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).

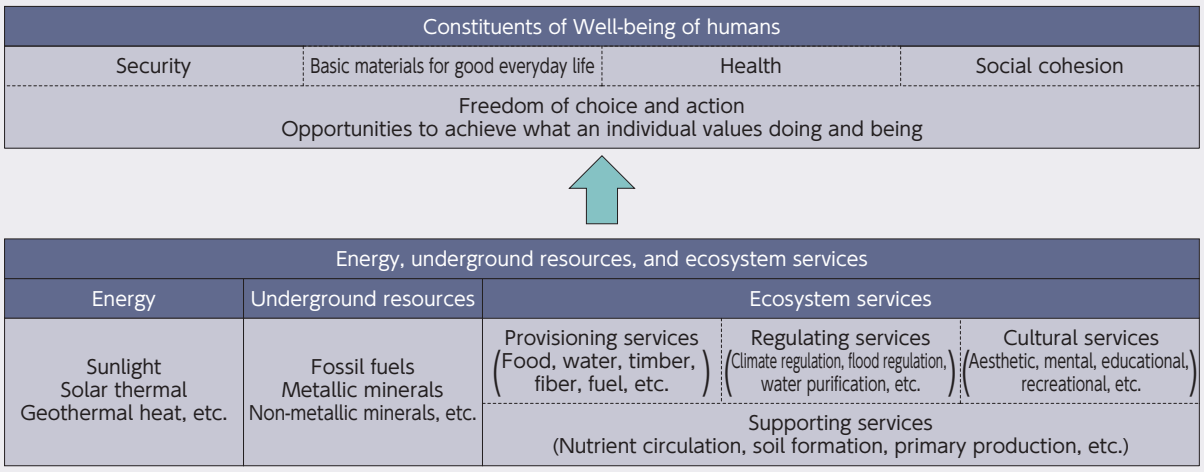
In Chapter 2, we will consider about how to achieve the wisdom in order to assist local everyday lives which based on traditional knowledge, to maintain the relationship in good condition between human beings and the Earth's environment and to share the benefits of ecosystem services with the future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

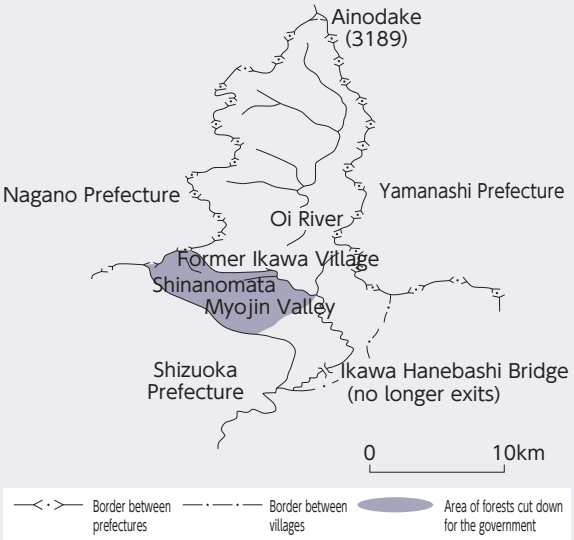
Comparing the amounts of rainwater inflow into these river basins during three days after rainfall, the amount of rainfall in the Bekanbeushi River Basin is only about 10% of the amount of rainfall and the amount of rain fall in the Obetsu River Basin is approximately 70% of the amount of rainfall flows. 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



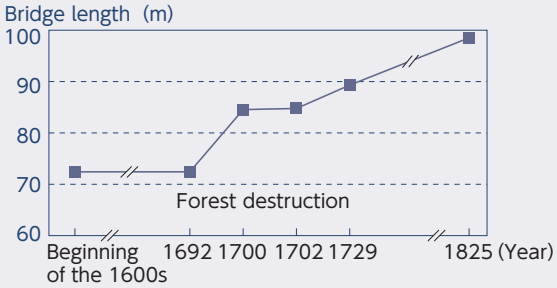
Source: Illustration by the Ministry of the Environment, based on The Relationship between the Length of Hanebashi in the Oi River in the Edo Period and Cut Down Forests, by Kazuhiro Takao and Yutaka Omura (2008), Journal of Forest Research Issue 90: 190-193

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.

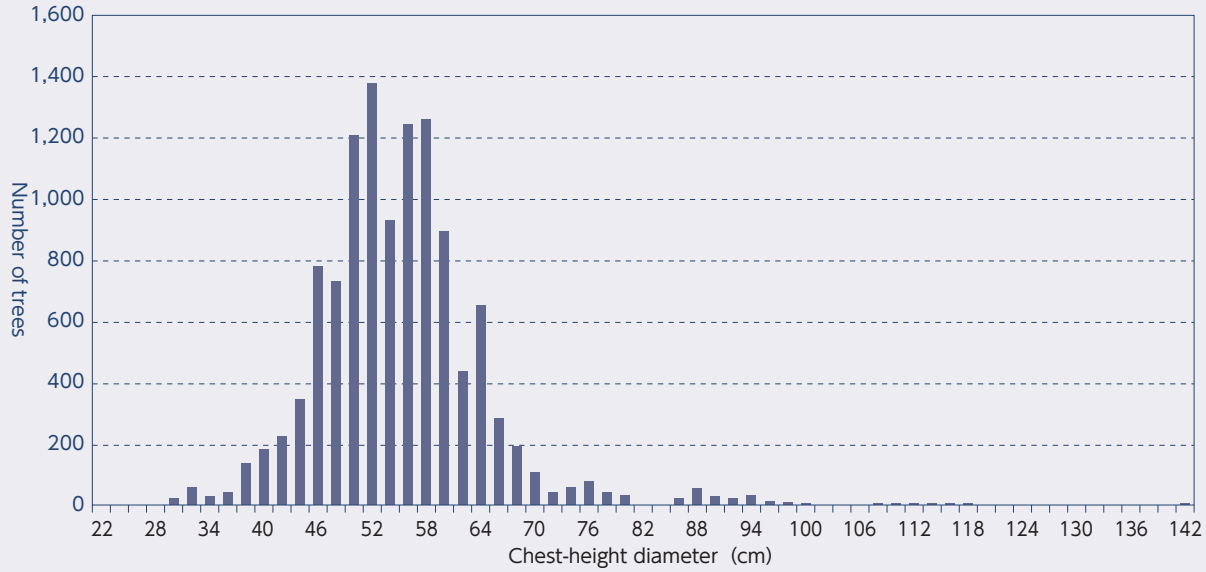
In addition, the Isejingu Shrine has its own forest for supplying the trees, which contains a sanctuary where cutting is prohibited (267ha), Number 1 Precinct Forest comprising natural forest (1,094ha), and Number 2 Precinct Forest where forest operations such as production of timber for building the 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

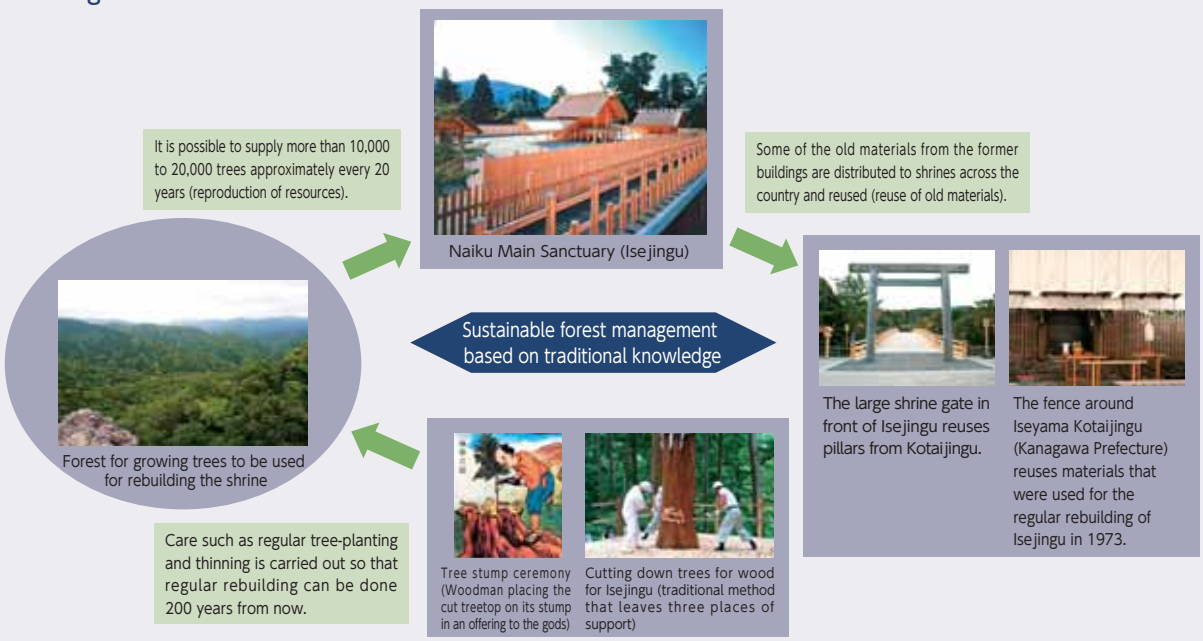
Tetsuro Watsuji (1889-1960), who was a Japanese philosopher and argues that there is essential relationship between climate and other environmental factors and human culture, wrote the following in his book "Climate and Culture: A Philosophical Study." "Climate is the most deeply related to production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

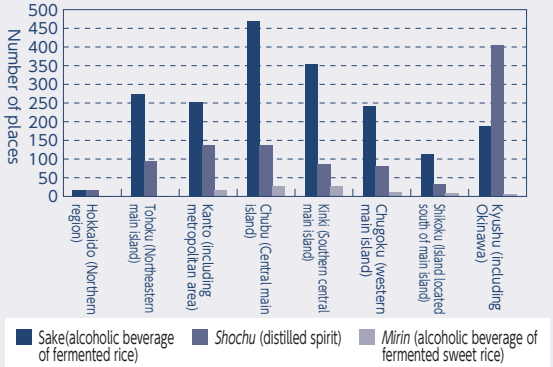
We humans have used the regional and biological resources as ingredients, but we do not choose any biological resources just because they are available. Humans have evolved traditional and unique cuisine that varies from region to region by choosing, cooking and eating the food that reflect geological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

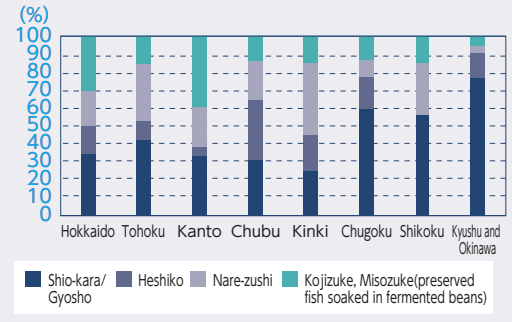
Loss of biodiversity can make it difficult to supply ingredients for these traditional fermented foods, resulting in the loss of regional and unique individualities. Next we will consider this issue using an example of fermented

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



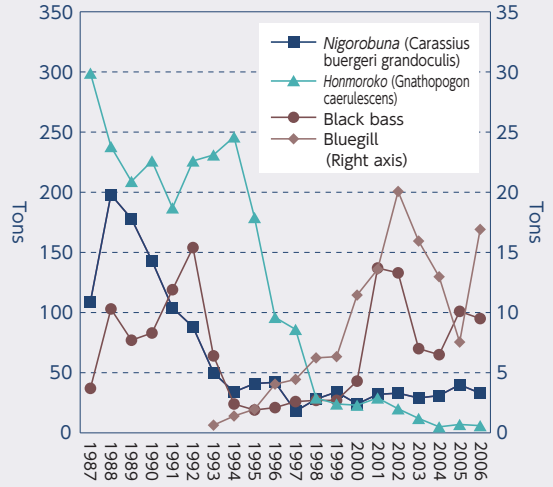
Source: The National Tax Agency's Annual Statistics Report (2009)

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)

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."

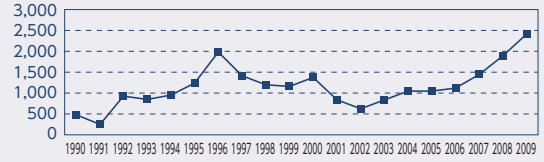
4. Biological Genetic Resources Used in Bio-Technology

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.

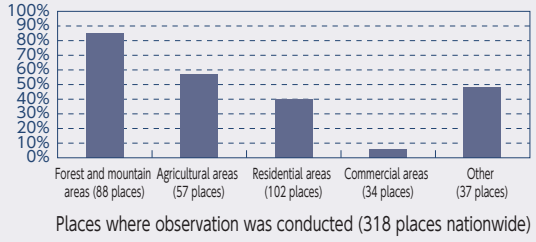
Natural objects and natural sceneries around us are continuing to be lost in recent years. How does it affect on the culture in the future? Here we will take a look at examples of animals and plants mentioned in the poems gathered in Collection of Ten Thousand Leaves.

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.

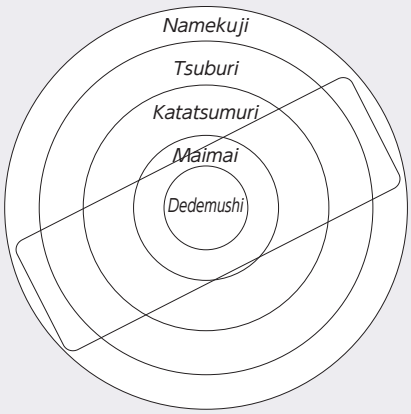
According to the Japanese Linguistics Map (1977. National Institute for Japanese Language and Linguistics), regional names related to snails are sorted into "*name-kuji*", "*mai-mai*", "tsumuri", "*tamakura*", "*katatsumuri*", "*dendenmushi*", "*deero*", "*tsunodashi*", and other isolated word forms. 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.

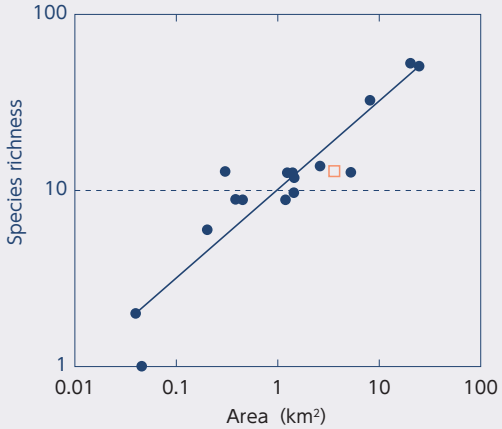
There is another report about snails which points

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.