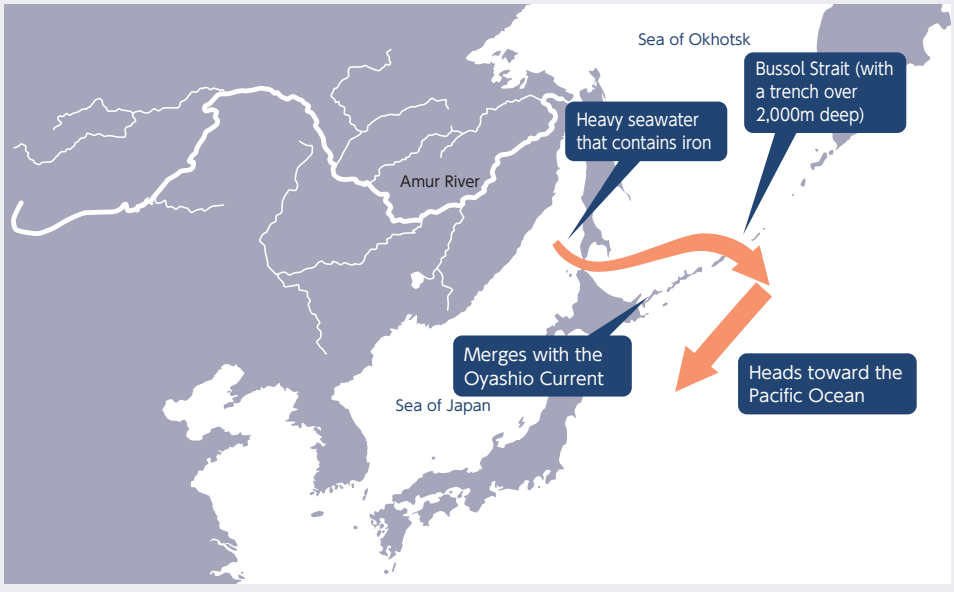


Figure: Created by the Ministry of the Environment, using information from the article "Amazing Discovery of Eel Eggs" in the February 12, 2011 Nihon Keizai Shimbun morning edition

Figure 2-2-5 Iron That Flows From the Amur River, Carried by Ocean Currents



Source: Created by the Ministry of the Environment

recently a portion of the migration route of sea turtles has been clarified by tracking using satellites, baby eel and eel eggs have been discovered in oceans far away from Japan, and accumulation of knowledge related to such animal movement has made remarkable progress (Figure 2-2-6).

Lastly, in contrast to the flow of nutrient from land to ocean, there are also flows that go from ocean to land through rivers. For example, nutrients from the ocean are carried up in rivers by salmon swimming upstream. The salmon that have come upstream are preyed on by brown bears and sea eagles and become wastes such as leftovers and excrement. Nutrient salts are supplied to land by sea birds, which catch fish in the ocean and carry them to their nests in land and return them to soil as waste. These organic molecules are used by the plants and animals living in the forest (Figure 2-2-7)

Figure 2-2-7 Connections based on the Food Chain between Land Areas and Sea Areas in Shiretoko

Source: Shiretoko National Park pamphlet (Ministry of the Environment)

Column

The History of Bird Dropping and Humans

From the time that agriculture began until the present, we humans had a serious problem concerning how to obtain the nutrient salts necessary for fertilization. The three major elements necessary for growing plants are nitrogen, potassium and phosphorous. Potassium is an element that is found in greater amounts in land areas than in the sea. Nitrogen is an element that is circulated through the air and soil by bacteria that can fix nitrogen from the air to the ground. However, phosphorous is abundant in the sea but scarce in land areas, and natural cycle systems for circulating the soil of ocean and land were limited.

Great Cormorants Building a Nest

Photograph provided by Kentaro Takagi of the NPO Japan Bird Research Association

Chile and Peru have large amounts of mineral ore derived from bird excrement called "guano" that sea birds such as Cormorant built up over the past several thousand years. Since the era of the Inca Empire, "guano" has been used as precious phosphorous and nitrogen fertilizer. It is believed that on Chincha Island, which is one of the islands that has guano, there were sediments derived from bird excrement that exceeded 30m. From the 19th century to the 20th century, countries mainly in Europe imported this mineral ore as a resource necessary for fertilizer. It contributed greatly to the increase of food production of in the European region at that time and was treated as important mineral resource for the region.

In Japan as well, it was a known wisdom from long ago to use the excrement of water birds as a means of solving problems related to a shortage of phosphorous. The Great Cormorant in the photograph on the left is one of such water birds.

The Great Cormorant is a fish-eating water bird that inhabits all of Japan. It dives into the water to catch fish across a wide range of water areas from ocean areas to brackish water areas in coastal regions and in freshwater areas in inland regions. It is also known that they cause enormous damage to inland fishery because of the greedy appetite. In order to raise their chicks, Great Cormorants build nests in the tree crowns of forests near waterfronts, and in recent years in Japan they have formed a giant colony of tens of thousands of birds on Chikubu Island in Shiga Prefecture.

Amounts of excrement of Great Cormorants is so large that it causes large impact on vegetation and trees around the colony wither and die. On the other hand, since long ago that excrement has been utilized as very valuable in the form of fertilizer for agriculture.

At Daiganji Temple, which was designated by Chiba Prefecture in 1935 as a natural treasure, there are records of Great Cormorants building colonies from 400 years ago. It is said that the residents carpeted with straw and sand under their nests and they made the fertilizer from the collected excrement until around 1960. The price of the fertilizer reached several thousand yen at that time as important income for the residents. This colony disappeared in 1971 because of development in the surrounding area.

Although the excrement of these birds is no longer used as resource because of the introduction of chemical fertilizers, this can be considered a piece of important wisdom toward coexistence between nature and humans that depend on a nutrient cycle between water and land.

2. Loss of interaction between human and ecosystem

All living organisms, including humans, are deeply interacted with each other. In order to keep interactions in good condition, it is necessary for us to maintain the Earth's environment such as land, ocean and biodiversity, which serves healthy cycle systems of water and air. These biotic interactions in ecosystems are referred to as the ecological network, in which the multi-faceted functions of biodiversity are fully performed. The ecological network provides wildlife habitat and human interaction with nature.

However, in recent years urbanization and other various human activities have caused the loss of ecosystems, fragmentation of the network, and trans-boundary environmental problems that spread through global-scale cycle systems of water and air. Photochemical oxidant causes trans-boundary air pollution, coming from the emission sources through the air and cross national borders to affect even regions thousands of kilometers away. Marine litters comes via the ocean, drifts ashore, and disperses. Here we will consider loss of healthy interactions in the earth's environment caused by human activities.

(1) Loss of interactions in Forest Ecosystems

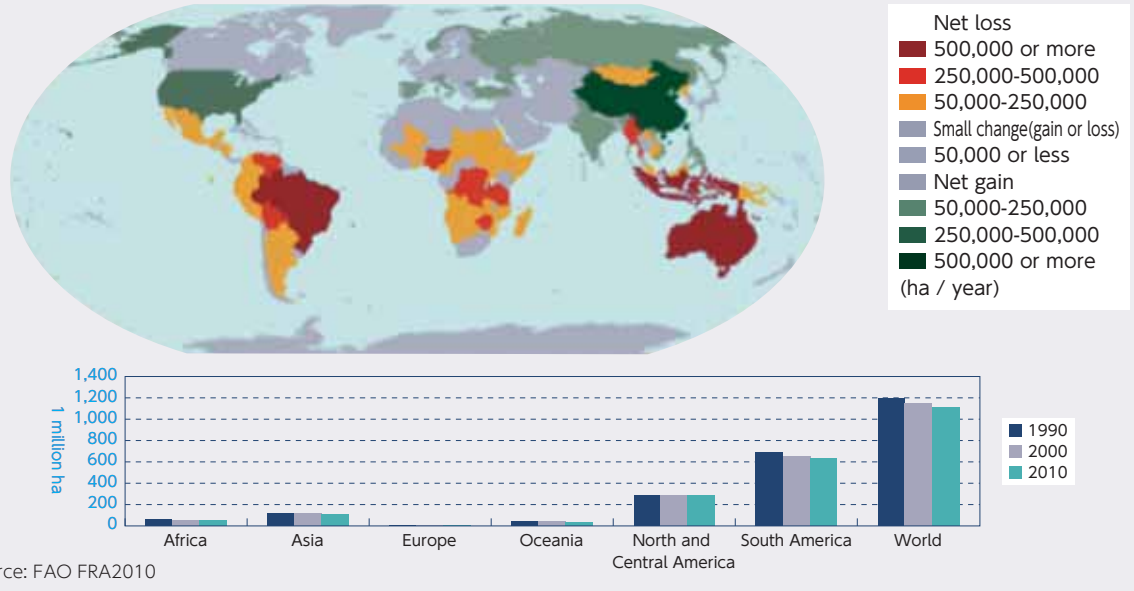
As seen in Chapter 1, the world's forests have been decreasing due to human-caused effects such as commercial logging, excessive logging for wood fuel or converting forests to other purposes such as agricultural land, and due to natural causes such as forest fires.

From 2000 to 2010, each year around 13 million hectares of forests were converted to other uses. In this ten-year period, there has been an annual net reduction of 5.2 million hectares of forests, and although the speed of reduction is shifting slower than the annual 8.3 million hectares of the 1990s, it remains at a high level.

Primary forests, which are important for conservation of biological diversity, exist approximately 1.1 billion hectares around the world and are distributed mainly in North America, South America, and Southeast Asia. Primary forests are declining around the world, with approximately 88.6 million hectares of them disappearing between 1990 and 2010.

It is important to evaluate the degree of the size and connection for measuring the biodiversity of forests. In the tropical forests of Southeast Asia, the fragmentation of forests causes major impacts on the biodiversity of the

Figure 2-2-8 Annual change of forest area by country 2005-2010 (Upper Illustration) and Area of primary forest by region (Lower Graph)



Source: FAO FRA2010

forests. In Thailand, large elephants and tigers are distributed national parks with land area of 1,400 km^2 or more, while neither animal are distributed two-thirds of national parks with 500 km^2 or less. In Malaysian-ruled Sarawak and Sabah on the island of Borneo, orangutans are distributed the approximate area of 2,800 km^2 around the Hose Mountains, while there is no natural distribution of orangutans in national parks of 700 km^2 or less. Large herbivorous animals such as elephants and orangutans have functions of seed dispersal by eating the fruit of plants and moving around expansive areas within forests. Thus fragmentation of forests causes serious impact on plant reproduction that depends on these animals.

Quantitative evaluation methods of the degree of fragmentation has been developed. In Europe, fragmentation of forests is quantified according to the size of patches and distances between patches on maps. From 2000 until 2006, forest fragmentation is increasing in Sweden and Portugal, while forest land size does not decline. In Finland the level of connections is recovering (Figure 2-2-10). In Finland, forest managements based on the Finnish Forest Certification System (FFCS) as a means of sustainable forest management are proceeding, and more than 90% of the forests in Finland are managed under that system.

As for Japan, there remain forests with relatively high connection that run along the mountainous backbone, and around them there are small-scale forests fragmented by agricultural land, city land, and roads. Figure 2-2-11 shows the ratios of forests included in the 500m pixels of the figure on the left and the 4km pixels of the figure on the right, of which color-coding is according to the ratio. These figures suggest tendencies of low fragmentation in the Hokkaido, Tohoku, and Chubu areas and high fragmentation in the Kinki, Chugoku, and Kyushu regions (Figure 2-2-11).

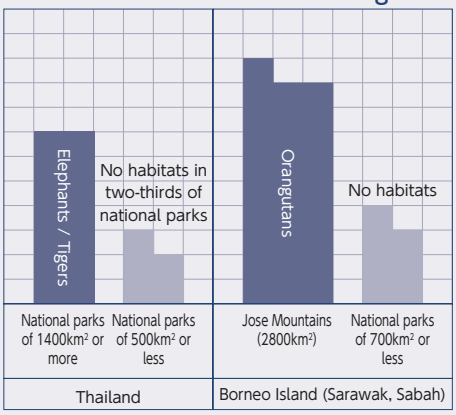
The habitats of wildlife become separated due to fragmentation. Asiatic black bear, a large mammal living in forest, is reported to have a large range of activity; an annual range of movement is about 5,000 hectares for males and 1,000-3,000 hectares for females. Asiatic black bears are regional endangered species of the Shimokita Peninsula, the Kii Peninsula, East Chugoku, West Chugoku, Shikoku, and Kyushu, in which the forests are isolated from the others. They have listed on the Ministry of the Environment's Red List as threatened local populations.

Migration paths called "green corridors" have been established in 24 locations in national forests in Japan, which link the "forest reserve" and serve as networks in order to keep interaction among habitats of plant and animal and to preserve genetic diversity.

(2) Loss of Interactions in Fresh Water Ecosystem

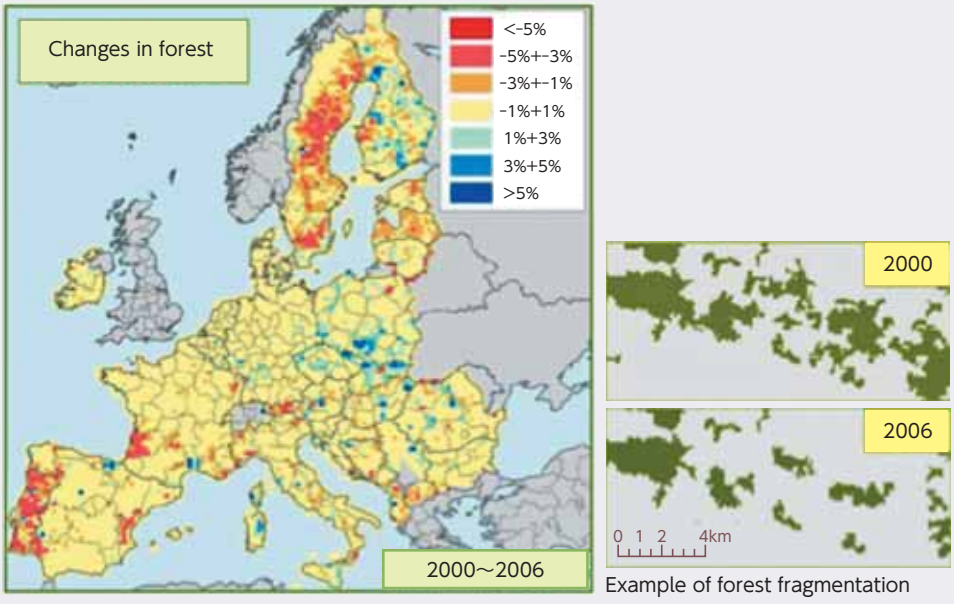
The interactions in fresh water ecosystem are extremely important for living organisms that habit in fresh water areas. For example, adult Tokyo salamanders

Figure 2-2-9 Relationships between Forest Land Area and Existence of Habitats for Large Animals



Source: Created by the Ministry of the Environment, using information from "Tropical Rainforests" by Takakazu Yumoto

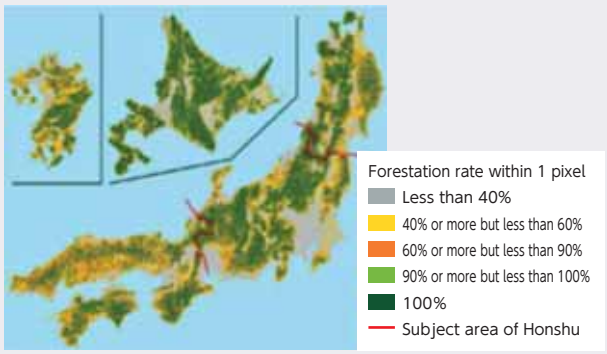
Figure 2-2-10 Changes in Forest Fragmentation in the EU



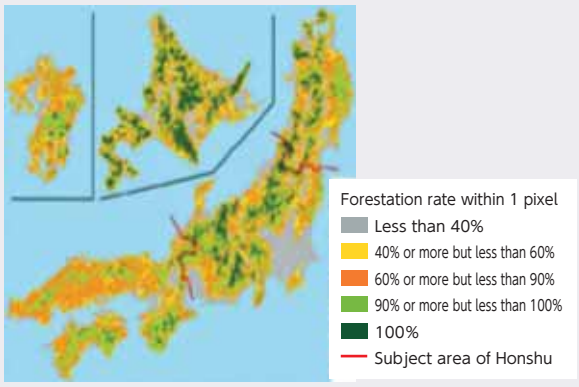
Example of forest fragmentation

Source: EC Joint Research Center European Forest Fragmentation

Figure 2-2-11 Distribution of Forestation Rates in Japan and an Image of a Green Corridor

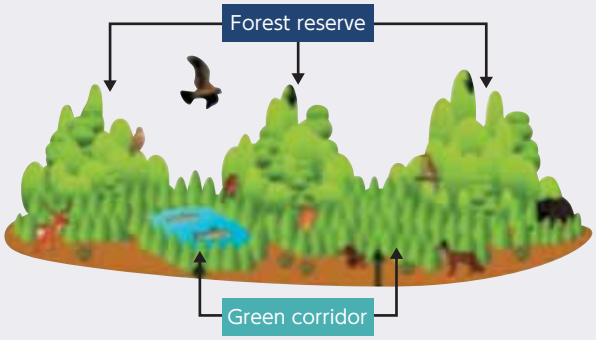


Distribution of forest rate within pixels in the case of 500x500 pixels



Distribution of forest rate within pixels in the case of 4,000x4,000 pixels

【Image of a green corridor】



Source: Forestry Agency Montreal Process Second Report by Country and an image of a green corridor (available in the website)

(*Hynobius tokyoensis*) inhabit forests, but, during their larval stage they move to moist environment such as rice paddies and mountainous wetlands and lay their eggs in water. The distance of movement for their egg laying is approximately 50-130 meters, and they needs interaction between forest and water ecosystems such as rice paddies within a relatively narrow range.

As another example, Japanese giant salamander (*Andrias japonicus*) spends most of their lives in the water of a river. During their breeding season, they move several hundred meters or several kilometers upstream and downstream in the river. It is difficult for them to move back upstream if there is an obstruction of approximately 80cm in height lying across the river. So they rely on a river environment with few obstructions in their habitat.

River ecosystems have been affected significantly by various impacts such as water shortage, changes of river course, fragmentation of river flow, reduction of sand and gravel supply, reduction of flood disturbance and river water pollution. These are because of residential housing and other infrastructural development around riverside and of conversion of floodplains, wetlands and riverfront forests into agriculture land.

According to the United Nations Environment Programme - World Conservation Monitoring Center (UNEP-WCMC), fragmentation due to dams and river deposits can be seen in two-thirds of the world's large rivers. Rivers tend to be highly fragmented in dry areas or in countries with extremely large populations, such as the United States, Europe and China. On the other hand, rivers in areas with low population density, such as Alaska, Canada, and Russia, tend to be not fragmented, and flow freely in their original state (Figure 2-2-12).

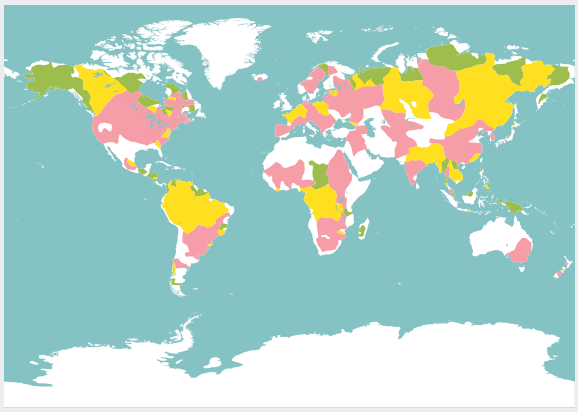
In Japan as well, fragmentation caused by dams can be seen since around 1930s. In the 1990s, Ministry of the Environment had a survey about the range of river flows in which it is possible for fish, such as cherry salmon and sweetfish with strong ability for swimming up, to swim up freely from river mouth to upstream. The 41 % of main rivers in Japan (46 of the 113 rivers) are fragmented rivers in which the range possible for fish to swim up from the river mouth is half or less of the river flow. The 15% of main rivers (17 of 113 the rivers) are highly fragmented rivers in which the range is only a quarter or less (Figure 2-2-13).

It was also reported that change of river basin environments impacts on the ocean environments. Here is an example of the relationship between Sagami River and Sagami Bay in Kanagawa Prefecture.

In the Sagami River, which flows into Sagami Bay, various human activities such as erosion control, construction of dams, and gravel extraction have been carried out. These human activities have various benefits for people's everyday lives, but they also change the dynamics of sediment transport, which recently causes the reduction of dam's capacity for water storage and the impacts on ecosystem of the river basin.

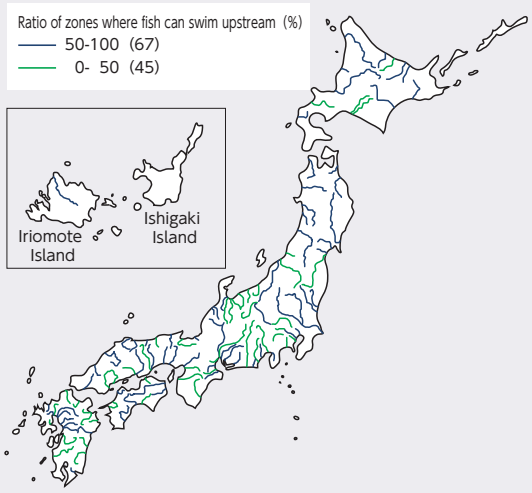
The dams in Sagami River are affected by these changes of sediment transport. In Sagami Dam, sand deposition in the dam is proceeding and the water storage capacity is declining. From Shiroyama Dam to the mouth

Figure 2-2-12 State of Fragmentation of the World's Rivers



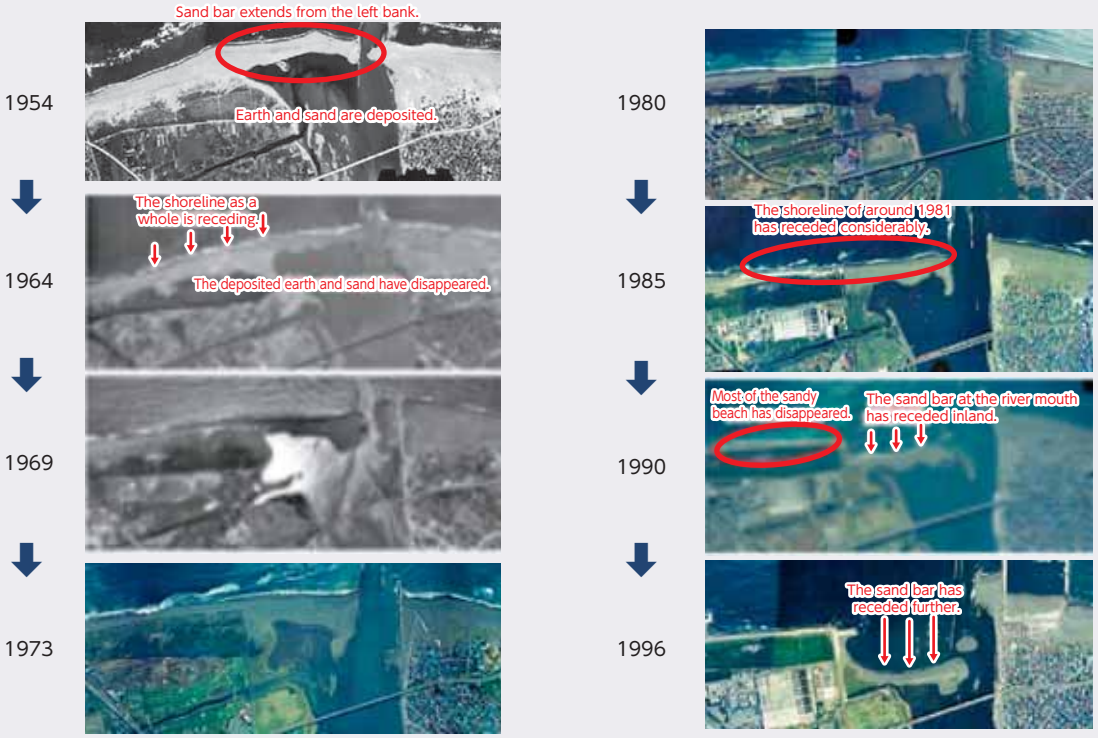
Source: Created by the Ministry of the Environment, using information from the United Nations Environment Planning - World Conservation Monitoring Center

Figure 2-2-13 Ratios of Zones Where Fish Swim Upstream



Notes
1: The rivers subject to the study were 112 Class A rivers and the Urauchi River (Iriomote Island, Okinawa Prefecture). In principle the study zones were the directly controlled areas of main rivers.
2. A zone where fish can swim upstream is the study zone from the mouth of the river up to the first place where there is something lying across the river making it impossible for fish to swim upstream.
3. This is data from a study conducted in FY1998, but it does not necessarily indicate the exact situation of that fiscal year.
Source: Environment Agency, Basic Study on Preservation of the Natural Environment, Study on Rivers (5th)

Figure 2-2-14 Changes in the River Mouth of the Sagami River

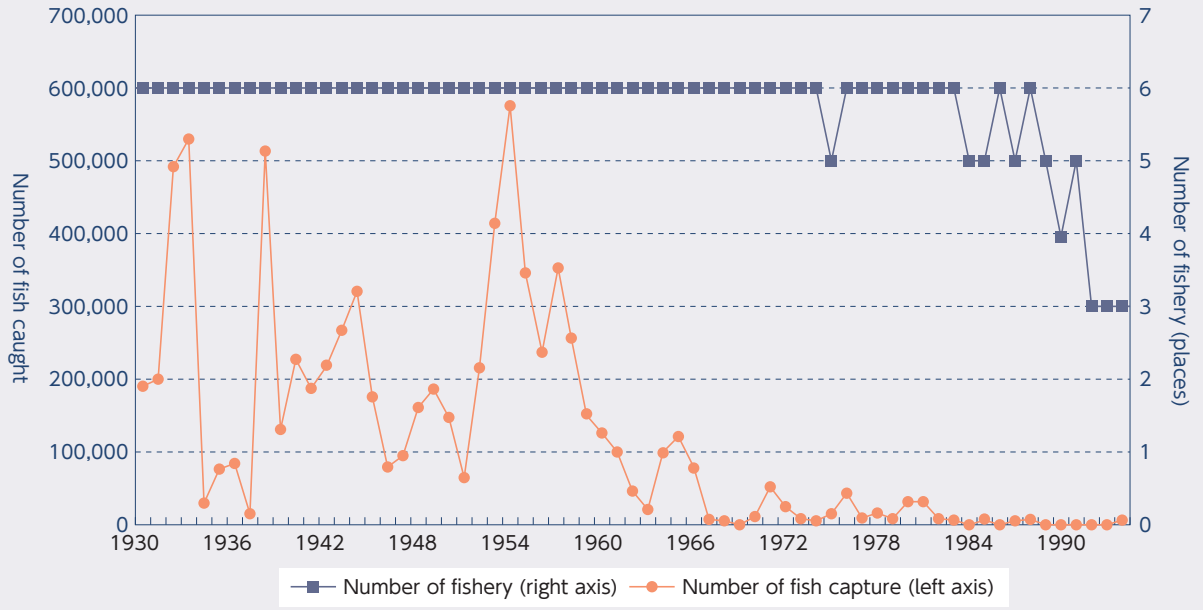


Source: Ministry of Land, Infrastructure, Transport and Tourism, "Basic Policy for Improvements of Sagami River Water Systems, Management of Earth and Sand."

of the river, which is the mid- to downstream of the Sagami River, riverfront ecosystems are destructed due to reduction of gravelly dry riverbeds. The environment of rapids and pools of the river become to worsen, which is needed for aquatic organisms as their habitat. These are because of a reduction in the amount of gravel movement due to dam construction. In coastal areas around the Sagami River mouth, there is a decline of tidelands that are stopover site for migrating birds, and the sandy beaches on the Chigasaki coast are receding (Figure 2-2-14).

In ocean areas of Sagami Bay, the fish migratory path way of yellowtail has changed. Around 1955 Sagami Bay was one of Japan's leading near shore fishery for yellowtail and there were maximum captures of approximately 600,000 fish. But since the 1990s the numbers have decreased between several dozen fish and several thousand fish (Figure 2-2-14). There are various

Figure 2-2-15 Shifts in the Number of Yellowtail Capture in Sagami Bay



Source: Created by the Ministry of the Environment, using information from "Changes of Set Net Type - Changes of Set Net Type in Sagami Bay - 2. Big Set Net Type" by Taisuke Hiramoto

Figure 2-2-16 Image of Marine Recovery Action

・The pollution load from land areas is large.
・Purification abilities in ocean areas are declining.

Recover of a beautiful, approachable, rich ocean, through a forest-river-ocean network
※This image depicts Osaka Bay.

Source: Japan Coast Guard, Bay recovery Project website

conceivable causes for this, but in order to restore yellowtail capture, local government are trying to keep the interaction with forests and the sea by restoring the forests in the upstream region of the Sakawa River, which flows into Sagami Bay (Figure 2-2-15).

In the perspective of management of the wide-range environment from land areas to ocean through rivers, integrated management of the river basins is being promoted. As an effort to promote improvement of the environment, there is a Bay recovery Project that is being jointly implemented by the national government, local governments, and various organizations (Figure 2-2-16). At present, work is being done in the four places of Tokyo Bay, Osaka Bay, Ise Bay, and Hiroshima Bay to conduct monitoring based on quantitative scientific data. and efforts are taken to improve ocean area environments, improve sewage systems in basins, reduce pollution from river, and collect waste in ocean areas.

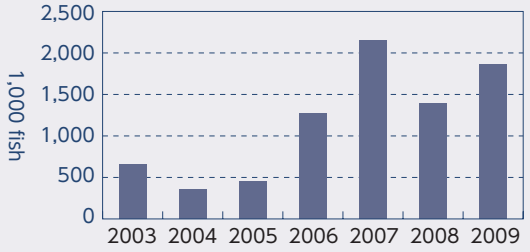
In recent years some of basin environments are heading in the direction of improvement. The environment of the Chikuma River in Nagano Prefecture was improved through adjustment of water amount, and in 2010 salmon swam upstream for the first time in 65 years.

The water quality of Tama River, which flows out from Mount Kasatori in Yamanashi Prefecture and flows into Tokyo Bay, has been improved and in recent years the population of young sweetfish swimming upstream is increasing. These are results of improvements of sewage treatment in the basin, while it has still been affected by environmental impacts such as spread of invasive alien species like black bass and a trend of increasing river water temperature (Figures 2-2-17, 18). Further, Tama River was designated a model river since 1991 under the "Program for Improving Rivers of Fish Easily Swimming up" and fish passages has been made on dams that were obstacles for fish swimming up.

(3) Trans-Boundary Pollution

The first time that trans-boundary air pollution became a problem was in the 1960s and 1970s when acid rain was affecting the ecosystems of lakes and forests and

Figure 2-2-17 Trends in the Number of Young Sweetfish Swimming Upstream in the Tama River (Estimated Numbers)

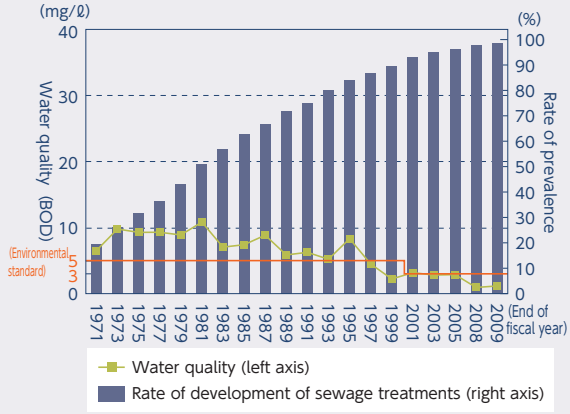


Source: Tokyo Islands General Center for Agriculture, Forestry, and Fisheries

Figure 2-2-19 Damage to Crops and Plants Caused by Photochemical Oxidants

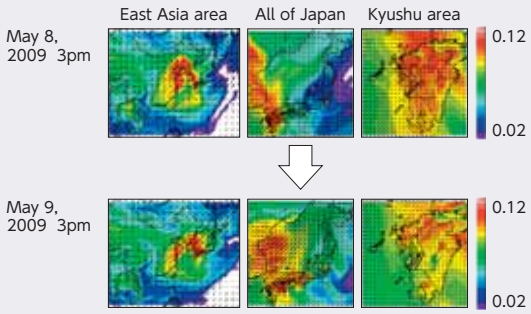
Photographs provided by the Center for Environmental Science in Saitama Prefecture

Figure 2-2-18 Trends in Rate of Prevalence of Sewage Systems and Water Quality in the Tama River Basin



Note 1: Rate of prevalence is the rate of prevalence in the Tama River basin.
Note 2: Water quality is the annual BOD value at the Tama River Hara Bridge (75% water quality value)
Source: Bureau of Water Management, Tokyo Metropolitan Government

Figure 2-2-20 Air Pollution Prediction System



Source: National Institute for Environmental Studies, air pollution prediction system

traditional buildings in North America and Europe. It is known that through air cycle systems on a global scale acid rain damages on areas several thousand kilometers away from the source of the material that caused it, and it is an environmental problem that crosses national borders.

In Japan, efforts related to trans-border air pollution, which was initially targeted at acid rain, have in recent years broadened to target photochemical oxidants. Photochemical oxidants are the substances that cause photochemical smog, which damages human health, crops, and plants (Figure 2-2-19).

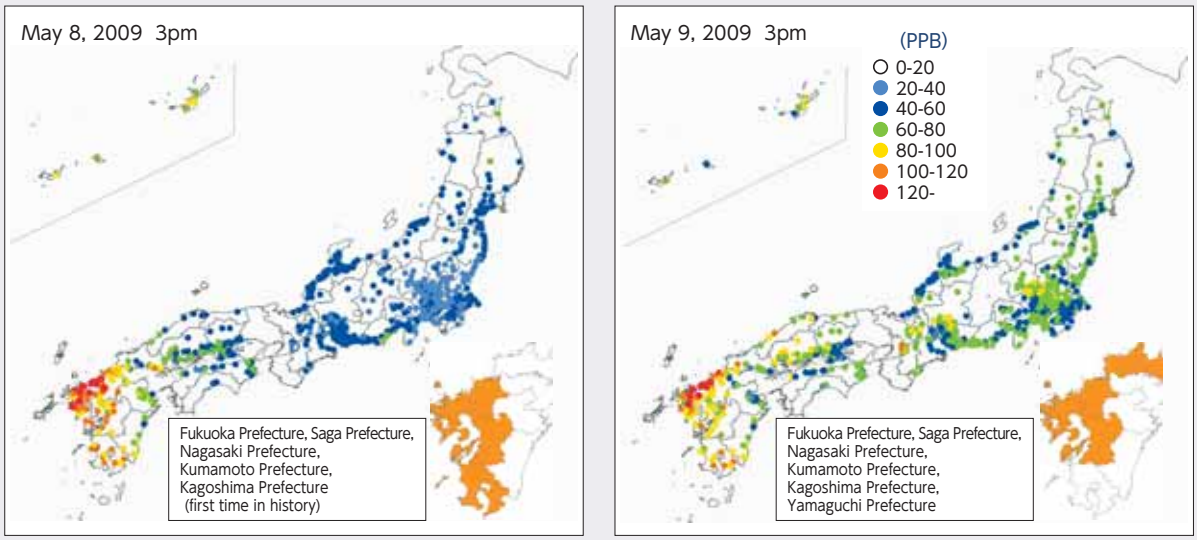
Highly concentrated photochemical oxidants continue to be observed. In May 2009 an increase of concentration was seen across a wide area in the Kyushu and Chugoku regions, and a photochemical oxidant warning was issued for the first time in Kagoshima Prefecture. When it is predicted that photochemical smog can easily develop across a wide area, the Japan Meteorological Agency announces information about general smog weather. The National Institute for Environmental Studies uses an "air pollution prediction system" to predict the air pollution concentration of photochemical oxidants and nitrogen dioxide in the East Asian region from a weather model and a chemical transport model, and announces the results every hour on a trial basis in the form of a distribution map of pollution concentration (Figure 2-2-20). This prediction system divides East Asia into meshes of 100 km^2 and Japan into meshes of 25 km^2, and since April 2010 it has been possible to indicate prediction results for all of Japan. Figure 2-2-20 shows in color gradation from yellow to red the areas for which highly concentrated photochemical oxidants were predicted by the air pollution prediction system in May 2009. Meanwhile, Figure 2-2-21 shows the distribution of concentration actually measured by the Ministry of the Environment's "Sora Mame Kun (Atmospheric Environmental Regional Observation System)" and the state of photochemical oxidant warnings issued. According to these figures, on May 9 in each of the areas of Japan where highly concentrated photochemical oxidants were predicted, air pollution was actually measured.

There is also an environmental problem of trash that drifts via circulation in the ocean: it affects scenery and leisure; it affects security of everyday life, which is especially caused by medical waste; it affects the fishing industry and marine transport due to interference with navigation; and it affects living organisms in the ocean by entangling their bodies.

In Japan, related ministries and agencies are tying up under the Council for Promoting Measures Against Marine Litters, which was newly established based on the Law Concerning the Promotion of Disposal of Marine Litters for Conservation of Good Scenery and Environment on the Coasts. And monitoring of marine litters, studies for source of them, and actions against marine litters are going forward. Moreover, in order to strengthen world-wide measures to this problem, cooperation such as mutual information exchanges and policy dialogues for investigating for resource of marine litters come from are being promoted through.

All of the organisms on the Earth, including humans, are able to receive various benefits from the Earth by keeping ecosystem in good condition. The healthy interactions between ecosystems and organisms are essential to the existence of all organisms.

Figure 2-2-21 State of Photochemical Oxidant Warnings Issued



Source: Ministry of the Environment's Atmospheric Environmental Regional Observation System

Section 3 Wisdom in Order to Take over the Earth to Future Generations

The loss of biodiversity caused by changes in our society and economy affects the interaction between organisms on the Earth as well as our everyday and traditional lifestyle. What are necessary for taking over our life and culture across generation, and for preservation and sustainable use of biodiversity?

In this section we will focus on "wisdom" and consider how to achieve a sustainable society which reflects the geographical and climates conditions in regions.

1. Wisdom in Our Everyday Life

Here we try to get the hints of the wisdom from our everyday life through clothing, cooking and housing.

(1) Wisdom in Life Cycle of Japanese Traditional Clothing

Japanese traditional clothing "Kimono" is made from linear parts of cloth. A piece of rolled cloth called a "*tan-mono*", that is about 12 meters in length and 36 centimeters wide (for clothes of a woman who is 160cm tall), is cut into several liner parts and then sewed them flatly together. Kimono is "incomplete", in a sense, at the product stage because they acquire a function as clothes when it is "wrapped and fitted" to fit one's body shape who wears it, while western clothing is made "completely" by sewing parts of cloth together three-dimensionally at the product stage (Figure 2-3-1).

Because of this style of Japanese traditional clothing, it is relatively easy to return it from clothes ("Kimono" state) to rolled cloth (its original "*tan-mono*" state). In addition, silk, which is one of the materials used in the fabric of Japanese traditional clothing, is a very strong fiber that silkworms produce within their bodies. If managed appropriately, it can use over an extremely long time, and rolled clothes can be retailored to fit one's body shape and preferences.

Kimono that was tailored in a parent's generation can be retailored to fit preferences and body shape, and then passed on to a child's generation and in some cases even carefully passed on to a grandchild's generation. After that, when the clothes finally can no longer, it can be reused as house hold uses such as children's dolls and wallets. This important resource from living organisms can be used to the end with none to waste.

This recycling system of Kimono was general in the Edo Period. Clothes were so expensive that people needed to continue to wear as long as possible. This was a spirit to use the value and role of the products to the end. This is summarized in a word "*mottainai*" (means "what a waste!"), and this spirit is one of important wisdom in our everyday life for the sustainable use of resources.

(2) Local Production for Local Consumption and Seasonal Production for Seasonal Consumption: Wisdom for Controlling Consumption

Next we will discuss the wisdom for sustainable use of resources, focusing on Japan's dining table.

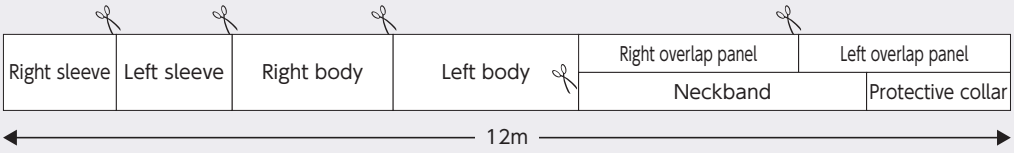
Agriculture, forest, and fishery products are important products that are derived from the ecosystem services that are based on biodiversity. We have obtained,

Figure 2-3-1 Examples of Kimono and an Example of Cutting a *Tanmono*

Kimono with dyed threads (cooperation from the Nishijin Textile Industrial Association)

Clothing from the Heian Period

Child's kimono



Source: Ministry of the Environment

Ingredients and Dishes from Throughout the Year

Source: Ministry of the Environment

cooked, and eaten foods that reflect the geographical and climate background. We not only eat food in order to get nutrients but also to enjoy our everyday lives through meals that use ingredients available from the ocean or mountains in each season. Japanese people enjoy butterbur sprout and bamboo shoots in the spring, bonito in the summer, chestnuts and persimmons in the fall, and wild boar meat and mountain vegetables and mushrooms that have been preserved in salt or by drying in the winter.

In each region of Japan there are many varieties of vegetables that reflect the climate of the region and that are familiar to the people living there, since the people have produced them in that region for a long time. For example, there are 41 varieties of traditional vegetables from Kyoto, such as Kintoki carrots and Kujo green onions, and 14 varieties of traditional vegetables from Aizu, Fukushima Prefecture, such as Aizu Kogiku squash.

"Local Production for Local Consumption and Seasonal Production for Seasonal Consumption" is an effort for encouraging consumption of crops in the regions where the crops are harvested. In recent years these efforts have been drawing attention from the aspects of consumption efficiency and food security. If crops are transported to distant places and consumed far from the places of production, more energy is needed for such style of consumption than the style of consuming without transportation. Consuming local products in the places of production, the distance for transportation of the crops will become shorter and the amount of energy use for transportation can shorten consumption energy. By production of vegetables that are adjusted to the climate, consumption required for production can shorten consumption energy. There are also advantages for consumers, because they can feel comfortable due to such so-called "agriculture with a visible face" since crops are produced nearby.

Production and consumption of food that are adjusted to the climate will enable us to achieve high energy efficiency required for mass ransportation, reduce the impacts on the environment and enjoy the seasonal change and comfortable everyday life.

(3) Efforts for Creating Residential Spaces that Reflects Climate Conditions

Kenko Yoshida, who was a Japanese monk and author in 13th to 14th century, wrote in the 55th essay of his work entitled "Tsurezuregusa (Essays in Idleness)", "A house should be built, considering the summer condition. In winter one can live anywhere." While this expression may be a bit of an exaggeration, it was an important perspective to build a well-ventilated and cool home in order to escape the humidity and hot air of the summer at that time, when there were no air conditioners.

Since in modern buildings people artificially control room temperature by air conditioners, constructing entire

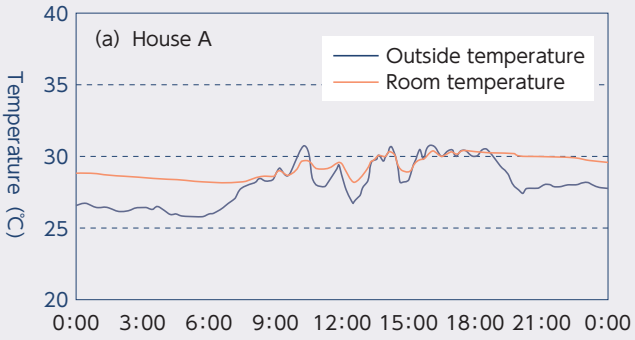
buildings tend to be highly insulated and air-tight, and to maintain a pleasant living space while at the same time conserving energy.

On the other hand, this direction of modern design is not necessarily appropriate for all regions of Japan. For example, in Okinawa, which has subtropical weather, buildings made of reinforced concrete after World War II, which is strong against damage from typhoons and termites. People rely on artificial cooling by air conditioners to deal with the heat and humidity, but the increased air-tightness of buildings causes indoor mold. For that reason, it becomes problem whether that was truly a pleasant living environment and whether it was an efficient design in terms of energy conservation.

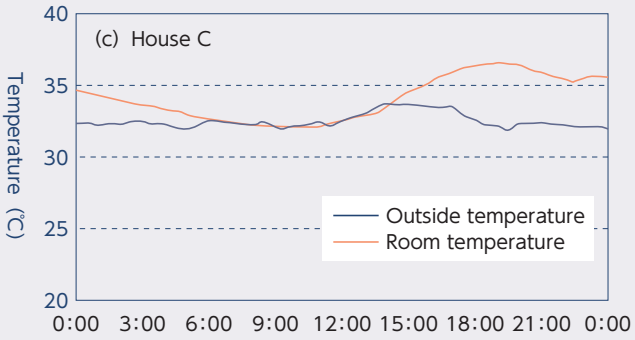
Here is a study for comparing ventilation of the traditional houses and modern houses in Okinawa. Because traditional Okinawa houses have an open and well-ventilated structure, changes in room temperature tend to quickly respond to changes in outdoor temperature. On the other hand, houses made of reinforced concrete shift at almost the same temperature as the outside temperature during the day, but then room temperature suddenly rises from late afternoon until around 7pm and goes back down to about the same level as outside temperature from evening until daybreak. The difference of temperature between inside and outside of houses is higher in houses made of reinforced concrete than it is in traditional houses. Residences made of reinforced concrete are easy to be heated up (Figure 2-3-2).

In Okinawa, this function of well-ventilated traditional houses is reevaluated. In recent years, well-ventilated Piloti architecture and passive cooling systems that do not rely on air conditioners are drawing attention as residences made of reinforced concrete not only to

Figure 2-3-2 Changes in Room Temperature in Okinawa Buildings and Outside Temperature



Examples of changes in temperature and room temperature (Photograph of traditional house provided by NPO Takidhun.)



Examples of changes in temperature and room temperature (House made of reinforced concrete)

(*) All measurements were made of houses when air conditioners were not being used. The graph is an example of data from one day during the measuring period when the weather was good. Photographs are not of the actual houses subject to the study. They are examples of a traditional house and a concrete house in Okinawa.

Source: Study on actual environmental conscious and healthy houses fit for climate and living environment in subtropical Okinawa
Junichiro Tsutsumi, Tetsuya Ando

Nago City Hall, which was designed with the aim of not relying on large-scale air conditioning (Photograph provided by Nago City.)

prevent damages from typhoons, but also to achieve high energy efficiency.

Our traditional life style reflects the geographical and climate background, which is unique in region to region. People achieve the traditional wisdom in this regional background. The modern lifestyle of mass production, mass distribution, and mass consumption that was rapidly achieved after World War II is not necessarily suited to the geographical and climate conditions of each region, and it cannot be denied that this modern lifestyle impacts on the environment and causes the loss of traditional uniqueness. There is probably a great possibility that wisdom in traditional life style will be of use in order to reconsider our modern lifestyle and achieve the sustainable society.

2. Wisdom Within Regional Communities

(1) Life style in Satoyama Communities and Biodiversity

In Japan, over many years there has been a spread of secondary nature areas, which people in many ways maintain through agriculture and fisheries, such as farming land, plantation forests and secondary forests, irrigation ponds and canals, grasslands, and settlements. Those kinds of nature areas are referred to as satochi-satoyama, and since long ago we have been using the natural resources around us as the resources necessary for everyday life.

While living in satochi-satoyama, Japanese people have not consumed all of natural resources, but have instead continued to use them sustainably. For example, cultivation of rice (wet-paddy rice), which is Japan's most important crop, is suited to Japan's climate, which has a lot of rain throughout the year. It can be considered a sustainable and highly productive farming method, since it has withstood over 1,000 years of continuous cultivation. In addition, secondary forests including Sawtooth Oak, Quercus, and Japanese Red Pine are managed by logging in a cycle of approximately 10 to 20 years. Satochi-satoyama varied across Japan. They form ecosystems and scenery that are unique to each region.

(2) Sustainable Use of Hunting Resources and Traditional Wisdom

The wisdom in everyday life reflects the interaction between people and nature, and thought to be rooted in regional communities as culture and traditional techniques. Life in the Matagi community, which is group of traditional hunters with techniques and an organization for capturing large animals, can be given as an example of people who have sustainably used natural resources within the capacity of the natural environment and nature's ability to restore it. They have taken passes on the traditions and culture of their region.

Records of the history of use of game resources in Japan date back a long time. The Nihon Shoki, which was written in the year 600s, has descriptions of deer hunting in which deer were shot down from atop a horse, as well as descriptions of restriction of dangerous hunting methods such as pitfalls and fall traps. In the 1500s, records can be seen that indicate that Matagi communities had formed, mainly in areas between mountains in the Tohoku region.

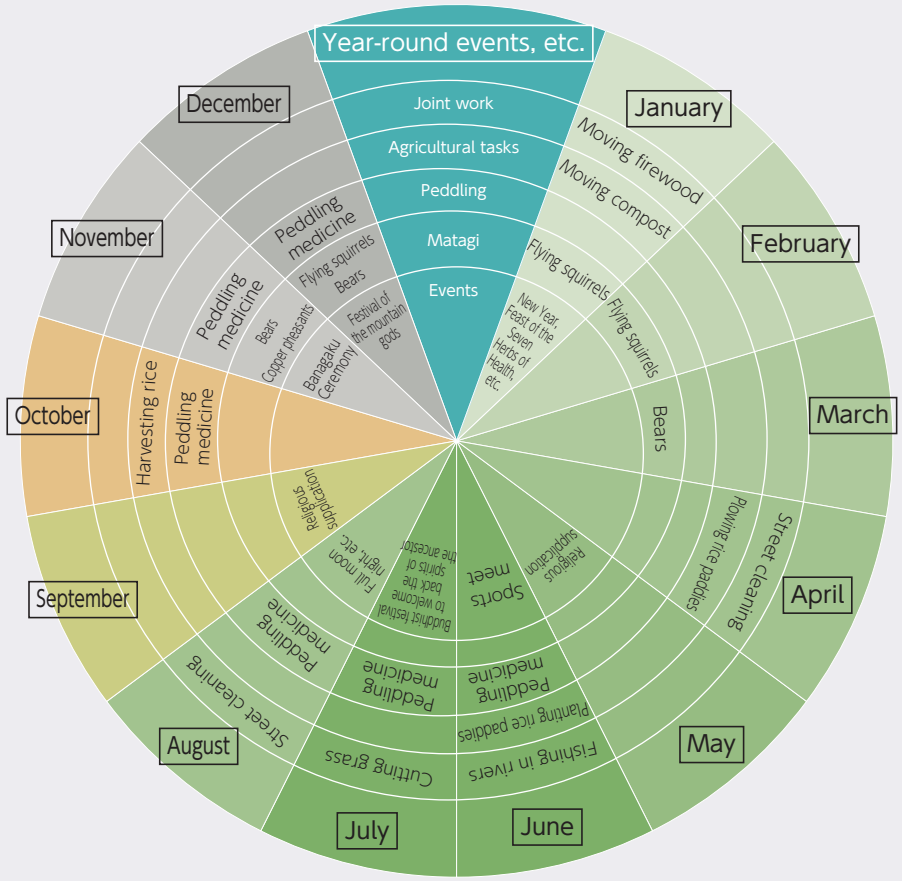
People who lived in Matagi communities did not hunt all year round. They led their everyday lives by dividing activities into agriculture in the summer and hunting in the winter (Figure 2-3-3). The best game for the Matagi were large animals such as Asiatic black bears and it was life-risking work in the winter. So they abstained from hunting any more than they needed by strict command-

Satoyama and various forms of wildlife that inhabit satoyama

Living organismsfrom all four seasons can be seen near satoyama.

Source: Ministry of the Environment

Figure 2-3-3 Example of a Year in a Matagi Community around 1955



Source: Created by the Ministry of the Environment, based on information from the Akita Prefecture Designated Tangible Folk Cultural Assets Ani Matagi Tools Cultural Assets Record Creation Study Report

ments and prohibitions based on religious faith in the gods of the mountains.

The ways of life in the Matagi communities in the Tohoku region, which is based on a hunting tradition coexisting with nature, became known across Japan around the 1930s, but in recent years the traditional Matagi lifestyle have been disappearing as lifestyles become modernized. In the Ani region of Akita Prefecture efforts are being made to pass down the traditional Matagi lifestyle.

(3) Conservation of Biodiversity and Cooperation with Stakeholders of the region

For preserving biodiversity and achieving sustainable use of the natural resources served by biodiversity, here we will discuss the importance of cooperation with stakeholders living in the regions.

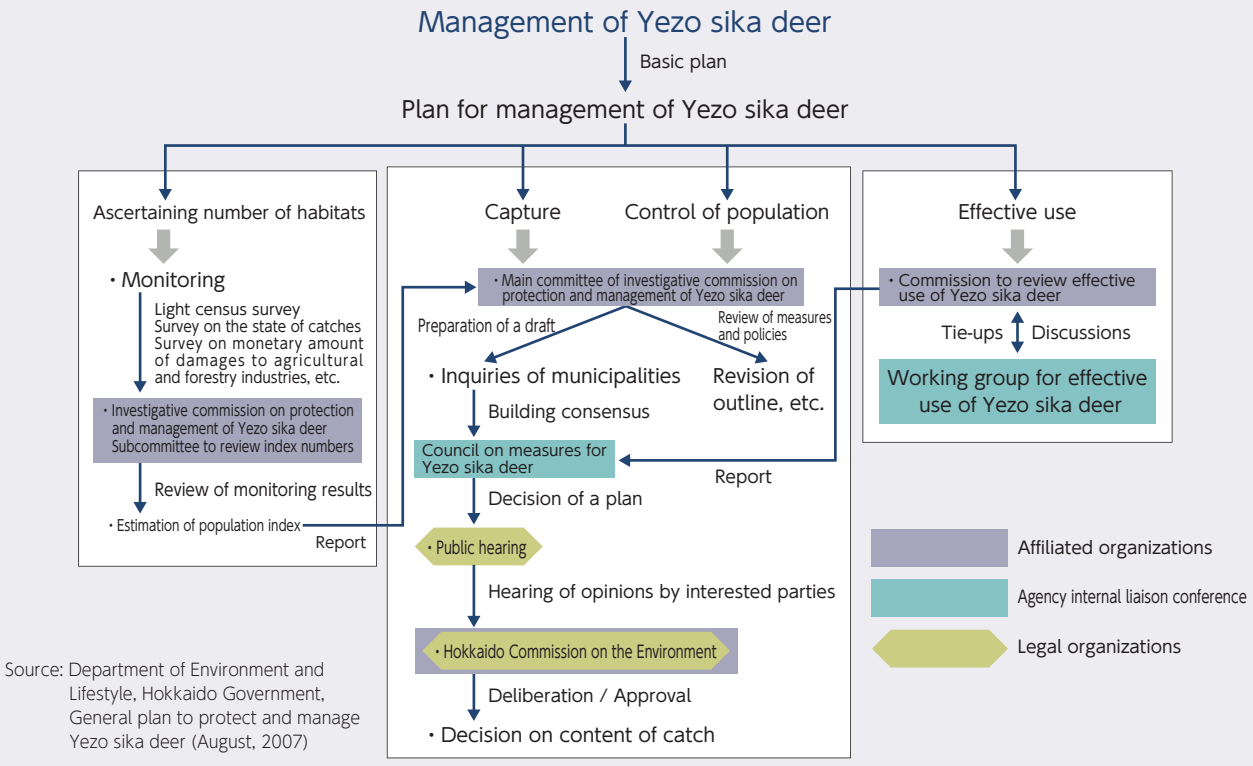
In Hokkaido in recent years there has been a increase in sika deer and it is having a serious damage on society and the economy in the prefecture. In order to manage those deer, local public organizations and residents of the region are cooperating to efficiently use deer meat as the high-class ingredient cibie. Hunters are given incentives for catching the deer, and efforts are being made to develop the region using the deer as a regional natural resource (Figure 2-3-4).

At Tanzawa in Kanagawa Prefecture, in order to conserve the water resource and promote integrated management of mountain forests, rivers and city areas, private-sector organizations and private corporations are working together to manage a water regulating forest through forest restoring (Kirin Brewery Company, Ltd.), thinning work (Suzuhiro Kamaboko Company, Ltd.), and nature trekking (Honda Gakuen Tsukuno Kindergarten).

In order to preserve biodiversity involving regional stakeholders, efforts has been taken based on biodiversity regional strategies. In the "Biodiversity Hyogo Strategy," Hyogo Prefecture cooperates with approximately 40 NPO and other groups. In addition, regional agricultural products are being made into brands, such as "Rice Cultivated by a Stork." There is increasing promotion of dietary education about local production and local consumption, and biodiversity is being conserved by cooperating with regional stakeholders (Figure 2-3-5).

Amid these efforts, regional residents change their awareness about biodiversity. For example, due to the release of Japanese crested ibis in Sado Island in September 2008 in order to return them to the wild, the awareness of residents in the region has been changed, such as that they feel that the Japanese crested ibis are familiar to them. In order to protect and manage threatened wildlife that live near human habitation, it is necessary to have the understanding and cooperation of the residents in the region. It is possible to build good relationships between the residents and nature by making efforts that include the stakeholders in the region.

Figure 2-3-4 The Flow of Building Consensus for Managing Yezo Sika Deer in Hokkaido



Source: Department of Environment and Lifestyle, Hokkaido Government, General plan to protect and manage Yezo sika deer (August, 2007)

Meanwhile, the number of people in the forestry and agricultural industries, who directly interact with nature in the places closest to mountains and forests, has been declining every year. The number of households involved in forestry declined by approximately 20 percent from the 1980s to the 2000s, and the number of households involved in agriculture declined by approximately half. The number of hunters, who have direct interaction with wildlife through the hunting activity of capturing wild birds and mammals, has also gone from a peak of approximately 500,000 people in the 1970s to less than half that at present.

Such decreases in human approaches toward forests and decreases in the number of people who manage forests are significantly affecting biodiversity. Increases in wild birds and animals such as deer and wild boar in recent years are a considerable example of this, and damage to the agriculture, forestry and natural vegetation due to strong pressure are occurring at high levels (Figure 2-3-6).

Cooperation with stakeholders who live in regions is an essential component when preserving biodiversity. For that reason, the question of how to develop the human resource to manage biodiversity is an extremely important.

3. Toward Sustainable Use of Biodiversity

(1) Fundamental Viewpoints for Achieving Sustainable Use of Biodiversity

It is possible to get a variety of hints from the wisdom in everyday life which reflects the geographical and climate condition of each region, because it is full of suggestions for achieving a sustainable society. It is necessary for the world to take action for achieving sustainable use of natural resources with the traditional wisdom which interacts to scientific knowledge, considering the international movement in order to achieve Earth's sustainable environment and essential elements which should be given equally for all people. These wisdom and knowledge should be shared among people who actually take actions.

Here we will give fundamental viewpoints about methods of evaluation based on scientific knowledge and of management that uses economical methods toward achieving sustainable use of natural resources.

(2) The method of Evaluation Based on Scientific Knowledge

Although there is not enough scientific knowledge about ecosystems, efforts are taken to evaluate the state of ecosystems and the biodiversity loss, using the knowledge available at present. As examples of international efforts, the "Millennium Ecosystem Assessment (MA)" was conducted from 2001 until 2005, in which over 1,000 specialists participated on suggestion by the United Nations. The "Global Biodiversity Outlook (GBO)" was conducted three times (in 2001, 2006, and 2010) by the Convention on Biological Diversity Secretariat.

In Japan, "JBO: Japan Biodiversity Outlook" was published by the Committee on Comprehensive

Figure 2-3-5 Cooperation with Specified Nonprofit Corporations under the Biodiversity Hyogo Strategy

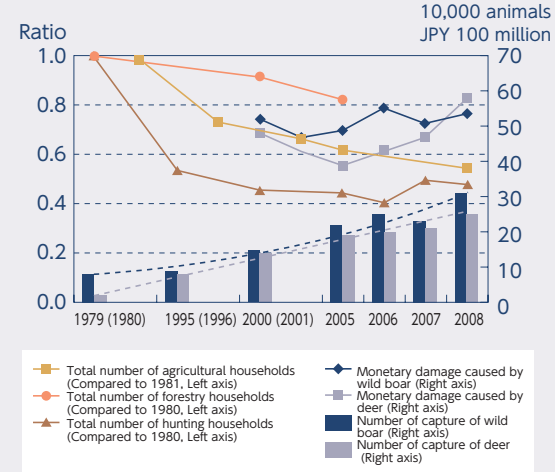
Source: Hyogo Prefecture's Biodiversity Hyogo Strategy

Assessment of Biodiversity set up by the Ministry of the Environment in 2010. JBO assesses the biodiversity of Japan over the past 50 years (Table 2-3-1). We will look at the results in detail in Chapter 3.

Efforts based on scientific knowledge are being made in relation to forest resources. In order to assess the progress in sustainable forest management, since 1994, the Montreal Process has been conducted, with participation by 12 major countries that have temperate and boreal forests, such as Japan, Canada, and China. In this process, criteria and indicators are set in order to preserve forests and manage them sustainably. Based on this, in October 2009, the Forestry Agency published the "Montreal Process Second Report by Country," which assesses the state of Japan's forests and forest management according to 7 criteria and 54 indicators.

Japan's fishery resources are also well assessed. Studies of the fishery are being conducted in order to estimate how rich fishery resources, to calculate biologically total allowable catch of fish to analyze information on catches by fishing boats and measurement of catches at fishing ports, and to survey samples. Data available from studies is used as a scientific basis for setting total allowable catch (TAC) and is necessary for management of fishery resources.

Figure 2-3-6 Decline in People's Involvement with Forests and Increase in Damage Caused by Mammals



(Note) Parentheses contain the year of data for total number of agricultural households.
Source: Created by the Ministry of the Environment, using information from Ministry of the Environment statistics on birds and mammals and an agriculture and forestry industry census conducted by the Ministry of Agriculture, Forestry and Fisheries

Table 2-3-1 Main conclusions of Japan Biodiversity Outlook (JBO)

Ecosystems that show a considerable loss of biodiversity	The degree of loss of biodiversity has been especially large in inland water systems, marine and systems, and island systems. The trend towards biodiversity loss continues up to now
Drivers of loss of biodiversity	① As for the "crisis caused by human activities, especially development (First Crisis)," although the speed at which loss of biodiversity attributable to this crisis has eased somewhat, effects from past development will still continue from now on. ② As for the "crisis caused by reduction of human activities (Second Crisis)," that crisis is now intensifying. ③ As part of the "crisis caused by species brought in by humans (Third Crisis)," the effects of invasive alien species are particularly prominent. ④ As for the "crisis caused by climate change," there are concerns about some fragile ecosystems, particularly alpine flora and coral reefs.
State of responses	Although various response have been taken to address loss of biodiversity and these responses have been effective to a certain degree. But given the major socioeconomic changes that indirectly drive biodiversity loss. These responses have not been sufficiently effective.
Direction of future responses	Because regional uniqueness in biodiversity is important, it will be important for various measures that include the constituents to be taken amid social and economic activities (make biodiversity mainstream).

Source: Ministry of the Environment

Table 2-3-2 Scientific and Quantitative Assessment of Biodiversity, and Examples of Economic Means of Preservation Measures and Policies

Field of measures and policies	Main examples		Overview
Quantitative assessment of biodiversity	Millennium biodiversity assessment		Large-scale comprehensive assessment of biodiversity that was carried out from 2001 to 2005 with participation of 1,360 specialists from 95 countries, based on a call by the United Nations
	Ecological footprint		Quantitative assessment of environmental impact, based on the values found by comparing the Earth environment's intrinsic production abilities and the amount of human consumption, and calculating an ideal land area referred to as a "global hectare."
	TEEB: The Economics of Ecosystems and Biodiversity		Analysis conducted mainly by United Nations Environment Planning (UNEP) concerning the economic value of biodiversity, and costs due to loss and preservation of biodiversity
Conservation of biodiversity and sustainable use using market mechanisms	Economical incentives	Payment for ecosystem services (PES)	Parties receiving the benefits of ecosystem services pay compensation costs to parties managing resources.
		Taxation	Taxes are applied to actions that affect biodiversity.
		Subsidies	Subsidiaries are paid for actions that contribute to preservation of biodiversity, or subsidiaries that have a negative affect on preservation of biodiversity are eliminated.
		Trading of rights	Rights for using the environment are assigned as certificates, and environmental problems are solved by negotiations among parties making transactions in the market.
	Certification system		Certification is given to raw materials from living organisms are appropriately considered in terms of the ecosystem of the source, biodiversity, regional society, and the people who live there, and a unified certification mark is displayed so that consumers will know of the certification.
	Mitigation		In order to reduce negative effects on biodiversity that are caused by development projects, efforts are made to avoid portions or all of such projects, minimize project scale, and consider correction or reduction of the natural environment that incurs such effects. Rather than compensation measures, priority consideration is given to avoidance and reduction of the effects themselves.
	Biodiversity offset		For negative effects caused by development projects, appropriate reduction measures are implemented. By taking compensation actions to target negative effects that remain even after such measures are taken, the quality and quantity of biodiversity as a whole is maintained in the same state. Bankers that are expert organizations on restoration and creation for conservation (compensatory mitigation banks) receive fixed amounts of credit and accurately restore and create on behalf of parties conducting development projects. This mechanism by which it is deemed that parties conducting development projects have taken compensation measures is referred to as mitigation banking.

Source: Created by the Ministry of the Environment, using information from "Fundamental Knowledge about Biodiversity, Ecosystems, and the Economy," "Research on Measures and Policies for the FY2010 Environment Economy (Research on Measure and Policy Options that Aim for Sustainable Use of Ecosystem Services by Internalizing Economic Value)," etc.

(3) Measures for Conserving Biodiversity that Have Been Included in Society and the Economy

In recent years, policy option tools for decision making have been proposed in order to reduce deterioration of biodiversity and loss of ecosystem services, and to mainstream biodiversity into all kinds of decision-making. Some specific examples are methods of internalizing the economic value of biodiversity and ecosystem services in the market mechanism.

Article 11 of the Convention on Biological Diversity states that, "Each Contracting Party shall, as far as possible and as appropriate, adopt economically and socially sound measures that act as incentives for the conservation and sustainable use of components of biological diversity." Countries around the world and international organizations are taking efforts for preserving biodiversity and achieving sustainable use by using market mechanisms. Quantitative assessment of biodiversity is to be important for promoting preservation of biodiversity and sustainable use with these market mechanisms,.

As examples of quantitative assessment of biodiversity, the ecological footprint assesses the human impacts on

the environment, and "The Economics of Ecosystems and Biodiversity(TEEB)" assesses the economic value of biodiversity and costs due to loss of biodiversity. In addition, as a means of preserving biodiversity and achieving sustainable use with market mechanisms, there are several examples. Tax systems and subsidies are mechanisms to internalize the external economic impacts on biodiversity in the market through economic

Column

Wisdom in Managing Groves Biodiversity in a City Areas (Kyoto)

The City of Kyoto has many traditional temples and shrines since it is a city with a long history of over 1,200 years. Various large and small green areas, such as Kyoto Gyoen (Kyoto Imperial palace park), are preserved, although it is a large city with a population of over 1.4 million people. In particular, within the grounds of temples and shrines, there are groves that have existed since long ago without being cut down. In the groves, the large-diameter trees, understory vegetation grow and various wild animals inhabit. In the 63-hectare expanse of Kyoto Gyoen, goshawks are observed even though the park is located in the middle of the city.

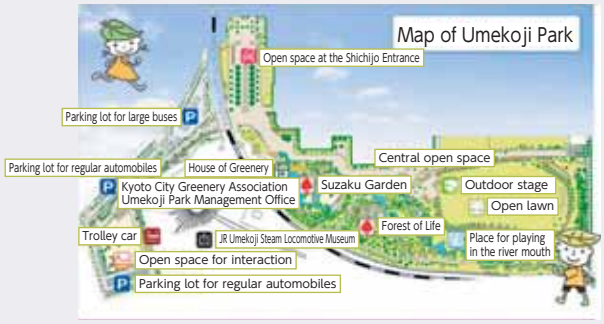
The grove of Shimo-gamo Jinja Shrine is called "Tadasu Forest," which is an approximately 12-hectare, and is a forest that has been known since long ago, appearing in"The Pillow Book"(written in 10th century). Citizens are familiar with the forest, and many people come to and enjoy traditional events such as the Aoi Festival, which is one of Kyoto's three biggest festivals. Even when there are no events, as many as 1,000 to 1,200 people come per day. Within the grave, the brown hawk owl use the hollows that are formed in the large-diameter trees and breed there. This "Tadasu Forest" is registered as a world cultural heritage as part of Shimo-gamo Jinja Shrine and is carefully managed.

The wisdom for managing graves of shrines and temple in Kyoto, which have been carefully preserved since ancient times, is adjust to the restoration and management of modern city parks. In 1996 a restored green space called the "Forest of Life" was installed in Umekoji Park, which was built on the site of an old National Railway freight train shunting yard. The state of vegetation in "Tadasu Forest" is adopted as the target for restoration and management to achieve not only the functions of an ordinary city park but also Kyoto's original ecosystem. In the process of restoration specialists from various fields such as landscape architecture, botany, and zoology are involved.

The way of management of this green space is

Shimogamo Jinja Shrine

Young brown hawk owls that built a nest in Tadasu Forest



Photographs: Ministry of the Environment
Source: From the Umekoji Park map by the Kyoto City Greenery Association

unique. Monitoring is conducted almost entirely by city resident volunteers independently under the guidance of specialists. The vegetation monitoring has been conducted almost every month since 1998, and detailed data about changes has been compiled. Further, under a key theme of "management in moderation," this management allows natural succession by holding back on trimming of underbrush. The number of people who enter the green space can be kept appropriatly because the gate is in a garden called "Suzaku Garden" that charges entrance fee. The income plays a role in management of the green space.

As a result of these efforts and ingenuity, 364 species of plants are identified in 2009, while 74 species was identified when the green space opened. In a addition, goshawks are observed within the park in recent years.

It can be said that various types of green areas have been well conserved with the wisdom of traditional and modern management methods in the City of Kyoto.

incentives., Certification systems are to designate regions that are appropriately working to preserve biodiversity. Biodiversity offset is an appropriate reduction measure which are implemented by taking actions the quality and quantity of biodiversity and maintaining in the same state for negative effects caused by development projects, (Table 2-3-2).

Summary

In Chapter 1 we saw that the Earth's environmental problems continue to be one of the most serious risks and threats to the humans as well as to the future generations. In Chapter 2 we considered the current situation of the biodiversity, which provides the benefits that support our lives, and human wisdom for preventing loss of biodiversity and preserving it.

The Earth's resources are limited. It is our wisdom and duty for us to achieve sustainable use of natural resources, formulate social rules, and take action so that we can use limited resources sustainably and share them with future generations.

What kind of rules should be formulated and what kinds of actions are necessary, in order to use the benefits available from the Earth sustainably and fulfill our duty to future generations? In the next chapters we will discuss the latest international movements for achieving sustainable use and conservation of biodiversity, and actions on a global scale that utilize Japan's technologies.