JAPAN BIODIVERSITY OUTLOOK

Report of Comprehensive Assessment of Biodiversity in Japan

The Current State of Biodiversity in Japan

-An assessment of biodiversity over the past 50 years and action to be taken-

There are many types of ecosystem in the world, for example, forests, rivers, marshes, mud flats, coral reefs, where many species of plants and animals live and grow. Even within a single species, there exist differences depending where it lives, or even from individual to individual. "Biodiversity" means such differences among ecosystems, species, and individuals.

All over the world, however, we are now seeing tropical forests shrink, coral reefs degrade and invasive alien species damage local environments, leading to serious concerns over the rapid loss of biodiversity. In the decades following the end of World War II, Japan saw phenomenal economic growth, but at the same time, biodiversity suffered great losses as a result.

Given these developments, many have come to recognize the need to evaluate the current state of biodiversity in Japan. The Committee on Comprehensive Assessment of Biodiversity in Japan, which was established by the Ministry of the Environment, produced the *Report of Comprehensive Assessment of Biodiversity in Japan* (or *Japan Biodiversity Outlook* for short), which was released in May of 2010.

Preamble

The year 2010 is not only designated as the International Year of the Biodiversity but also marks Japan's hosting of the 10th meeting of the Conference of the Parties to the Convention on Biological Diversity (COP10) in Nagoya, Aichi Prefecture. It is also a year when Japan and the entire world face a significant turning point in tackling issues on biological diversity. While it has become increasingly clear in many respects that biological diversity is indispensable for our daily life, and as related science has advanced a great deal, I do not believe that social awareness of its importance has gained much, even nearly 20 years after the Convention on Biological Diversity was first adopted in 1992. I accepted the role of chairman of the Japan Biodiversity Outlook Science Committee, in hopes of pursuing significant changes in the current situation, and with 2010 marking a turning point, encouraging many different segments of society to launch activities focused on conserving biological diversity and its sustainable use.

Over the last 50 years, biodiversity in Japan has undergone dramatic changes to a degree never witnessed in our history—changes undoubtedly triggered by the socioeconomic activities of human beings. As a result, Japanese society has created a life of material wealth and convenience. In exchange, however, we are now on the brink of losing living creatures unique to Japan and close to our life, and causing a number of other harmful consequences. We have also imported a significant amount of products nurtured by nature, and consequently, I fear that we only end up depriving local people of benefits they should otherwise enjoy, such as ecosystem services, in some cases. I think we should take a closer look at these changes, and then decide what to do in the future. I regard this Report of Comprehensive Assessment of Biodiversity in Japan (Japan Biodiversity Outlook) as the basis thereof.

Similar comprehensive assessments have been already made and published as the Global Biodiversity Outlook (GBO) by the Secretariat of the Convention on Biological Diversity, as well as assessments conducted by the EU, the UK and Australia. This report is an advanced approach aiming to build on these previous assessments. Although we spent two years conducting this examination before finally publishing the results, we are far from fully satisfied with its content. There are a number of issues to be addressed in the future, such as inadequate scientific data vital for our examination, ecological services not being properly assessed, and an inability to always present full and concrete activity options. However, I am confident that we at least present a general picture of biodiversity and the problems it faces. I would take much pleasure in this report possibly allowing you to find more opportunities for thinking about biological diversity in Japan, and making use of it in developing activities for helping to conserve biodiversity in the future.

Lastly, in producing this report, I would like to offer my sincere gratitude to the Nature Conservation Bureau of the Ministry of the Environment, as well as the Japan Wildlife Research Center, for their help in collecting various data and preparing materials for the Committee, as well as to the members of administrative offices, corporations and NGOs, and other researchers who kindly offered us their valuable data.

May 10, 2010

Tohru Nakashizuka

Chairman

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Summary of Assessments

Five Major Conclusions drawn from Japan Biodiversity Outlook (the Comprehensive Assessment of Biodiversity)

1. Loss of biodiversity as a result of human activities in Japan has affected all ecosystems, and the loss is continuing on the whole.

2. The degree of biodiversity loss has been especially large in inland water systems, marine and coastal systems, and island systems. The trend towards biodiversity loss is continuing at present.

3. As for the drivers of the loss, the "First Crisis (brought about by development, direct use, and water pollution)," particularly development, has had the greatest impact, but the speed at which loss attributable to this crisis has slightly abated. The "Second Crisis (reduced use and management of *Satochi-Satoyama* areas)" continues to intensify. Furthermore, among all factors falling under the "Third Crisis (invasive alien species and chemicals)," the effects of invasive alien species are particularly prominent. The "Climate Change Crisis (the impact of climate change on living organisms)" poses serious concerns for certain ecosystems that are particularly vulnerable. Various responses have been taken to address these crises, 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.

4. The Japanese people currently enjoy lifestyles characterized by material wealth and convenience, but for the past 50 years those lifestyles have meant the domestic loss of biodiversity and dependence on the supply of ecosystem services overseas. From 2010 onwards, the lingering effects of past development (First Crisis), the increasing seriousness of the problem of reduced use and management of *Satochi-Satoyama* areas (Second Crisis), settlement and further encroachment by invasive alien species (Third Crisis), rising temperatures (Climate Change Crisis), and other related factors are expected to result in further loss. Thorough responses, including those that address indirect drivers, are necessary. For that purpose, it is important to build consensus at the local level.

5. Some biodiversity loss in inland water systems, island systems, and marine and coastal systems may in the future transform into a grave loss, causing irreversible changes or having other serious consequences.

Background

Biodiversity is defined as the existence of a variety of ecosystems. It also means that there are various differences among and within species. For example, there are different types of ecosystems, such as forests, rivers, marshlands, tidal flats and coral reefs. Each has a number of different fauna and flora living and growing there, and within identical species, there emerges different living habits, depending on location and individual species.

As human beings, we can neither live nor lead a comfortable life without the benefits brought by biodiversity. Our lives and culture are supported by supplies brought by biodiversity, including foodstuffs, lumber and medicines, adjustable effects such as the pollination of crops, control of noxious insects or cultural diversity unique to each region.

However, there have been reports from all over the world that tropical rain forests are diminishing, coral reefs degrading and alien species causing damage, leading to concerns about the rapid loss of biodiversity. In 1992, "the Convention on Biological Diversity (a convention related to the diversity of living things)" was adopted, aiming to achieve the "Conservation of Biodiversity," "Sustainable Use of Its Components," and "Fair and Equitable Sharing of Benefits Arising out of the Utilization of Genetic Resources." Despite efforts made by each member country, the loss of biodiversity has continued. At the 6th Conference of the Parties to the Convention on Biological Diversity (COP6) held in 2002, the target for the Convention on Biological Diversity in 2010 was set to achieve "a significant reduction of the current rate of biodiversity loss by 2010."

Japan lies vertically next to the Eurasian continent, with differences in altitude from its coasts to its mountains, and with territory consisting of a few thousand islands. Reflecting the history of repeated tectonic movements in merging with and separating from the continent, Japan's land is rich, though small, with a number of biota unique to the country. Our marine territory is located along the periphery of the equatorial Pacific Ocean and boasts of outstanding marine biodiversity among developed countries, due to a combination of sea currents flowing north to south, a long and winding coastline, and a steep slope from shallow seas to deep-sea trenches.

Japan adopted the Convention on Biological Diversity in 1993 and has formulated its National Biodiversity Strategy on four occasions since 1995, leading to recognition of "the crisis of biodiversity" in our country. We recently adopted successive initiatives, including enactment of the Basic Act on Biodiversity in 2008, development of the National Biodiversity Strategy of Japan 2010 based on the aforementioned legislation in 2010, and holding of the forthcoming 10th Conference of the Parties to the Convention on Biological Diversity (COP10) in Nagoya, Aichi Prefecture. The importance alleviating the loss of biodiversity is gradually being recognized.

Assessment of Biodiversity

In order to alleviate biodiversity loss, various entities need to commence concrete activities immediately. As a start, we must demonstrate the entire scale of biodiversity loss and the direction of related measures, by understanding what is happening in biodiversity and what caused the loss thereof, and then assess what can be done.

Such an assessment process has already begun in the form of an international project: the Millennium Ecosystem Assessment (MA) was implemented between 2001 and 2005, with more than 1,000 experts participating to assess biodiversity and ecosystems on a worldwide basis. The Global Biodiversity Outlook 2 (GBO2)—compiled by the Secretariat of the Convention on Biological Diversity and published in 2006—assessed how the measures to meet the 2010 target have been progressing. Later in May 2010, the Global Biodiversity Outlook 3 (GBO3) and this report were released to show that the 2010 target had not been met, with more pressure being placed on biodiversity and resulting in continuing loss.

In Japan, the Basic Act on Biodiversity was enacted to provide guidelines for assessing the current status and benefits of biodiversity in the country. The National Biodiversity Strategy of Japan 2010 prescribes that "the situation of biodiversity in Japan must be assessed comprehensively, taking socioeconomic aspects into consideration....." An assessment of biodiversity is now very much required.

Japan Biodiversity Outlook (Comprehensive Assessment of Biodiversity)

The purpose of the Comprehensive Assessment of Biodiversity in Japan is to assess the current status regarding the loss of our biodiversity by comprehensively analyzing existing scientific and subjective information related to the current and changing situation, in order to provide materials on which policies for environmental administration are decided, and make the general public aware of the current status of biodiversity.

The Japan Biodiversity Outlook Science Committee established by the Ministry of the Environment began a comprehensive assessment of biodiversity in FY 2008. This report JBO was published in May 2010 after the results of examination over the past two years were compiled while it did not fulfill the purpose sufficiently or satisfactorily.

JBO focused on the period during the second half of 1950s to the present, and assessed the nationwide causes of biodiversity loss in Japan (particularly the degree of effects) and the current status (in terms of the degree of loss) by using about 30 indicators and 104 sets of data. The causes of loss were classified into the following four categories provided by the National Biodiversity Strategy of Japan 2010: "the first crisis (development, direct use, and water pollution)," "the second crisis (a reduction in use/management of Satochi-Satoyama areas consisting of agricultural lands, reservoirs and open fields)," "the third crisis (alien species and chemical materials)," and "the climate change crisis." The status was assessed by dividing domestic ecosystems into six classifications: "forest and mountain systems," "cultivated systems," "urban systems," "inland water systems," "marine and coastal systems," and "island systems."

When assessing the data, hearings were conducted among biology experts in Japan. We conferred with 208 experts for their opinions at the outset of the assessment process, and with 54 experts when compiling the assessment report.

Loss of Biodiversity up to 2010

To determine the priorities of measures to be taken and examine effective measures, it is important to understand the loss in ecosystems, the causes thereof, and trends. The causes of biodiversity loss since the second half of 1950s and the current status of biodiversity loss in 2010 are described as follows (also see Table: Biodiversity loss up to 2010).

By 2010, biodiversity loss has spread to all ecosystems, and continues as a whole.

"The first crisis," not least development, was the most damaging factor behind biodiversity loss in the past, due to social demands during the period of high economic growth, with all ecosystems being exposed to this negative impact. At the moment, the rate of new additional loss is decelerating; however, the impact of development on a smaller scale and in some regions remains to exist. It is also concerned about that a possible lingering impact from ecosystems already lost due to past development, where effects might only be seen after a certain time has elapsed. In addition to such conventional measures as designating an area of concern as a conservation sanctuary, consideration has also been given in recent years at the start of land development, but it have not always been seen satisfactory benefits from such consideration. Larger loss incurred in the past also remains not to be restored.

"The second crisis" involves a reduced use of biological resources and the progression of vegetation succession in forest and mountain systems and Satochi-Satoyama areas which are part of cultivated systems. These factors are triggered by changes in the energy supply structure, in agriculture and agricultural methods, and in depopulation and an aging population in rural areas. To a large degree, we must wait for further research on the effects from this source, but these issues remain to be addressed, and are concerned about even greater impact. We have been considering how to sustainably use and control biological resources, but radical measures are difficult to implement.

During "the third crisis," the effects of alien species have been enormous in recent years. It is concerned about the effects on inland water systems and island systems, both of which are particularly fragile against alien species. New regulations were recently introduced regarding the importation and handling of alien species, while certain invasive species already settled in Japan are rapidly expanding in terms of distribution.

Regarding "the climate change crisis," there has been debate on the cause and effect relationship between rising temperatures and actual effects on biodiversity, but climate change is generally believed to have a strong impact on forest and mountain systems (highlands), marine and coastal systems (coral reefs), and island systems.

The loss of biodiversity caused by these factors has now spread to all ecosystems. Particularly greater loss can be found in inland water systems, marine and coastal systems, and island systems, and is likely to continue. In these ecosystems, "the first crisis (development)" and "the third crisis (alien species)" interact in a complex manner. The loss in ecosystems in forests and on agricultural land is also substantial, being exposed to "the first crisis (development)" and "the second crisis (a reduction of use/management)."

The aforementioned causes of biodiversity loss, namely "the first crisis," "the second crisis," "the third crisis," and "the climate change crisis" do not act alone. Rather, these factors interact in a complex manner to cause loss in each ecosystem (see Table: Assessment of loss in each ecosystem).

Table: Biodiversity loss up to 2010

	Current state of loss and trends		Drivers of loss (degree of impact) and current trends				
	Degree of loss from original state	Degree of loss from state as of the second half of 1950s and current trends	First crisis: Development, direct use and water pollution	Second crisis: Reduction in use and management	Third crisis: Invasive alien species and chemical compounds	Climate change crisis	Other
Forest and mountain systems						 *1	
Cultivated systems	–						•Decrease in local varieties of crops and livestock
Urban systems	–			–			
Inland water systems					 *2		
Marine and coastal systems				–	 *3		•Outbreaks of coral predators •Coralline flat
Island systems				–			

Legend

Subject of assessment	State				Drivers			
	Degree of current loss		Trend of current loss		Degree of impact during assessment period		Current trend of impact	
Legend	Not Lost		Recovering		Weak		Decreasing	
	Not significantly lost		Same		Medium		Same	
	Lost		Being lost		Strong		Increasing	
	Significantly lost		Being rapidly lost		Very strong		Increasing rapidly	

Note: The dashed lines for assessing the degree of impact indicate insufficient data.
Note: "*" indicates multiple factors and data related to the indicator in question, as well as existing factors and data that show trends that differ from current assessments of the degrees, effects, and trends of overall loss.
*1: The degree of impact on alpine ecosystems has been and continues to be serious.
*2, *3: While the problem of chemical compounds has been mitigated to some extent, the problem of invasive alien species is serious.

Table: Assessment of loss in each ecosystem

Ecosystem	Assessment of loss in each ecosystem
Forest and mountain systems	Loss in forest and mountain systems occurred during the assessment period from the second half of 1950s to the present, and is likely to worsen on a long-term basis. ○ The overall size of a forest apparently does not make a large difference, but pristine natural forests have diminished through conversion into artificial forests. The connectivity of forests has also been decreasing. [First crisis] ○ During the latter half of the assessment period, the rate of deterioration of pristine natural forests slowed down, but the quality of ecosystems in secondary forests and artificial forests has been declining. [Second crisis] ○ Recently, as deer populations have increased along with an expanded distribution, the damage to trees and underlying vegetation has become evident. There are also reports about a negative impact on alpine plants probably due to global warming. [Second crisis and climate change crisis] ○ Presently, there is less impact on forests by development due to changes in the socioeconomic situation, but ongoing impact raises concern.
Cultivated systems	Loss in cultivated systems occurred during the assessment period from the second half of 1950s to the present, and is likely to worsen on a long-term basis. ○ The development of residential land mostly in the first half of the assessment period, as well as changes in agriculture and agricultural methods, contributed to smaller-scale cultivated systems and lower quality. [First crisis] ○ The reduced use of fields, mostly in the first half of the assessment period, as well as less use of agricultural land, mostly in the second half of the assessment period, contributed to smaller-scale cultivated systems and lower quality. [Second crisis] ○ Presently, there is less impact on cultivated systems resulting from development, as well as changes in agriculture and agricultural methods, due to changes in the socioeconomic situation, but ongoing impact raises concern. It is also concerned about the growing influence of the reduced use and control of agricultural land.
Urban systems	Loss in urban systems occurred during the assessment period from the second half of 1950s to the present to some extent, and is likely to worsen on a long-term basis. ○ A reduction of green tracts of land in cities, such as agricultural land and woods, as well as the deteriorating quality of river water, during a period of high economic growth in the first half of the assessment period contributed to a reduction and lower quality of habitats for living creatures. [First crisis] ○ The preparation of new green lands in urban areas as well as the improved quality of river water progressed in the second half of the assessment period; as a result, the distribution of some living creatures inhabiting such environments is expanding.
Inland water systems	Significant loss in inland water systems occurred during the assessment period from the second half of 1950s to the present, and is likely to worsen on a long-term basis. ○ A gathering of pebbles and gravel, the creation of artificial rivers, and the reclamation of lakes, marshes and wetlands since the first half of the assessment period contributed to smaller-scale inland water systems, as well as lower quality and more fragmentation, throughout Japan. [First crisis] ○ Conversely, the quality of lake water and marshes, likely to have deteriorated in the first half of the evaluation period, improved in the second half. [First crisis] ○ Presently, there is less impact on inland water systems from development due to changes in the socioeconomic situation, but ongoing impact raises concern. It is also concerned that living creatures may be captured and gathered for ornamental purposes, as well as a greater impact of alien species. [First crisis and third crisis]
Marine and coastal systems	Significant loss in marine and coastal systems occurred during the assessment period from the second half of 1950s to the present, and is likely to worsen on a long-term basis. ○ In particular, development in the first half of the assessment period contributed to a significant reduction in the nationwide scale of some marine and coastal systems, such as tidal flats and natural coastlines. [First crisis] ○ Presently, there is less impact on marine and coastal systems by development, such as reclamation in coastal areas, due to changes in the socioeconomic situation, but ongoing impact raises concern. We also face new concerns over deteriorating erosion of the coastline, an invasion of alien species, and the effects of global warming. [Third crisis and climate change crisis]
Island systems	Significant loss is currently observed in island systems. While there is lack sufficient data to assess conditions in the first half of the assessment period, the situation deteriorated in the second half of the assessment period (since the second half of 1970s) and is likely to worsen on a long-term basis. ○ Due to the development and invasion/settlement of alien species, the habitats of some domestic species, including endemic ones, are deteriorating. [First crisis and third crisis] ○ It is concerned about the effects of global warming on the coral reef ecosystem. [Climate change crisis]

Loss of Biodiversity and Ecosystem Services

Ecosystem services refer to the benefits and convenience that human beings enjoy from ecosystems. Our lives depend on ecosystem services. In general, the loss of biodiversity reduces ecosystems services. However, during the assessment period, it has become apparent that biodiversity is being lost because only some ecosystems received attention among various ecosystem services and that our overseas dependence on ecosystem services progressed significantly.

For example, during the high economic growth period, society demanded that a large quantity of ecosystem services, such as lumber from forest and mountain systems, and foodstuffs from cultivated systems, should be supplied efficiently. As a result, agricultural land was developed, forests were converted, and a large quantity of agricultural chemicals and fertilizers were used, all of which led to the loss of biodiversity.

Also after the high economic growth period, Japan began importing huge quantities of biological resources, such as lumber and foodstuffs, resulting in a majority of ecosystem services becoming dependent on supplies from overseas ecosystems. It is possible that domestic ecosystems such as forests can supply what is needed, but in effect, cannot fully satisfy demand. It has been pointed out that while this situation leads to "the second crisis" domestically, it also causes a loss of biodiversity overseas.

Loss of Biodiversity after 2010

Based on the premise that socio-economy will progress for the future as currently anticipated and aiming at around 2050—the year set as a medium- to long-term target by the National Biodiversity Strategy of Japan 2010, the following illustrates the expected loss of biodiversity and the direction of long-term measures.

With regards to "the first crisis" and given that Japan's population is expected to decline, economic growth will slow down, and residential/industrial facilities and social infrastructure have already been constructed to a large degree, the rate of development will lose pace, but it is expected that the impact of past development will linger. Thus, it is still an important issue that new development will remain restrained by creating conservation areas, for example, and that measures must be taken to restore large losses from the past. It should be conducted a technical examination of what it is needed to consider when attempting to restore nature and start similar projects, while establishing an ecological network on both a nationwide and regional basis. It is also anticipated that development will continue to obtain natural materials for maintaining and renewing existing residential/industrial facilities, as well as social infrastructure. Therefore, it is expected to develop the methods and technologies for the evaluation and avoidance of influence and restoration of damages. Moreover, it is necessary to take mesures for those areas that require strengthening in existing measures, including the conservation of coasts and oceans and smaller-scale yet important habitats.

With regards to "the second crisis," it is concerned that the situation will become more serious, due to a lack of management and use of Satochi-Satoyama areas (agricultural land, secondary grasslands, secondary forests and artificial woods, etc.), together with a declining and rapidly aging population in rural areas. It is important to try to manage and use such areas in a sustainable manner by forming a regional consensus as the basis of any action. Having accomplished this, we should be able to encourage various entities including residents in urban areas and corporations to participate in the activities, while searching for the best way to find new sustainable uses, such as

Satoyama biomass. And as a decreased number of hunters leads to lower capture pressure, it is expected that a rapid increase in the populations and expanded distribution of medium- to large-size wild mammals, and thus it is necessary to control the populations of wild birds and animals from a wider perspective. Moreover, it should be considered that comprehensive measures with reference to the future socioeconomic situation, such as progressively transforming secondary forests into natural forests.

With regards to "the third crisis," it is expected that opportunities for alien species to enter Japan (including unintentional cases) and the expanded distribution of those already settled here will be a continuing trend to a certain extent. Therefore, it will need to be continue controlling migration and, at the same time, pay particular attention to preventing new invasions and eliminating those alien species already settled here (by capturing, collecting or eliminating those species, or taking preventive measures against potential damage), and technological development is also another important issue.

With regards to "the climate change crisis," the trend of rising temperatures may continue as forecasted, and some irreversible effects may take place within fragile ecosystems. It is necessary to strengthen monitoring systems, evaluate how fragile these ecosystems are, and, based on these efforts, realize and implement concrete and appropriate measures.

Given the degree of loss up to 2010, it is feared that the following in particular will lead to irreversible and much greater damage for the future: fragmentation of rivers within inland water systems (the first crisis), the continuing influence of lower riverbeds (the first crisis), the destruction of small-scale habitats such as springs (the first crisis), an expanding influence by invasive alien species in inland water systems and island systems (the third crisis), a continuation and expansion of various effects on tidal flats, algal and seaglass bed, coral reefs and natural coasts within marine and coastal systems (the first crisis and climate change crisis), a lack of management of artificial woods and greater damage to flora caused by deer (the second crisis). We will need to continue and even increase monitoring, as well as taking preventive measures.

In order to take measures to address the crisis situation described above, it is important to "biodiversity mainstreaming" as the basis thereof. The concept of conserving biodiversity and its sustainable use must also be reflected not only in policies developed by the government and local authorities, but also in how private activities in this area should be organized. In particular, the regional uniqueness contained in biodiversity is indispensable, and there are many examples of effective measures being taken when the region in question takes the initiative. Therefore it is hoped that a regional society encompassing cities, towns, villages and communities will form a consensus regarding the biodiversity of that region.

Introduction

Section 1 Background Behind the Assessment of Biodiversity

Biodiversity is defined as the existence of a variety of ecosystems. It also means that there are various differences among and within species.

Ever since the beginning of life in history, living creatures have survived more than 4 billion years by adapting and evolving within various environments. Today, there is a true variety of living creatures on the earth. Various ecosystems were formed and various functions play a part in these ecosystems, through interactions among creatures as well as those between the creatures and their environment—the air, water and soil.

Human beings exist by virtue of the benefits brought by biodiversity, that is, ecosystem services. Biodiversity is the basis of our existence. Our lives and cultures are supported by supplies brought by biodiversity, including oxygen in the air, soil, foodstuffs, lumber and medicines, as well as the diversity of cultures, each having a regional uniqueness. Biodiversity also supports the diversity of cultures, where each has its regional uniqueness as treasured characteristics of a particular region.

However, there have now been reports from all over the world that tropical rain forests are diminishing, coral reefs degrading, and alien species causing damage, leading to concerns that biodiversity is rapidly being lost. In 1992, "the Convention on Biological Diversity (a convention related to the diversity of living things)" was adopted, aiming to achieve the "Conservation of Biodiversity," "Its sustainable Use" and a "Fair and Equitable Sharing of Benefits Arising out of the Utilization of Genetic Resources." Despite efforts made by each member country, the loss of biodiversity has continued. At the 6th Conference of the Parties to the Convention on Biological Diversity (COP6) in 2002, the target for the Convention on Biological Diversity in 2010 was set to achieve "a significant reduction in the rate of biodiversity loss by 2010."

In order to alleviate biodiversity loss, various bodies need to commence concrete activities immediately. As a start, it is needed to demonstrate the entire scale of biodiversity loss and the direction of measures against such loss, by assessing what is being lost in terms of biodiversity, what caused that loss, what is the background behind the loss, and what measures can be taken to address the loss. There are not always have sufficient information about biodiversity, yet it has now become necessary to compile and assess the entire scale of biodiversity loss in a comprehensive manner.

Such an assessment should be conducted by different social strata on various scales, namely worldwide, nationally and regionally, since differences of scale mean differences in the degree of causes in the background and in the volume of required resources when measures are taken.

An international project—the Millennium Ecosystem Assessment (MA) have been already begun. The MA project took place in 2001 and 2005, involving the participation of more than 1,000 experts in assessing biodiversity and ecosystems on a worldwide basis. The Global Biodiversity Outlook 2 (GBO2)—compiled by the Secretariat of the Convention on Biological Diversity and published in 2006—assessed how the measures to meet the 2010 target have been progressing. It showed that biodiversity loss has progressed, with 12 out of 15 indicators showing a deteriorating trend. The Global Biodiversity Outlook 3 (GBO3) and this report were released in May 2010, prior to the 10th Conference of the Parties to the Convention on Biological Diversity (COP10). GBO3 showed that the 2010 target had not been met, along with greater pressure on biodiversity and continuing loss. Some countries and regions (particularly in Europe) are now engaged in a process of assessing the status of biodiversity loss on a national level.

In Japan as well, since the Convention of Biological Diversity was adopted in 1993, The National Biodiversity Strategy of Japan has been drawn up on four occasions, leading to recognition of the need to alleviate biodiversity loss. In recent years, the 3rd Basic Environment Plan (finalized in 2006) was drawn up, where "Guidelines for the Areas of Conservation of Biodiversity" prescribed nine guidelines. The Basic Act of Biodiversity (enacted in 2008) established the development of guidelines "in order to comprehensively assess the current status and benefits of biodiversity" as a task that the government must undertake. The National Biodiversity Strategy of Japan 2010 (finalized in March 2010 and based on the Basic Act of Biodiversity), succeeded the 3rd National Biodiversity Strategy of Japan, by positioning biodiversity loss in Japan as "a crisis in biodiversity." It clarifies the purpose of its establishment and stated that "it will comprehensively assess the current situation of biodiversity in Japan, while taking socioeconomic aspects into consideration" and "with the participation of a number of experts, will implement, compile in a simple manner, and publish a comprehensive evaluation of biodiversity in Japan."

Within this positive environment, it was decided that the city of Nagoya in Aichi Prefecture would host the 10th Conference of the Parties to the Convention on Biological Diversity (COP10), and Japan is encouraged to take more responsibility for the conservation of biodiversity and its sustainable use. As Japan is highly dependent on the importation of biological resources from overseas, such as agricultural, forestry and fishery products, as well as fossil fuels and mineral resources, we may have significant influence over biodiversity worldwide. With this full recognition, it is necessary to take measures progressively to realize the sustainable use of resources on a global basis in the future.

Given the background described above, the Japan Biodiversity Outlook Science Committee (established by the Ministry of the Environment) conducted "the Comprehensive Assessment of Biodiversity in Japan" over a two-year period since FY 2008, with the intention of completing it before COP10 is to be held. Thus, this report (Report of Comprehensive Assessment of Biodiversity in Japan) intended to examine the issue and, though far from reaching a satisfactory outcome, compiled the results at a level as complete as possible for assessment at this point. It was eventually released in May 2010.

Section 2 Implementation of Comprehensive Assessment of Biodiversity in Japan

1. Purpose of Assessment

The purpose of the Comprehensive Assessment of Biodiversity in Japan is to assess the current status regarding the loss of our biodiversity by comprehensively analyzing existing scientific and subjective information relating to the current and changing situation, in order to provide materials on which policies for environmental administration are decided, as well as to make the general public aware of the current state of biodiversity.

This evaluation can be reviewed in the future, reflecting the trend of international debates relating to the Convention on Biological Diversity, the aims set out by the National Biodiversity Strategy of Japan, and new knowledge on the matter.

2. Subjects of Assessment

It is our understanding that "biodiversity loss" refers to a decrease or degradation of biodiversity and the diversity of species/genes, thereby inhibiting sustainable interaction among living things within ecosystems, and interaction between living things and the environment, or species that comprise biodiversity.

We define the assessment of biodiversity loss as an assessment of causes for such loss, measures taken against the loss, and the current status of loss. The causes of biodiversity loss and the measures against that loss are assessed based on the "crisis of biodiversity" and status of loss by ecosystems. The progress toward meeting the 2010 target is also assessed.

3. Framework of Assessment

(1) Classification of causes of loss (crisis of biodiversity)

"Crisis of biodiversity" refers to the direct causes of biodiversity loss. Based on the National Biodiversity Strategy of Japan 2010, such causes are classified into four categories: the first crisis (brought about by human activities and development), the second crisis (caused by a reduction of human activities), the third crisis (brought about by human beings), and the climate change crisis.

The First Crisis (brought about by human activities and development)

The National Biodiversity Strategy of Japan 2010 defines the first crisis as "a decrease or extinction of species directly brought about by human activities or development, or a reduction or disappearance of habitats or living space through the destruction, division or degradation of ecosystems." For our assessment purposes, we use this definition and include the effects of development and water pollution as concrete examples.

The Second Crisis (caused by a reduction of human activities)

The National Biodiversity Strategy of Japan 2010 defines the second crisis as "changes in environmental quality, such as in Satochi-Satoyama areas (rural landscapes formed by the sustainable use of natural resources), as well as a decrease of species or changes in habitats or living space, by a reduction or retreat of human activities in nature, along with changes in lifestyle and industrial structure, as well as such socioeconomic changes as population growth." For our assessment purposes, we also use this definition to define the reduction of use/management of Satochi-Satoyama areas.

The Third Crisis (brought about by human beings)

The National Biodiversity Strategy of Japan 2010 defines a third crisis as "the disturbance in ecosystems by those artificially brought in, such as alien species." For our assessment purposes, we also use this definition and include the effects of alien species and chemical substances as concrete examples.

The Climate Change Crisis

The National Biodiversity Strategy of Japan 2010 defines the climate change crisis as "a decrease or extinction of species brought about by global warming, or a reduction or disappearance of habitats or living space through changes in ecosystems." For our assessment purposes, we also use this definition.

(2) Classification of ecosystems

With reference to the classification of ecosystems adopted by the Convention on Biological Diversity, the status of ecosystems is classified according to six ecosystems for our assessment purposes: forest and mountain systems, cultivated systems, urban systems, inland water systems, marine and coastal systems, and island systems. In view actual circumstances, there may be some overlapping between these systems.

Forest and mountain systems

For assessment purposes, forest and mountain systems refer to ecosystems comprising forests, including subarctic evergreen coniferous forests, cool-temperate deciduous broadleaf forests, warm-temperate deciduous broadleaf forests, and warm-temperate laurel forests, as well as the fauna and flora living in these habitats. For assessment purposes, the alpine ecosystems found in forests exceeding 2,500 meters above sea level in Honshu are also included.

The forest and mountain systems in Japan have been used in various ways throughout our history. As a result, there are differences in how forests have been related to human activities, whether natural forests (the original forest and mountain systems), secondary forests used for firewood and charcoal, or artificial forests used for lumber. Secondary forests and artificial forests are artificially created ecosystems, however, and depending on their use and management, such forests can be habitats for fauna and flora that previously relied on natural forests.

Cultivated systems

For assessment purposes, cultivated systems refer to those ecosystems found on agricultural land (paddy fields and fields) and in surrounding forests, woods and inland waters, as well as the fauna and flora that live in these habitats. In addition to wild animals and plants, crops and livestock also form part of such ecosystems.

The cultivated systems in Japan were formed over a long history of agricultural use, beginning with rice farming. Such systems are typified by the ecosystems in Satochi-Satoyama areas, where rice paddies and fields are formed around villages, along with a mosaic of waterways and reservoirs, forests including wood for agricultural use, and grasslands for harvests and grazing.

These ecosystems were artificially created. However, depending on their use and management, cultivated systems can eventually become habitats for those species settling in Japan when the weather becomes too cold or too dry, as well as for fauna and flora that depend on disturbances in the flood plains.

Urban systems

For assessment purposes, urban systems refer to such green land as forests, agricultural land and parks, rivers, and seashores within urban areas, as well as the fauna and flora that live in these habitats.

These ecosystems were originally formed when land was transformed for highly urbanized purposes, including residential, industrial or transportation purposes. Urban systems basically consist of flora and fauna that also live in surrounding cultivated systems, inland water systems, and marine and coastal systems.

Inland water systems

For assessment purposes, inland water systems refer to ecosystems comprised of inland waters, such as rivers, lakes and marshes, and wetlands, as well as the fauna and flora that live in these habitats. In our assessment, waterways and reservoirs used to irrigate agricultural land are regarded as a part of cultivated systems, but excluded from inland water systems. The inland water environment in Japan has undergone many changes since ancient times for controlling food production and irrigation, and thus has been subject to human influence for a long time.

Marine and coastal systems

For assessment purposes, the coast is defined as a land area and a marine area with a coastline in-between; the ocean is defined as any vast marine area offshore from a coast. The marine and coastal systems refer to ecosystems comprised of fauna and flora that live in these habitats. The coast includes ecosystems in shallow waters, such as tidal flats, kelp coasts and coral reefs. The marine and coastal systems in Japan have long been used for fishing, with living creatures (including fish) being used as food resources.

Island systems

For assessment purposes, island systems refer to such ecosystems as forests on the smaller islands of Japan, excluding the four major islands of Hokkaido, Honshu, Shikoku and Kyushu, as well as ecosystems comprised of fauna and flora that live in these habitats. In terms of biodiversity, our islands are typified by the Ryukyu Islands that were formed after a repeated process of separation and merging with the Eurasian continent, and the Ogasawara Islands (or Bonin Islands) that were formed as oceanic islands, having no connection whatever with the continent. These islands contain characteristic biota with a number of endemic species, and many of the islands have been inhabited far back in history.

(3) Range of assessment

Our assessment covers Japan's total land space and surrounding marine areas (by and large, the Japanese exclusive economic water zone) as a subject range.

The assessment period covers about 50 years (from the second half of 1950s to the present), including the period of high economic growth, which is considered to have had a significant influence on our natural environment. As necessary, we divided the entire period into the first half (from the second half of 1950s to the first half of 1970s) and the second half (from the second half of 1970s to the present).

(4) Framework of assessment

The following illustrates how the assessment was conducted regarding the causes of biodiversity loss, the status of biodiversity loss, and the measures taken against biodiversity loss.

The causes of biodiversity loss are assessed by "the degree of loss" and "the trends" of direct causes during the assessment period (from the second half of 1950s to the present). The causes of loss were classified into the following four categories: 1) the first crisis (development, direct use, and water pollution), 2) the second crisis (a reduction in use/management of Satochi-Satoyama areas or rural landscapes formed by the sustainable use of natural resources), 3) the third crisis (alien species and chemical substances), and 4) the climate change crisis. Causes are assessed comprehensively by using eight indicators, each describing the degree of influence and the trend. Each indicator is used in examining data that is considered appropriate, with a final comprehensive assessment being drawn by combining the assessment based on all the indicators, as shown by using the following visual signs. In the event that appropriate data cannot be obtained or trends differ depending on the data, note that some elements may be ignored when the overall result is indicated by the signs.

Table: Assessment of causes

Subject of assessment	Legend			
Degree of influence during assessment period	Weak	Medium	Strong	Very strong
	○	●	●	●
Long-term trend of influence and current trend	Decreasing	Same	Increasing	Increasing rapidly
	↘	→	↗	↑

Note: Some elements are ignored when visual signs are indicated.
Note: The dashed lines for assessing the degree of influence indicate insufficient data.
Note: "*" indicates that there are multiple factors and data related to the indicator in question, as well as existing factors and data showing trends that differ from current assessments of the degrees, effects and trends of overall loss.

The measures against biodiversity loss are assessed comprehensively by combining the results of four indicators for these measures against each relevant cause, and those of two basic indicators for measures applicable to all four causes. Each indicator examines the data considered appropriate, and a comprehensive assessment is drawn by combining the assessment of all these indicators being shown by using the following visual signs. As is the case with evaluating the causes of biodiversity loss, in the event that appropriate data cannot be obtained or trends differ depending on the data, note that some elements may be ignored when the overall result is indicated by the signs.

Table: Assessment of measures

Subject of assessment	Legend		
Trend of measures	Increasing	Same	Decreasing
	⇗	⇨	⇘

Note: Some elements are ignored when visual signs are indicated.
Note: "*" indicates that there are multiple factors and data related to the indicator in question, as well as existing factors and data showing trends that differ from current assessments of the degrees, effects and trends of overall loss.

The status of biodiversity loss is assessed by "the degree of loss" and "the trend" by using the status of the ecosystem at the beginning of the assessment period (the second half of 1950s) as standard. The status of loss is examined by establishing 16 indicators to measure the degree of loss and the trend from the following five viewpoints, as deemed necessary to maintain interactions between living things in the ecosystem, interactions between living things and the environment in the ecosystem, and species that constitute the ecosystem. The five viewpoints are: 1) scale of the ecosystem (i.e., physical reach of the ecosystem), 2) quality of the ecosystem (i.e., structure and functions of the ecosystem), 3) continuity of the ecosystem (i.e., unity of the ecosystem and continuity within living creatures in the ecosystem), 4) number and distribution of species (that constitute the ecosystem), and 5) status of biological resources (in reference to the four viewpoints above, particularly regarding the ecosystem or species used as biological resources). The final comprehensive assessment is made by combining all of these indicators, shown by using the visual signs outlined below. As is the case with assessing causes and measures, note that some elements may be ignored when the overall result is indicated by the signs.

Table: Assessment of status

Subject of assessment	Legend			
Degree of loss	Not Lost	Not significantly lost	Lost	Significantly lost
	▨	■	■	■
Trend of situation	Recovering	Same	Being lost	Being rapidly Lost
	↗	→	↘	↓

Note: Some elements are ignored when visual signs are indicated.
Note: The dashed lines for assessing the degree of loss indicate insufficient data.
Note: "*" indicates that there are multiple factors and data related to the indicator in question, as well as existing factors and data showing trends that differ from current assessments of the degrees, effects and trends of overall loss.

The assessment was conducted by compiling existing data (a total of 104 sets of data) and examples of biodiversity, with a total of 30 indicators used to describe the causes, measures and status (Figure: Indicators of assessment). As a guiding principle from the perspective of maintaining subjectivity, we only use data originally released to the public through statistical materials contained in public documents, or where a scientific process has been followed. As far as possible, we tried to take national subjects and use time-series data covering the entire assessment period. We also used subjects in specific regions and data covering only part of the assessment period, as well as concrete examples.

Assessment of causes (14 Indicators)

	Indicators of the First Crisis (6 Indicators)	Indicators of the Second Crisis (3 Indicators)	Indicators of the Third Crisis (4 Indicators)	Indicators of the Climate Change Crisis (2 Indicators)
Causes of loss	1 Development of ecosystem 2 Direct use of wild animals 3 Eutrophication of water area 4 Factors behind a decrease in endangered species	7 Use of Satochi-Satoyama 4 (Listed again) Factors behind a decrease in endangered species	9 Invasion and taking root of alien species 10 Influences on fauna and flora caused by chemicals 4 (Listed again) Factors behind a decrease in endangered species	12 Influence on organisms caused by the Global Warming 4 (Listed again) Factors behind a decrease in endangered species
Measurers	5 Conservation areas 6 Capture/collection control, projects of conservation and population growth	8 Scientific conservation and management of wildlife	11 Restriction of import and control of alien species	

Indicators as a basis of measures (2 Indicators)
13 Recognition of biodiversity
14 Technology transfer and fund provision to overseas countries

Assessment of status (16 Indicators)

	Indicators of forest and mountain systems (4 Indicators)	Indicators of cultivated systems (3 Indicators)
Scale/Quality of Ecosystem	15 Scale and quality of forest and mountain systems	19 Scale and quality of cultivated systems
Continuity of Ecosystem	16 Continuity of forest and mountain systems	
Number and Distribution of Species	17 Populations and distributions of species living in forest and mountain systems	20 Populations and distributions of species living in cultivated systems
Status of Biological Resources	18 Use and maintenance of artificial forests	21 Diversity of agricultural products and farm animals

	Indicators of urban systems (2 Indicators)	Indicators of inland water systems (3 Indicators)
Scale/Quality of Ecosystem	22 Scale of urban green space	24 Scale and quality of inland water systems
Continuity of Ecosystem		25 Continuity of rivers and lakes
Number and Distribution of Species	23 Populations and distributions of species living in urban systems	26 Populations and distributions of species living in inland water systems
Status of Biological Resources		

	Indicators of marine and coastal systems (3 Indicators)	Indicator of island systems (1 Indicator)
Scale/Quality of Ecosystem	27 Scale and quality of coastal ecosystems	
Continuity of Ecosystem		
Number and Distribution of Species	28 Populations and distributions of species utilizing neritic areas	30 Populations and distributions of species endemic to islands
Status of Biological Resources	29 Status of valuable fish resources	

Figure: Indicators of assessment

(5) Structure of the report

Based on the framework described above, this report consists of the following: Outline of the Natural Environment and Socio-Economy in Japan as the Premise of Assessment (Chapter I), Assessment of the Causes of Biodiversity Loss based on Indicators of Causes (Chapter II), Assessment of the Status of Biodiversity Loss based on Indicators of Status (Chapter III), Summary of Comprehensive Assessment based on the first and second chapters (Chapter IV), and Remaining Issues (Chapter V) (Figure: Structure of the Report).

Appendix 3 lists the data used in the assessment. Some actual data are shown in diagrams included with the main text (in Chapter II and Chapter III); data not shown in the main text are shown in Appendix 4.

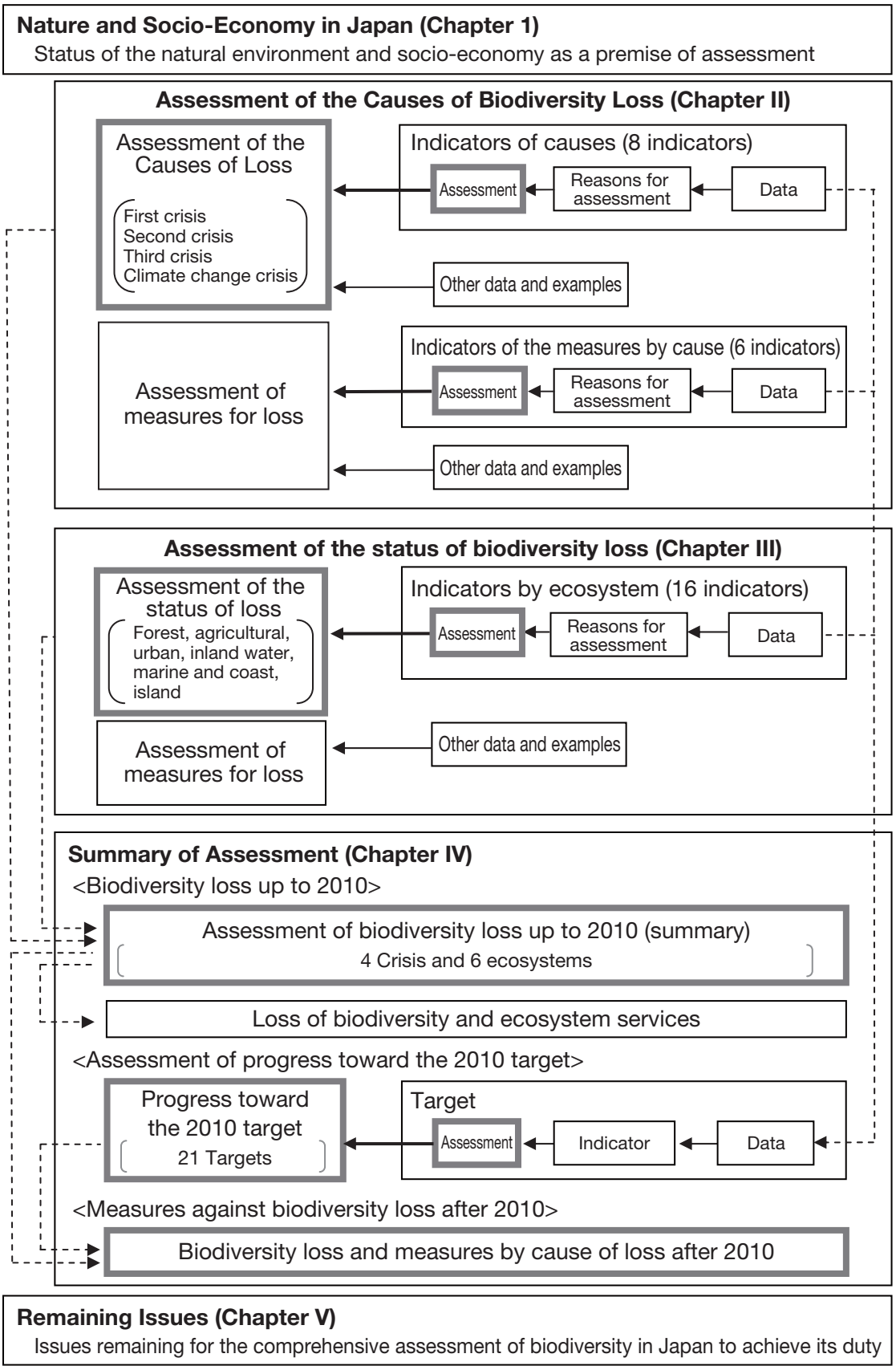


Figure: Structure of the report (with assessment shown in bold brackets)

4. Organization of Assessment

The Japan Biodiversity Outlook Science Committee (established by the Ministry of the Environment) conducted the assessment with reference to the opinions of a number of experts throughout the country.

Table: Structure of Committee for Comprehensive Assessment of Biodiversity in Japan (Japanese in alphabetical order)

Committee Member	Title
Makoto Kato	Professor, Graduate School of Global Environmental Studies, Kyoto University
Akio Takenaka	Director, Environmental Biology Division, National Institute of Environmental Studies
Tohru Nakashizuka (Chairman)	Professor, Graduate School of Life Sciences, Tohoku University
Futoshi Nakamura	Professor, Graduate School of Agriculture, Hokkaido University
Hiroyuki Matsuda	Professor, Graduate School of Environment and Information Sciences, Yokohama National University
Shingo Miura	Professor, Faculty of Human Sciences, Waseda University
Tetsukazu Yahara	Professor, Faculty of Sciences, Kyushu University
Izumi Washitani	Professor, Graduate School of Agricultural and Life Sciences, University of Tokyo

In FY 2008, prior to commencing the assessment, a questionnaire on the causes and status of biodiversity loss during the assessment period was sent out to a total of 581 biology experts in Japan, including members of the Japan Biodiversity Outlook Science Committee under the Ministry of the Environment, committee members and directors related to nature conservation at major academic institutions of biology, and other biology experts, from which we received 208 responses (see the table below and Appendix 1). With reference to their opinions, we classified information on the causes and status of biodiversity loss and selected the indicators. For compiling the Report of Assessment in FY 2009, We sent a draft report to those 208 respondents for their opinions and received 54 responses. Those responses were used as a reference for the account (see the table below and Appendix 2).

We also referred to contents of a debate during a hearing when questioned by the Sub-Committee of Conservation and Restoration, the Science Council of Japan in FY 2009, as well as debates during symposiums held at the Ecological Society of Japan in FY 2008 and FY 2009. We were also fortunate to receive some data or analytical assistance from 16 experts.

Table: List of biology experts who offered opinions

Committees for assessment related to the Ministry of Environment	Committee and Sub-committee for Selection and Assessment of Wildlife Threatened with Extinction, Sub-committee for Vegetation Science under the Committee for Basic Assessment of Natural Environment Conservation, Department of Vegetation Science Research, Committee for Bird Banding Assessment, Committee and Sub-Committee for Assessment of Monitoring Promotion in Significant Ecosystem Surveillance Areas (Monitoring Site 1000 project)
Committee members and directors related to nature conservation at major academic institutions of biology	The Ecological Society of Japan, Japanese Forest Society, Japanese Society of Grassland Science, Japanese Society of Limnology, Oceanographic Society of Japan, Japanese Society of Systematic Zoology, Japanese Society for Plant Systematics, Mammalogical Society of Japan, Ornithological Society of Japan, Herpetological Society of Japan, Ichthyological Society of Japan, Entomological Society of Japan, Japanese Association of Benthology, and Botanical Society of Japan

Chapter I
Nature and Socio-Economy in Japan

This chapter describes the general conditions of biodiversity in Japan and the country's natural environment, which form the basis, as well as those of our socio-economy, which exercise influence as an indirect cause of biodiversity loss, as a premise to assess the causes and status of biodiversity loss.

Section 1 The Natural Environment and Ecosystems in Japan

1. Natural Landscape of Japan

(1) Outline

Japan offers habitats for a variety of living things, since its land area runs lengthwise north to south just off the Eurasian continent, has landscapes ranging from seashores to mountains with different altitudes, includes thousands of islands, is influenced by monsoons that create climatic conditions affording four distinct seasons, and exposed to various sources of disturbance, including volcanic eruptions, the flooding of steep rivers, and typhoons. As a result of the geological process of merging with and separating from the Eurasian continent, Japan also forms the biota of a number of species, including endemic ones. Our biodiversity has strong links with Asia and the Eurasian continent, including the movement of migratory birds.

(2) Position and area

Japan lies to the east of the Eurasian continent and consists of an arcuate archipelago parallel to the continent across the Sea of Japan. The archipelago is positioned between latitude 20 degrees 25 minutes north and latitude 45 degrees 33 minutes north, and stretches a length of 3,000 kilometers. Japan consists of some 6,800 islands, and its total area is approximately 380,000 km^2.

(3) Climate

The Japanese archipelago extends from the sub-tropical zone to the sub-arctic zone, with the Kuroshio Current flowing from the south and the Oyashio Current flowing from the north in nearby seas. The climate is humid with significant monsoons, and generally there are four distinct seasons.[1)] Rainfall levels during summer and autumn, as well as snowfall in winter, are significantly above world averages. In Honshu, the mountainous backbone stands on the boundary of two areas, between which striking differences in the seasonal distribution of precipitation are observed, thereby creating the two characteristic climatic patterns of Pacific climate and Sea of Japan climate.

(4) Landform

The Japanese archipelago belongs to one of the most recent diastrophism belts in the world, showing various active geological phenomena. The landform is undulating and the mountainous regions, including volcanic areas and hilly country, account for three-quarters of Japan's total land space.

The slopes of this mountainous country are generally steep, with some valleys being finely curved. Hilly landscapes are seen in many parts of Japan between the mountains and the plains. Plains and basins are relatively small, dotted between the mountainous regions or along the seashore, with many formed by the alleviation of rivers.

(5) Biogeographical region and historical geology

Flora is classified into six kingdoms, and those in Japan belong to the Paleotropical Kingdom and the Holarctic Kingdom. Pandanacae and palm trees are representative of the Paleotropical Kingdom, while Japanese chestnut trees (*Castanea crenata*) and Salix trees and shrubs are distinctively distributed in the Holarctic Kingdom. Fauna is classified into six zoogeographical provinces, and those in Japan belong to the Palearctic region and the Indomalaya region. The Watase Line that cuts through the Tokara Islands forms the boundary between the Palearctic and Indomalaya regions.

A number of fauna that live south of the Watase Line are closely related to species in Taiwan and Southeast Asia, while those living north of the Watase Line have a high affinity with species on the Eurasian continent. The Blakiston Line creates a boundary along the Tsugaru Strait between Hokkaido and Honshu, and divides the Palearctic regions into two: the Siberian sub-region in the north where Blakiston's fish owl (*Ketupa blakistoni*), Brown bear (*Ursus arctos*) and Pika (Rock rabbit) live, as well as a number of species in common or closely related to those in Siberia and the Russian Far East, and the Chinese sub-region to the south, home to the Asian black bear (Ursus thibetanus) and a number of species common with those on the Korean Peninsula. It resulted from a repeated process where land in the Korean Peninsula area that connects the Japanese archipelago with the Eurasian continent was uplifted and then flooded during an ice age and an interglacial period in the Quatemary Period, when flora and fauna from the continent gained entry into Japan, followed by the separation of land and subsequent isolation.

(6) Vegetation

Natural vegetation

The Japanese archipelago that stretches far north to south and contains many locations also features wide-ranging natural vegetation. Due to a humid climate, vegetation under natural conditions (natural vegetation) is mostly forest. Well-developed forests, in ascending order from the southern regions, are as follows: subtropical evergreen broadleaf forests (on the Ryukyu Islands and the Ogasawara Islands (or Bonin islands)), warm-temperate evergreen broadleaf forests (in south-central Honshu), cool-temperate deciduous broadleaf forests (from central Honshu to south of Hokkaido), and subalpine evergreen coniferous forests (in Hokkaido). Alpine vegetation is established in areas beyond the vertical forest lines (i.e., mountainous regions of central Japan and Hokkaido). Each of these forests comprises a number of spermatophytes in common with the continent, as well as endemic species.

Limitations due to soil conditions or hydrologic environment in some special locations have developed mire vegetation, sand dune vegetation or mangroves.

Existing vegetation

In reality, vegetation in the Japanese archipelago has largely been replaced by secondary vegetation through human disturbance. There are also other various forms of vegetation, including vegetation succession subject to natural disturbance.

The 5th Nature Conservation Basic Survey of the Ministry of the Environment revealed that natural forests and natural vegetation (including natural grasslands) currently account for 17.9% and 19.0% of our land, respectively. For other vegetation, secondary forests (including those close to natural forests) account for 23.9%, forested land 24.8%, secondary grasslands 3.6%, agricultural land (including residential land with a significant amount of green land) 22.9%, urban land 4.3%, and others (such as open water) 1.5%.

Natural vegetation is distributed in areas where human influence is difficult to detect, mainly in steep mountains, on peninsulas, and islands. Plains and gently undulating mountainous areas have a higher occupancy rate of secondary vegetation, including secondary forests or secondary grasslands, as well as forested and agricultural land.

Forests account for 67% of Japan's total land area. For the past 500 years, when the use of meadowlands and slash-and-burn fields was developed, in addition to the development of agricultural land, the current percentage of forests to Japan's total land stands at a very high level — as high as in the countries of Northern Europe, such as Sweden (70%), and overwhelmingly higher relative to other developed countries including the United Kingdom (12%) and the United States (33%).[1)]

(7) Number of species and endemic species

It is estimated that there are more than 90,000 species already known to be living in Japan, and in excess of 300,000 species when including unclassified species,[1)]. This shows that, despite a limited land space of approximately 380,000 km^2, Japan comprises rich biota. The high ratio of endemic species is also quite evident: within the group of terrestrial mammals and vascular plants, Japanese endemic species account for approximately 40%, reptiles about 60%, and amphibians around 80%.[1)] On the Ogasawara Islands (or Bonin Islands), virtually all terrestrial birds are endemic species and 93% of land snails are either endemic species or endemic subspecies. On the Ryukyu Islands, some species such as the Amami rabbit (*Pentalagus furnessi*) and Pryer's woodpecker (*Sapheopipo noguchi*), which are already extinct on the continent, survive as relic species,[1)] that is, a phenomenon whereby species are observed to differentiate into endemic species.[1)] These islands therefore deserve particular attention.

Japan is the only advanced country where monkeys live in the wild. A number of medium-size and large wild animals (including bears and deer) also live in Japan.

Biota in the Coasts and Oceans

In the marine areas, several currents including the Kuroshio, Oyashio and Tsushima flow around Japan, thereby creating a varied environment along the Japanese archipelago that extends a long way from north to south. Japan's coastline is about 35,000 km long or equivalent in length to three-quarters of the earth's circumference, as well as intricate, where varied ecosystems of abundant biota are observed, including tidal flats, kelp coasts, coral reefs, sandy beaches, dunes, ledges, seagrass beds and mangroves. Rich habitats exist in Japanese waters that encompass wide-ranging water temperatures from the subarctic zone to the subtropical zone. It is notable that more different kinds of saltwater fish live in Japanese waters than in the Mediterranean Sea or off the West Coast of the United States, both of which are located at the same latitude.[1)]

Japanese waters form habitats for a number of species — 0 out of 112 species of marine mammals, as well as about 25% (or 3,700 species) of the world's approximately 15,000 species of saltwater fish, in addition to many endemic species, live in Japan's coastal areas. Given its location along the periphery of the Pacific Ocean near the equator (where extremely rich biodiversity can be found), Japan boasts of exceptionally varied species among developed countries.[1)]

Breeding Grounds/Stopover Points for Wide-Area Migratory Animals

Some wild animals including migrant birds, sea turtles and marine mammals migrate across borders from Pacific Rim countries in Asia and North America, and from Australia. Some birds such as the White-fronted goose (*Anser albifrons*) and Whooper swan (*Cygnus cygnus*), which mainly breed in the northern part of the Russian Far East during summer, as well as the Black-faced spoonbill (*Platalea minor*) that breeds on the Korean Peninsula or some remote islands in China, pass the winter in Japan.[1)] The Barn swallow (*Hirundo rustica*) — a summer bird in Japan — passes the winter mainly in Southeast Asia.[1)] A number of species within scolopacidaes and sharadriidaes as a mass not only use tidal flats in Japan as a stopover point in spring and autumn, but many also spend the winter in Japan.[4)]

The Loggerhead sea turtle (*Caretta caretta*) that hatches in Japan makes a seasonal migration to the North American coast, and then returns to Japan as an adult to lay eggs.[1)] Salmon that hatch in Japan make a seasonal migration to the Bering Sea,[1)] while the Humpback whale (*Megaptera novaeangliae*) breeds in Japanese waters and uses marine areas off the North American coast as feeding grounds.[1)] These are just some examples of migratory fish and marine mammals spend some time in the marine areas of Japan during their lives.

2 . Outline of Ecosystems

(1) Forest and mountain systems

Due to Japan's mild and humid climate, forests are widely established throughout the Japanese archipelago, except along the seashores and in areas exposed to strong winds. Reflecting the different characteristics of each region, evergreen broadleaf trees dominate in the south or areas of lower altitude, and deciduous broadleaf trees and coniferous trees dominate in the north or areas of higher altitude. These forests form important habitats for many varieties of fauna and flora. And in Honshu, alpine vegetation is observed at elevations generally higher than 2,500 meters. Approximately 70% of mammals and about 70% of the birds that breed in Japan (or 170 species out of a total of 251) rely on forests as their habitats.

The majority of forests in the Japanese archipelago, even after having been exposed to such disturbances as a forest fire or the felling of trees, eventually revive. Hence, forests have historically been used as sites of slash-and-burn cultivation, for gathering such foodstuffs as mushrooms and nuts, or for the production of such fuel sources as firewood and charcoal, and for lumber. Forests as the sites of slash-and-burn fields, fuel sources and production were normally found near residential areas, given the convenience of transporting materials, and have formed unique landscapes as secondary forests, having been regularly exposed to such disturbances.

Until the issue of transport capability was solved, major lumber production sites based on afforestation were situated near large consuming areas or areas of well-developed water transport (such as Ohme, Kitayama and Tenryu).

(2) Cultivated systems

Ever since rice farming was propagated from the continent, landscapes in Japan have formed like a mosaic around farming villages, consisting of agricultural land such as rice paddies and fields, waterways and reservoirs that supply river water to agricultural land, forests such as woods from which fallen leaves and twigs are collected to make fertilizers for agricultural use, and secondary green land used for meadows and grazing. The use of water for rice farming has also formed a peculiar landscape, such as Yatsuda (rice fields in a ravine) and Tanada (terraced rice fields). A number of relic species originating from the continent also exist in Japan, having expanded their distribution during the ice age and settled in Japan, with a majority choosing habitats in the flood plains of a river, such as natural wetlands and natural fields, but also in forest and mountain systems, and in cultivated systems that are exposed to regular human disturbance.

(3) Urban systems.

Since Japanese landscapes include a number of steep mountainous or hilly areas, agricultural as well as residential sites were mainly developed at estuaries, in such plains as alluvial fans, and on plateaus. Reed plains and estuary tidal flats used to spread around the mouth of inner bays, but the foundation of the three largest metropolitan urban areas was already established by the Edo period (from the 17th Century to the early 19th Century). Most urban areas in the Meiji and Taisho eras (from the late 19th Century to the early 20th Century) were once castle towns of the feudal domain period, and developed as central towns and cities of the region. Medium-size and small towns were also established in seashore areas and the plains.

The improvement of rivers has also progressed for the purpose of flood control and irrigation since the Edo period. The land area for urban use doubled from 3% of the total to 6% between 1850 and 1950, and road and rail networks made rapid progress.[5] However, only part of the land in urban areas was covered with asphalt prior to the high economic growth period, and there remained forests (near residential areas), agricultural forests (as used for agricultural purposes) and temple/shrine forests (near the sites of temples and shrines) within many urban areas throughout the country.

(4) Inland water systems

Given Japan's narrow and mountainous landmass, rivers characteristically have a narrow catchment area and flow rapidly. Moreover, the volume of sediment can be significant, as precipitation tends to be seasonally concentrated due to typhoons and the rainy season, combined with the geological complexity of the land. Therefore, riverside boulders have developed and extensive food plains are easily formed. Fish swimming upstream from the sea, such as Ayu (or Sweetfish) and salmon, as well as a number of living things that use the brackish water, are found there. Many freshwater fish living in Japan's inland waters are endemic species. Wetlands and the surrounding riversides are also important habitats for many migrant birds, not to mention large cranes and storks, and terrestrial animals, including amphibians and insects.

Japan's inland water environment has a long history of flood control and irrigation, having been shaped by both human and natural influences. Large-scale land reclamation has been conducted through drainage, as well as the conversion of flood plains into agricultural land (or the development of land for cultivation, such as irrigated rice fields) , but there was little drastic or artificial transformation of the environment before the 1950s, except for such events as the extinction of the Black kokanee (*Onchorhynchus nerka kuwamurae*) resulting from an accidental inflow of strong acidic water into Lake Tazawa.[6] Until then, it was always the case that a number of fauna and flora were living in artificially controlled environments. Only when the large-scale construction of dams began in the 1950s did enormous changes start to affect the rivers. It was around the same time that water pollution and eutrophication caused by drainage into rivers, lakes and marshlands became an issue.

(5) Marine and coastal systems

Japan consists of islands stretching approximately 3,000 km from north to south, and is surrounded by four oceans — the Sea of Okhotsk, the Sea of Japan, the East China Sea and the Pacific Ocean. Its submarine topography is also complex with various marine environments, from a continental shelf of gentle slopes to steep marine areas dropping sharply into an abyss. As for currents, the cold Oyashio Current flows southwards from the north, while the warm Kuroshio Current flows northwards from the south. This environmental complexity hosts rich varieties of fish in excess of 3,500 species from the boreal to the tropical, and from the coastal to the deep sea.

Surrounded by seas containing rich varieties of fish, the Japanese people have long used the ecosystems of coasts and oceans in various ways, with seafood being a major source of protein, and seaweed being used as food and as green manure.

The ecosystems of coasts and shallow waters, including tidal flats, kelp coasts, coral reefs, sandy beaches, dunes and ledges, have not only been extremely important as habitats and breeding grounds for living things, but also used for human activity since ancient times, not least where the inner bays have provided popular sites for residential premises and economic activity. Prior to the high economic growth period, the coastal and shallow water areas had little artificial modification, such as reclamation or sea walls, and it is expected that a number of good tidal flats and kelp coasts will remain. Japan's self-sufficiency rate regarding seafood was in excess of 100% until the 1950s.[7] There were no problems of eutrophication or water pollution back then.

(6) Island systems

In addition to its major four islands, Japan includes about 6,800 islands, both small and large, including the Ogasawara Islands (or Bonin Islands) and the Ryukyu Islands, which have long been isolated and contain unique biota. The majority of these islands serve an important role as stopover points for migrant birds, not least the uninhabited islands used as breeding grounds.

The Ryukyu Islands were connected by land with the Eurasian continent until about 15 million years ago. The islands became isolated after the East China Sea formed about 2 million years ago, leading to the establishment of unique biota with relic species left behind from the continent, and endemic species that were created through speciation on the islands. The Ogasawara Islands (or Bonin Islands) are oceanic islands that were never connected by land with the continent. A group of these islands was created following submarine volcanoes about 150,000 years ago. The species that were introduced and settled there by chance evolved in their own way, the majority of which became endemic species. The cultivation of the Ogasawara Islands (or Bonin Islands) was encouraged after the Meiji Era, followed by an expansion of agricultural land and diminishing of forests.

References

1) The National Biodiversity Strategy of Japan 2010 pproved by the Cabinet on March 16, 2010).
2) The Society for the Issues of Forestry and Nature Conservation (ed.). The Commission of Japanese Forestry Industry, 1989. Forests/Forestry and Nature Conservation — The Conservation and Management of New Forestry, 346pp.
3) The Ministry of the Environment, 2006. Report of the FY 2005 Survey on Significant Areas of the Ryukyu Islands, Recommended as a World Heritage Site (Commissioned).
4) Amano, Ichiyo, 2006. Current State of Migrant Birds which Use Tidal Flats. Global Environment, 11, 215-226.
5) Himiyama, Yukio, 1992. Modernization of Japan and Changes in Land Usage.
6) The Ministry of the Environment (ed.), 2003. Revised・Wildlife in Japan on the Brink of Extinction — Red Data Book 4 (Brackish-Water and Freshwater Fish), The Japan Wildlife Research Center.
7) The Ministry of Agriculture, Forestry and Fisheries. Chart for Supply and Demand of Foodstuffs in Japan.

Section 2 Trends of the Socio-Economy in Japan

Given the long history of engagement in agriculture, forestry and fishery in its coastal areas, Japan has created its own culture of coexistence with a number of living things and the riches of nature. However, following a growing amalgamation with Western culture in recent years, especially in the development of scientific technology, the relationship between the Japanese people and nature has diminished, and the cultural climate characteristic of Japan where regional nature and culture were linked appears to be disappearing.

After the Meiji Restoration (in the late 19th Century) and especially after WWII, the Japanese economy advanced a great deal, while formerly rich biodiversity has been lost. We were aware of the importance of economic development, but inclined to forget that richness in biodiversity in fact brings about abundance in our lives.

Given this recognition, the following outlines the socioeconomic trends in Japan over the past 50 years, covering the period of our assessment from the second half of 1950s (around Showa 30) to the present day.

1. From the Second Half of the 1950s to the First Half of the 1970s

<High Economic Growth and Land Development>

During this period, we experienced a period of high economic growth upon completing postwar rehabilitation. The Economic White Paper released in FY 1956 described a situation where the Japanese economy had recovered to its prewar level, moved on from economic growth of the postwar rehabilitation period, and was entering a new growth phase through "modernization," as "it was no longer the 'postwar' era." The population was growing rapidly at 1% or 2% per annum, and people migrated from rural areas to the cities.[1)] The industrial structure changed to a heavy chemical industry-oriented one, and the real GDP kept increasing by approximately 10% annually.[2)]

Japan began importing cheap oil in large quantities, and the structure of energy supplies shifted from dependence on coal, hydroelectric generation and firewood/charcoal to mainly oil ("The Energy Revolution"). This dependency on importing this primary energy supply rose from about 20% in the mid-1950s to about 80% by around 1970.[3)]

At the same time, the Japanese people changed their lifestyle, whereby nuclear family resulted in fewer people living in the same household, durable consumer goods—The so-called "Three Sacred Treasures of the Imperial Household" being an electric washing machine, an electric fridge and a TV — ecame popular, and automobiles spread throughout society. The society of mass production and consumption had arrived.

Given Japan's growing population, the migration of people, changes in the structure of energy supplies and industries, and the construction and improvement of residential properties and industrial facilities consequently progressed throughout the country. In addition, the development of social infrastructure as the basis of economic growth advanced. A nationwide comprehensive development plan was drawn up in 1962, and a new follow-up nationwide comprehensive development plan was also created in 1969, following which large-scale development (called "The Transformation of the Japanese Archipelago Boom") spread nationwide. As a result, residential areas expanded rapidly, but the area per capita (privatized land) remained lower or at about the same level as in the prewar era.[4)] Cities on the plains including along "the Pacific Coastal Belt" stretching from Tokyo Bay westwards to the Tokai, Kinki and Setouchi regions, and north of Kyushu expanded due to the industrial and residential sites located there, and coastal areas were reclaimed to supply more land for that purpose. Between 1960 and 1975, the population of this densely inhabited district (DID) grew 1.5 times, while the land area doubled.[1)] In contrast, more remote places in the mountains suffered seriously from depopulation; as a result, the Act for Urgent Measures against Depopulation was enacted in 1970.

In order to meet the growing demand for more water and the need to take measures against damage caused by flooding in urban areas, dams were constructed on rivers, with riverbanks being artificially modified and straightened. In some areas, enormous efforts were made to collect pebbles and gravel. In addition, more seashore areas were created artificially to deal with the potential damage caused by exceptionally high tides generated by typhoons.

<The Agricultural, Forestry, and Fisheries Industries>

The percentage of the population engaged in the primary industries accounted for about 40% of the total population in 1955, but fell to about 20% in 1970.[1)] The areas used as agricultural land peaked at about 61,000 km^2 in the first half of 1960s and then declined, while agricultural techniques also changed with the spread of agricultural chemicals and chemical fertilizers, as well as greater mechanization. Farm production was also liberalized in a few stages since the 1960s, leading to a lower self-sufficiency rate of foodstuffs (on a calorie supply basis) from 79% in FY 1960 to 60% in 1970.[6)]

Along with high economic growth, the demand for lumber as a building material, paper and pulpwood showed a marked increase. In order to meet this demand, secondary forests, which lost economic value following the Energy Revolution, were converted into artificial forests of Japanese cedar and Japanese cypress (via expansive afforestation). With the liberalized importation of lumber in the 1960s, the supply volumes of imported lumber surged, leading to a lower self-sufficiency rate of lumber of 87% in 1960 to 45% in 1970.[7)] Fishery production also increased due to expanded deep-sea fishing.[8)]

<Occurrence of Pollution>

By then, pollution had become a social problem. Many incidents of pollution occurred, such as the Sumida River in Tokyo beginning to smell bad in the 1950s, and water quality or eutrophication continued to deteriorate in rivers, lakes and marshlands due to industrial and residential drainage. Air pollution in industrial zones then became a problem in the 1960s. The outbreak of Minamata disease (from poisoning caused by industrial mercury pollution) was also confirmed in the 1960s.

2. From the Second Half of the 1970s to the 1980s

<Stable Growth and the Bubble Economy>

The high economic growth period ended in the mid-1970s with the Oil Crisis (in 1973) as a turning point. Real GDP maintained an annual increase of approximately 5%.[2)] Population growth became marginal and the migration from rural areas to urban areas slowed down.[1)] Residential areas per capita (privatized land) started to significantly exceed prewar levels, and residential land generally became more available compared with the high economic growth period.[4)] Based on the point of view expressed in "The Balanced Development of Land," land development extended its reach to rural areas, and the social infrastructure including roads, railways, harbors, and facilities near rivers and seashores advanced.

Real GDP maintained annual growth in a range of +3% to +5% in the first half of the 1980s[2)] before the so-called "bubble economy" developed in the second half of 1980s. Industry and population were both concentrated in the metropolitan Tokyo area in what was described as "the concentration of capital, resources and activities in Tokyo." Land prices in central urban areas skyrocketed and resort developments progressed around the urban areas, encouraged by the Resort Development Act in 1987.

<The Agriculture, Forestry and Fisheries Industries>

Rural areas faced the issues of depopulation and aging residents. The ratio of population engaged in primary industries relative to the total population continued to decline, and reached as low as approximately 10% in the 1980s.[1] An imbalance in the supply and demand for rice developed, resulting in serious rice production controls being imposed since the 1970s, and leading to less planted acreage of rice plants. The profitability of forestry deteriorated and domestic forests were no longer used for industrial purposes. The importation of foodstuffs and lumber slightly increased. The self-sufficiency rate of foodstuffs (on a calorie supply basis) and that of lumber remained in the 50s and 30s percentage-wise, respectively.[6] Fisheries production peaked in the 1980s and maintained a high level, not least in offshore fishing.

3. From the 1990s to the Present Day

<Low Growth and Depopulation>

An increase in real GDP, including temporary negative growth, remained at under 3% per annum.[2] The migration of people into the Tokyo area continued, but population growth as a whole slowed and actually declined in the first half of the 2000s.[1] The total population having falling below 100 million in 2005 raised the possibility of continuing depopulation, coupled with a rapidly aging society where people aged 65 and older will account for as much as 40% of the total population.[9]

The globalization of the economy and society continued, and the traffic of people and things over the border increased. The importation of freight that had totalled about 10.5 million tons in 1950 rose to approximately 550 million tons in 1975, 760 million tons in 1995, and 820 million tons in 2005.[10]

The social infrastructure still continues to be enriched, but investment in construction, which had increased during the high economic growth period, started to decline in the 1990s.[11]

<The Agriculture, Forestry and Fisheries Industries>

Depopulation and aging continued in rural areas. The ratio of population engaged in the primary industries to the total population continued to fall, and was below 10% after the 1990s and is still declining.[1]

The importation of foodstuffs and lumber continued, with the self-sufficiency rate of foodstuffs (on a calorie supply basis) and that of lumber remaining in the 40s percentage-wise and around 20%, respectively.[6), 7] The importation of seafood increased and the self-sufficiency rate (on a volume basis) remains at approximately 60%.[6]

<Global Environmental Issues>

When oil prices suddenly soared temporarily in the second half of the 2000s, concerns were rising about whether there would be a (sufficient) supply of energy and foodstuffs. And since the 1990s, the recognition of problems related to the environment on a global scale also spread rapidly, with global warming advancing due to the emissions of greenhouse gases, such as carbon dioxide to name a few, thereby calling for international measures to be taken. The amount of carbon dioxide emissions due to human activities has been increasing worldwide since the 1950s, and the trend has continued since the 1990s.[12] In 2006, Japan accounted for 4% of the world's total emissions, and the volume of greenhouse gas emissions including carbon dioxide reached 1.374 billion tons (converted into volume of carbon dioxide) during FY 2007, marking a 9% increase over the level in 1990.[12] Emissions through industrial use

(including factories) was the largest cause (accounting for 36% of the total), but fell by 2% compared to 1990 levels, while that through transportation use (including automobiles and ships), other business use (such as office buildings) and household use rose by 15%, 44% and 41%, respectively.[12)]

References

1) The Ministry of Internal Affairs and Communication, National Census.
2) The Cabinet Office, Government of Japan, System of National Accounts.
3) The Agency for National Resources and Energy, Annual Energy Report.
4) The Ministry of Internal Affairs and Communication, General Study on Prices of Fixed Asset Properties (Land).
5) The Ministry of Agriculture, Forestry and Fisheries, Statistics of Cultivated Land and Planted Acreage.
6) The Ministry of Agriculture, Forestry and Fisheries, Chart of Supply and Balance of Foodstuffs.
7) The Ministry of Agriculture, Forestry and Fisheries, Chart of Supply and Balance of Lumber.
8) The Ministry of Agriculture, Forestry and Fisheries, Annual Report on Production of Fish-Raising Industry.
9) The National Institute of Population and Social Security Research, 2006: Future Population Projections (estimated in December 2006).
10) The Ministry of Land, Infrastructure, Transport and Tourism (ed.), White Paper on Land, Infrastructure, Transport and Tourism in Japan, 2008.
11) The Policy Bureau, Ministry of Land, Infrastructure, Transport and Tourism, Construction Investment Projection, and Forecast of Construction Investment.
12) The Ministry of Environment (ed.), Annual Reports on the Environment, the Sound Material-Cycle Society and the Biodiversity in Japan in FY 2009.

Chapter II
Assessment of the Causes of Biodiversity Loss

In this chapter, we assess the extent and trends of the influence of factors that directly triggered biodiversity loss during the assessment period (from the second half of the 1950s to the present day). We examine the trends of the measures implemented by cause and then assess how the general public has understood the issue, which was the basis for implementing the measures, as well as the necessary funding and techniques.

Section 1 Assessment of the First Crisis

In this chapter, we use four indicators to assess the extent and trends of the impact of "the first crisis" as one cause of biodiversity loss during the assessment period (from the second half of the 1950s to the present day), and the trends of related measures implemented.

1. The First Crisis

○ "The first crisis" refers to the impact on biodiversity caused by human activity, such as land development. Development and water contamination are factors that reduce the scale and quality of an ecosystem, as well as its continuity. The direct use of wild animals and plants (by capturing or collecting them through hunting or fishing, or for ornamental purposes) is a factor in reducing the populations and distributions of species.

2. Assessment of Loss Factors of the First Crisis

○ The impact of the first crisis was substantial during the assessment period from the second half of the 1950s to the present day, and is likely to increase on a long-term basis.

○ During the high economic growth period in the first half of the assessment period, rapid and large-scale development substantially reduced the scale of ecosystems, in the context of highly natural forests, agricultural land, marshlands and tidal flats. Once an ecosystem has been developed, such impact is likely to linger or emerge after a certain period.

○ The direct use of wild animals and plants through hunting, for example, is decreasing on a long-term basis compared with the period after the Meiji era when the capture of wild animals was common. However, the practice of such direct use continues even today.

○ Compared with the periods of high economic growth and the "bubble" economy, the pressure resulting from development has now diminished due to changes in the socioeconomic situation. However, smaller-scale development, and the capture and collection of certain fauna and flora still continue, and the impact on species living in an already reduced habitat is likely to be more significant.

3. Reason of the Assessment

The following lists the indicators used in the assessment that represent the causes of loss due to the first crisis, and describes the assessment by each indicator.

Table II-1 Indicators representing the factors of loss due to the first crisis and their assessment

	Assessment					
	Long-term trend of impact		Degree of impact during the assessment period and current trends			
	First half of the assessment period	Second half of the assessment period	First crisis	Second crisis	Third crisis	Climate change crisis
Indicator 1: Development of ecosystems			 *1			
Indicator 2: Direct use of wild animals						
Indicator 3: Eutrophication of water areas			 *2			
Indicator 4: Factors of reduction in endangered species (the first crisis)						

Legend

Subject of assessment	Legend			
Degree of impact during assessment period	Weak	Medium	Strong	Very strong
				
Long-term trend of impact and current trends	Decreasing	Same	Increasing	Increasing rapidly
				

Note: Some elements are ignored when visual signs are indicated.
Note: The dashed lines for assessing the degree of impact indicate insufficient data.
Note: "*" indicates that there are multiple factors and data related to the indicator in question, as well as existing factors and data showing trends that differ from assessments of the degrees of overall effects and trends.
*1: Refer to the assessment of Indicator 1.
*2: Refer to the assessment of Indicator 3.

Indicator 1 Development of ecosystems

Explanation of the Indicator

○ The development of ecosystems including forests and tidal flats in our country is an indicator representing a cause of loss relating to the first crisis. It is also a direct cause of reducing the scale of an ecosystem.

Assessment by the Indicator

○ The impact of development on ecosystems is substantial, and the overall long-term trend is one of increasing loss.

○ In particular, the scale of some ecosystems was significantly reduced as more development took place nationwide during the period of high economic growth in the first half of the assessment period. In recent years, however, the pace of development has slowed down. Although smaller in scale than in the past, development affecting ecosystems is still continuing in certain areas.

○ Given the nature of this cause, even after an ecosystem has been lost due to past development, the impact continues to linger and does not stop. It is also concerned that we will only see an effect in some cases after a certain time has elapsed.

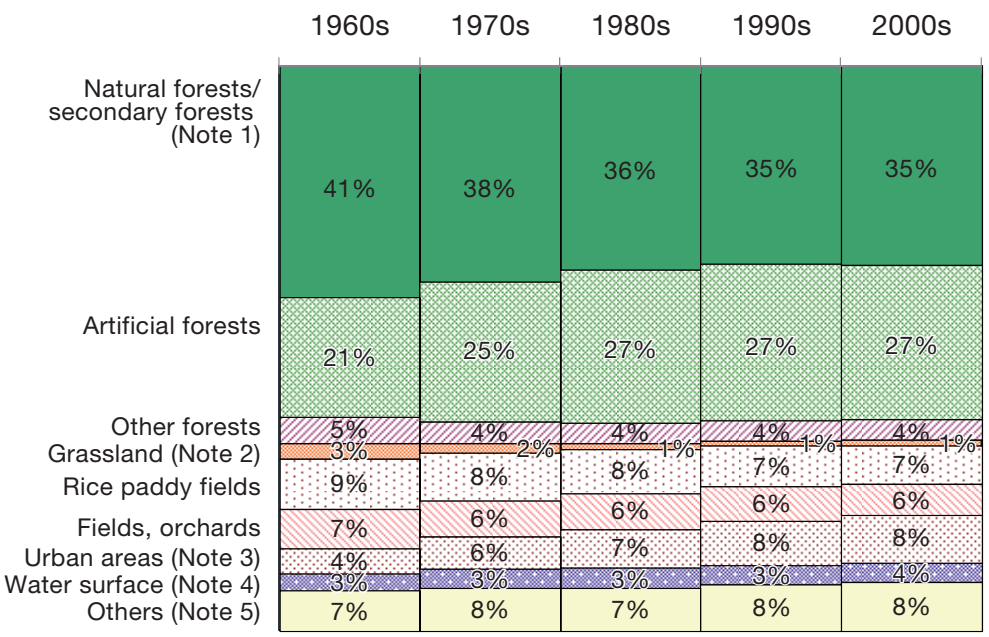
*1 (See Table II-1.) One should pay particular attention to the fact that, although the degree of impact now observed on a nationwide-basis appears to be falling compared with the period of the bubble economy, the impact of ongoing development on a regional basis may reveal a different trend.

Reason of the Assessment

Mainly during the period of high economic growth (from the second half of the 1950s to the first half of the 1970s) in the first half of the assessment period, Japan's GDP (gross domestic product) grew dramatically, its population increased as a whole and was concentrated in urban areas, and industrialization rapidly progressed. Accordingly, due to demands from the socio-economy and the need for land management, large development projects took place throughout the country. There were also large developments of resorts and other facilities during the period of bubble economy in the second half of the 1980s.

<General Situation of Land Use>

With regard to the trends in land use during the assessment period, the total area consisting of forests—accounting for 67% of Japan's total land—has been maintained, while that of natural forests (i.e., natural forests, secondary forests), grasslands and agricultural land decreased, and urban areas expanded (Data 1- ① : Figure II-1).



Note 1: This refers to natural forests as defined in the following source by the Ministry of Agriculture, Forestry and Fisheries.
Note 2: This refers to the total area of uncultivated land, meadows and pastureland, as classified in the following source by the Ministry of Land, Infrastructure, Transport and Tourism.
Note 3: This refers to the total area of roads and residential land as defined in the following source by the Ministry of Land, Infrastructure, Transport and Tourism.
Note 4: This includes land used for housing and industry, and other residential land as defined in the following source by the Ministry of Land, Infrastructure, Transport and Tourism.
Note 5: This refers to the total area of regular roads (excluding motorways), farm roads and woodland paths, as defined in the following source by the Ministry of Land, Infrastructure, Transport and Tourism.
Source: Ministry of Land, Infrastructure, Transport and Tourism: White Paper on Land and Real Property; Ministry of Agriculture, Forestry and Fisheries: Survey on Forestry Resources; Ministry of Agriculture, Forestry and Fisheries: Statistics on Cultivated Land and Planted Acreage; Ministry of Agriculture, Forestry and Fisheries: Basic Research on Infrastructure of Land Use.

Figure II-1 Trends in land use (Data 1-①)

<Development of Forests>

Mainly during the period of high economic growth, natural forests (i.e., natural forests, secondary forests) decreased, while artificial forests increased. From the 1960s to the 2000s, about 21,000 km^2 (14% of the original area of natural and secondary forests) have been lost, while about 24,000 km^2 (31% of the original area of artificial forests) have been added (Data 1- ① : Figure II-1、1- ② : Figure II-2). Forests with a higher degree of naturalness (such as natural and secondary forests) were reduced or divided upon conversion into artificial forests of Japanese cedar and Japanese cypress, which offer economic advantages.[1)] The decrease in natural forests (excluding secondary forests) is considered more significant than shown in these statistics. Conversion into artificial forests rapidly progressed during the period of high economic growth, and was still ongoing after the 1980s (Data 1- ⑤ : Appendix 15- ② : Figure III-2).

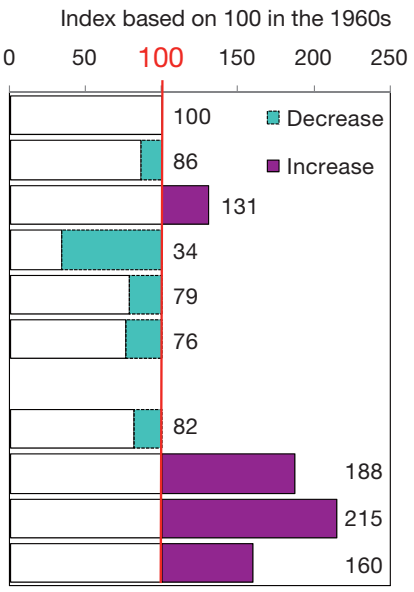
Forests on the plains were destroyed and converted into residential or industrial land, along with an expansion of urban areas (Data 1- ⑤ : Appendix, 1- ⑦ : Appendix). According to data of the topographic map of the Geospatial Information Authority of Japan, the conversion of land use is still being observed, where substantial areas of forests were initially converted into urban or agricultural land (of about 20,000 km^2) from 1950 to around 1980 (Data 1- ④ : Appendix). Forests were also converted into golf courses and resort facilities during the period of the bubble economy (Data 1- ⑦ : Appendix).

By now, vegetation not altered by human activity (i.e., degree of naturalness of 10 for natural green land or 9 for natural forests) accounts for less than 20% of Japan's total land (Data 1- ③ : Appendix). The mesh ratio of natural green land and natural forests (having degrees of naturalness of 10 and 9) accounts for more than 40% of the total regional land in Hokkaido, where land development is believed to have begun after the Meiji era, and Okinawa

Prefecture, where a significant amount of development is difficult to undertake given the many islets there. The same ratio records more than 20% in Yamagata Prefecture, where there are deep mountainous areas including Mt. Iide, Mt. Asahi, Mt. Choukai and Mt. Gassan, in Toyama Prefecture, home of the Hida Mountains (also called the Northern Alps), and in Kagoshima Prefecture, which includes such islands as Yakushima, Koshikijima, and the Amami Archipelago, as well as Mt. Kirishima. Unaltered land accounts for less than 10% of the land in each prefecture within the area stretching from Kita Kyushu to western Japan and up to the Kanto region, where high levels of development have historically been undertaken. Thus, the areas inhabited by fragile living things, which are easily affected by human activity, are now declining.

	1960s	1980s	2000s
Forests	2,517	2,526	2,510
Natural forests, secondary forests (Note 1)	1,551	1,367	1,338
Artificial forests	793	1,022	1,035
Uncultivated land, meadows and pastureland	105	41	36
Agricultural land	600	537	471
Rice paddy fields	339	295	258
(Including irrigated rice paddy fields)	27	124	155
Fields, orchards	261	242	213
Urban areas (Note 2)	167	258	314
Residential land (Note 3)	85	151	183
Roads (Note 4)	82	107	131

Unit: 100 km²



Note 1: This refers to natural forests as defined in the following source by the Ministry of Agriculture, Forestry and Fisheries.
Note 2: This refers to the total area of roads and residential land as classified in the following source by the Ministry of Land, Infrastructure, Transport and Tourism.
Note 3: This includes land for housing and industry, and other residential land as defined in the following source by the Ministry of Land, Infrastructure, Transport and Tourism.
Note 4: This refers to the total area of regular roads (excluding motorways), farm roads and woodland paths, as defined in the following source by the Ministry of Land, Infrastructure, Transport and Tourism.
Source: Ministry of Land, Infrastructure, Transport and Tourism: White Paper on Land and Real Property; Ministry of Agriculture, Forestry and Fisheries: Survey on Forestry Resources; Ministry of Agriculture, Forestry and Fisheries: Statistics on Cultivated Land and Planted Acreage; Ministry of Agriculture, Forestry and Fisheries: Basic Research on Infrastructure of Land Use; Ministry of Agriculture, Forestry and Fisheries: Statistical Research on Construction Work on Agricultural Land

Figure II-2 Scale of ecosystems in land areas (Data 1-②)

<Development of Grasslands and Agricultural Land>

Grasslands (i.e., uncultivated land, meadows, pastureland) as one component of Satochi-Satoyama areas have been substantially diminished both before and during the assessment period. The background behind this loss is that, along with the conversion of land into artificial forests and agricultural land (Data 1- ④ : Appendix), less use of secondary grasslands (the second crisis) during the period of high economic growth made a major contribution.

Similarly, agricultural land (including rice paddy fields) as another component of Satochi-Satoyama areas was also diminished throughout the assessment period. Since the 1960s, about 13,000 km^2 (21% of the original area of agricultural land) have been lost (Data 1- ① : Figure II-1, 1- ② : Figure II-2). In some areas such as Hokkaido, agricultural land actually increased. However, a significant level of conversion from agricultural land into land for residential and industrial use also occurred, particularly during the period of high economic growth, and agricultural land also was targeted for development during the period of Japan's bubble economy (Data 1- ④ : Appendix, 1- ⑥ : Appendix). Moreover, infrastructural improvements to agricultural land, including rezoning or redividing the land,

and the construction of irrigation and drainage canals have been undertaken since the 1960s in order to enhance productivity of the land. To date, agricultural improvements have been made to more than 60% of the rice paddies throughout Japan (Data 1- ② : Figure II-2, Appendix).

<Expansion of Urban Areas>

Urban areas rapidly expanded throughout the country during the first half of the assessment period, whereby the area of densely populated districts doubled from about 3,900 km^2 in the 1960s to about 8,200 km^2 in the 1970s, and continues to expand.[2] According to data of a topographical map by the Geospatial Information Authority of Japan, the conversion of land use indicates that (about 10,000 km^2 of) plains, forests, agricultural land, and other land (e.g., grasslands, open land, gravel areas, wetlands) began being changed into urban areas from around the 1950s to around the 1980s (Data 1- ④ : Appendix). Moreover, the conversion from forests and agricultural land into land for residential and industrial use continued even during the second half of the assessment period (Data 1- ⑥ : Appendix, 1- ⑦ : Appendix).

<Development of Inland Water Areas>

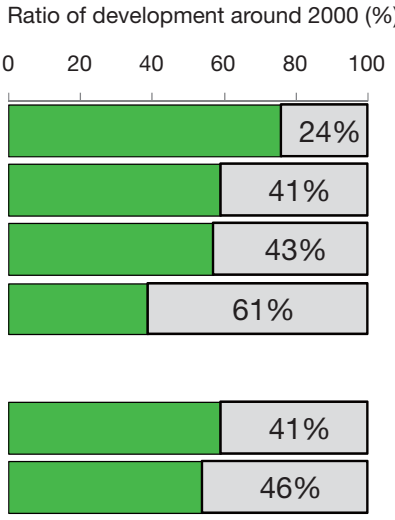
Since the period of high economic growth, the alteration of rivers progressed nationwide due to social demands for flood control and irrigation.[3] About 20% of the about 11,000 km of the midstream and downstream areas of 113 first-class rivers were tampered with (such as the edge of a river brushing by buildings) (Data 25- ③ : Figures II-3, III-16). Elements of the basic structure of rivers, such as rapids and abysses, are disappearing as the continuity with transitional areas from water is being divided, as well as rivers being straightened.[3),4)] And since the period of high economic growth, more engineering structures used for crossing rivers, such as dams and sluices, were constructed (Data 25- ① : Figure III-14). By around 2000, there was less than 50% of the entire length of a river where fish could not swim upstream in about 40% of the 113 first-class rivers mentioned above (Data 25- ② : Figures II-3, III-15).

The number of lakes and marshes has also declined due to traditional reclamation as well as reclamation by drainage. Lakeshores continued being changed by human activity[5] and, by around 2000, about 40% of the lakeshores (i.e., edges of lakes and surrounding areas) of the 480 major lakes and marshes of Japan had been altered (Data 25-④: Figures II-3, III-17). Although our available data predates the assessment period, significant portions of wetlands are also being lost (Data 24- ① : Figure II-3, Appendix).

<Development of Coastal Areas>

Since coastal areas are desirable for residential and industrial-use land, related development has been substantially pursued.[6] Since 1945, not least during the period of high economic growth, about 40% of the total tidal flat area disappeared due to such development as reclamation (Data 27- ⑤ : Figure II-3, Appendix). Kelp coasts and coral reefs are also diminishing due to reclamation and dredging (Data 27- ⑦ : Appendix, 27- ⑧ : Appendix). And since the period of high economic growth, society has demanded changes in seashores for such reasons as preventing disasters, and the alteration of seashores subsequently progressed nationwide. At present, about 50% of the total length of seashores has been altered from its original state (such as man-made structures being constructed along shorelines) (Data 27- ④ : Figure II-3, Appendix), and the natural seashore has been diminished. Though stricter regulations are being enforced, gravel was still being gathered from beaches, mainly along the Seto Island Sea. Nationwide, about 30,000 total tons of gravel had been extracted annually during the second half of the assessment period (Data 27- ② : Figure III-21).

	Around 1960s	Around 1980s	Around 2000s
Land area			
Ratio of artificial riverbanks (Note 1)		19%	24%
Ratio of rivers having a low range of upstream swimming (Note 2)		41%	41%
Ratio of artificial lakeshores (Note 3)		39%	43%
Ratio of disappeared wetlands (since around 1900) (Note 4)			61%
Coastal area			
Ratio of disappeared tidal flats (since 1945) (Note 5)		34%	41%
Ratio of artificial seashores (Note 6)		40%	46%
Area of annual reclamation (km^2)	26	19	9



Note 1: "Around the 1980s" refers to the survey data of FY 1978. "Around 2000" refers to the survey data of FY 1998. The ratio represents a percentage of rivers (other than natural rivers) to the 113 first-class rivers in Japan, which are defined as important for national security and the economy, within a certain section of rivers for the purpose of the survey (in principle, the direct section of major rivers).
Note 2: "Around the 1980s" refers to the survey data of FY 1985. "Around 2000" refers to the survey data of FY 1998. The ratio represents a percentage of rivers, where the section in which fish can swim upstream is less than 50% of the entire length of the aforementioned survey section.
Note 3: "Around the 1980s" refers to the survey data of FY 1979. "Around 2000" refers to the survey data of FY 1991. The ratio represents a percentage of lakeshores other than natural lakeshores.
Note 4: "Around 1900" refers to the data based on topographic maps made around 1886 to 1924. "Around 2000" refers to the data based on topographic maps made in 1975 to 1997.
Note 5: "Around the 1980s" refers to the survey data of FY 1978. "Around 2000" refers to the survey data obtained in FY 1995 to 1996.
Note 6: "Around the 1980s" refers to the survey data obtained in FY 1978 to 1979. "Around 2000" refers to the survey data obtained in FY 1995 to 1996. The ratio represents a percentage of seashore other than natural seashore.
Source: Environment Agency: Basic survey on conservation of the natural environment and survey on rivers (2nd, 3rd and 5th), Survey on lakes and marshes (2nd, 4th), Survey on tidal flats, kelp coasts and coral reefs (2nd), Survey on seashores and survey on environment of shallow waters (5th), Survey on coasts (2nd), Survey on seashores and survey on environment of seashores (5th); Geospatial Information Authority of Japan: Survey on lakes, mashes and wetlands (FY 1996-1999), Survey on land area

Figure II-3 Scale of ecosystems in inland water and coastal areas (Data 24-①, 25-②, 25-③, 25-④, 27-①, 27-④, 27-⑤)

BOX 1 Assessment of river environment as measured by the extent of detachment from ecosystems not modified by human activity

This section presents a brief and comprehensive assessment of the river environment in terms of its physical environmental elements. The following shows an example of assessing any point measured according to the extent of differences (extent of detachment) from "references" of minor modifications by human activity.

The Shibetsu River area in Hokkaido is chosen as the subject of assessment, since it is possible to establish references in the area, and we have selected 68 sites for this survey. An assessment is conducted from the perspectives of "artificial modification," "diversity of habitat," and "structure of rivers and floodplains." Concrete phenomena representing each point of view are set as indicators. We use the results of analyzing the major components based on each point of view in the assessment, divide the subject section by classification type, and then set the type with the least modification by human activity as the reference. Having calculated the extent of detachment at each survey site, we found that those sites showing differences from the reference in terms of many indicators including significant modification by human activity, less diversity of habitats along with fewer abysses and sandbanks, and a low degree of meandering have a large degree of detachment. We also conducted a survey using biota indicators at the same time, thereby yielding results that revealed a certain extent of correspondence between the composition and structure of detachment, and the biota concerned.

We therefore deduced that the extent of detachment generally reflects differences from the reference environments and helps to elucidate the degradation of ecosystems by human impact. This assessment method is not particularly tailored for the targeted section, and we believe it can be more easily applied to assess a wider area than just using biota indicators. We also consider the method to be effective for "a group checkup" of river environments.

<Current Trend of Development>

Compared with the period of high economic growth, there have been changes in the socioeconomic situation whereby we are currently seeing slower economic growth, a higher dependence on biological resources from abroad, and less demand for industrial sites. As a result, the pace of development in each aforementioned ecosystem is apparently easing, although smaller-scale development is still continuing (Data 1-②: Figure II-1, 1-⑥: Appendix, 1-⑦: Appendix, 24-①: Appendix, 25-③: Figure III-16, 27-①: Figure II-3, 27-④: Appendix, 27-⑤: Appendix). Once development takes place, the ecosystems at these sites physically disappear and are difficult to restore. It also remains concerned, as has been pointed out, about a time lag before the negative elements of development or water contamination are actually observed as having adversely impacted the ecosystems.

Indicator 2 Direct use of wild animals

Explanation of the Indicator

○ The excessive direct use of animals (through the capture of wild animals by hunting and fishing, and for decorative purposes) reduces both the distributions and populations of many species. This indicator therefore qualifies as a factor of loss relative to the first crisis. The following examines the capture of wild animals in land areas (see Indicator 29 for cases in marine areas).

Assessment by the Indicator

○ No data is available to indicate trends of the direct use of wild animals over long periods of time; however, prior to the assessment period, the indiscriminate hunting of birds and animals in land areas had a substantial impact.

○ During the first half of the assessment period, hunting was a popular sport. Therefore, along with the impact of development, it was concerned about declining numbers of wild birds and animals. During the second half of the assessment period, hunting had less impact, and the growing populations of some species due to lower capture pressure has become an issue for the conservation of biodiversity.

○ Recently, the attention have focused on the impact of wild birds and animals being captured for decorative purposes.

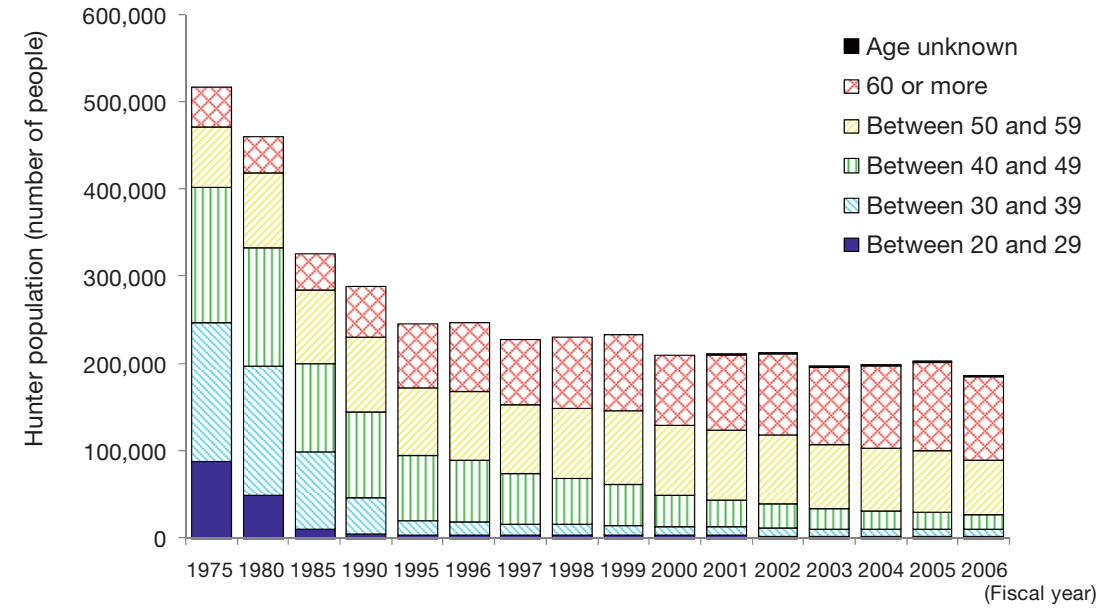
Reason of the Assessment

The indiscriminate hunting of wild birds and animals for their fur and meat was mainly observed prior to the assessment period, rather than during the assessment period that began in the second half of the 1950s. Some species became forcibly extinct or simply extinct in the wild (e.g., Crested ibis or *Nipponia Nippon*, Oriental stork or *Ciconia boyciana*, Japanese wolf or anis *Lupus Hodophilax*), or were on the verge of extinction (e.g., Japanese river otter or *Lutra lutra Nippon*, Short-tailed albatross or *Diomedea albatrus*).[8),9)] Since there was already less demand and hunting controls were in place during the assessment period, indiscriminate hunting was no longer being observed. Still, some species were able to recover (e.g., Japanese serow or *Capricornis crispus*, Short-tailed albatross or *Diomedea albatrus*), while others have not (e.g., Japanese river otter or *Lutra lutra Nippon*).[8),9)]

The first half of the assessment period saw more so-called "leisure hunters," leading to the popularization of hunting as a hobby and the development of new hunting techniques. Moreover, high economic growth encouraged the modification of wildlife habitats, and declining numbers of wild animals (birds) became an issue of concern. The second half of the assessment period saw less capture pressure. During the entire assessment period, the population of hunters, which exceeded 500,000 in 1975, was reduced by half by 1995. The percentage of hunters aged 60 years and older relative to the total hunter population was increasing, reflecting the aging of hunters (Data 2- ① : Figure II-4).

It was also pointed out that the populations of such medium-size and large mammals as deer and wild boars became uncontrollable in the 1990s, given the ongoing low hunting pressure on these animals.[10)] Now that the direct use of such mammals has subsided, a converse disadvantage has emerged whereby the growing population and expanding distribution of deer have resulted in greater damage to vegetation.[11),12),13)]

The capture of certain reptiles, amphibians, freshwater fish and insects for decorative purpose, however, remains a problem.[14),15),16)]



Source: Forestry Agency, Environment Agency, Ministry of the Environment, Statistics on wild birds and animals

Figure II-4 Trend of the hunter population (Data 2-①)

Indicator 3 Eutrophication of water areas

Explanation of the indicator

○ Nitrogen and phosphorus emitted by human activity cause eutrophication in closed water areas, lakes and marshlands. This causes an excessive growth of algae, subsequently leading to the formation of red or blue tides and degraded water quality. This is one of the indicators that demonstrate the factors of loss as related to the first crisis.

Assessment by the Indicator

○ Despite the lack of nationwide data available for the first half of the assessment period, eutrophication became a social issue during that period. The situation improved throughout the country, however, during the second half of the assessment period.

*2 (See Table II-1.): We must pay particular attention to the fact that some areas may have been strongly affected by eutrophication during the assessment period.

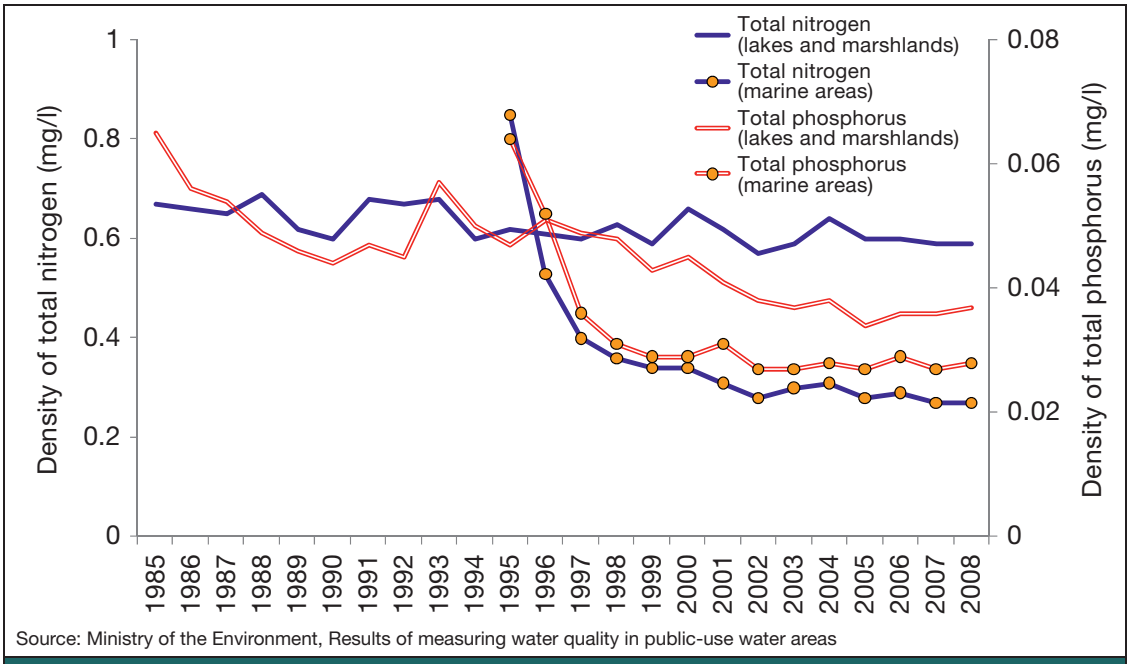
Reason of the Assessment

Given the extent of available nationwide data, eutrophication caused by nitrogen and phosphorus improved in lakes and marshlands after the second half of the 1980s. Improvements were particularly seen in marine areas after the second half of the 1990s. The density of total nitrogen in lakes and marshlands has remained at about 0.6 mg/l since the 1980s, while that seen in marine areas improved from about 0.8 mg/l to about 0.3 mg/l in the second half of the 1990s. The density of total phosphorus in lakes and marshlands, which previously exceeded a level of 0.05 mg/l, improved to less than 0.04 mg/l after the 1980s, while marine areas showed a similar improvement in the second half of the 1990s (Data 3- ① : Figure II-5).

The main reason for the accumulation of nitrogen and phosphorus in marine areas, lakes, marshlands and wetlands is believed to be the excessive discharge of nitrogen, phosphorus and organic matter (usually found in foodstuffs, animal feed and fertilizers) into the environment in the form of household and industrial effluent. The situation is believed to have initially deteriorated due to an increasing concentration of population in large cities during the period of high economic growth, as well as an actual volume increase of nitrogen and phosphorus through imported foodstuffs and animal feed. Other reasons for eutrophication include the loss of many tidal flats and reed fields that would have otherwise helped to purify the water quality.[17),18)]

Organic matter discharged into the environment as well as natural organic matter in the case of dam lakes, accumulated in the sediment of water areas. This accumulated organic matter decomposed and became a source of adverse impact. The accumulation of organic matter in sediment is said to have triggered eutrophication, particularly in closed sea areas, lakes and marshlands.[19),20),21)]

It is found that nitrogen affects ecosystems through the air. For example, nitrate levels in the mountain streams that are not affected by anthropogenic impacts are higher than the levels in the mid- to downstream area around 50 years ago except Hokkaido and Tohoku reagions. There are concerns about the impact of nitrogen load through the air (Data 3- ② :Appendix).



Source: Ministry of the Environment, Results of measuring water quality in public-use water areas

Figure II-5 Trends of density of total nitrogen and total phosphorus in lakes, marshlands and marine areas (Data 3-①)

Indicator 4 Factors of reduction in endangered species (as related to the first crisis)

Explanation of the Indicator

○ The ratio of extinct or endangered wildlife species to the total species in Japan indicates that the loss and reduction of species was caused by all of the following factors: "the first crisis," "the second crisis," "the third crisis" and "the climate change crisis." Indicator 4 assesses these factors as related to the first crisis.

Assessment by the Indicator

○ The first crisis, not least development, is the most serious factor behind the decrease of a number of species groups. The situation is currently improving, however, compared with the first half of the assessment period.

Reason of the Assessment

<Status of endangered species>

According to the latest Red List issued by the Ministry of the Environment,[22),23),24),25),26),27)] 26% of mammals, 15% of birds, 32% of reptiles, 34% of amphibians, 37% of freshwater/brackish water fish, and 25% of vascular plants are already extinct or endangered (Data 4- ① : Appendix).

With reference to the Red List issued by the Ministry of the Environment as well as the Red Data Book, 26 species of mammals, birds, amphibians, reptiles, freshwater/brackish water fish, and Coleopteras are confirmed as having become extinct (including extinct in the wild) from between the early 19th century to the present day, while seven species are confirmed as having become extinct during the assessment period that began in the second half of the 1950s. Although the status of many species in terms of being extinct or not has yet to be confirmed, there are no reliable records covering a few decades (Data 4- ② : Table II-2).

As for the number of extinct species of vascular plants by era, according to data in the Red List compiled by the Ministry of the Environment, 40 species have became extinct or extinct in the wild since the 1920s, and 22 species have become endangered. The data also shows that the average extinction rate over the past 50 years is 8.6 species per decade. The number of species confirmed as being extinct or extinct in the wild has declined by era during the second half of the assessment period, while such trend is not lowered when including "nearly extinct" species (Data 4- ③ : Figure II-6, Data 4- ④ : Table II-3).

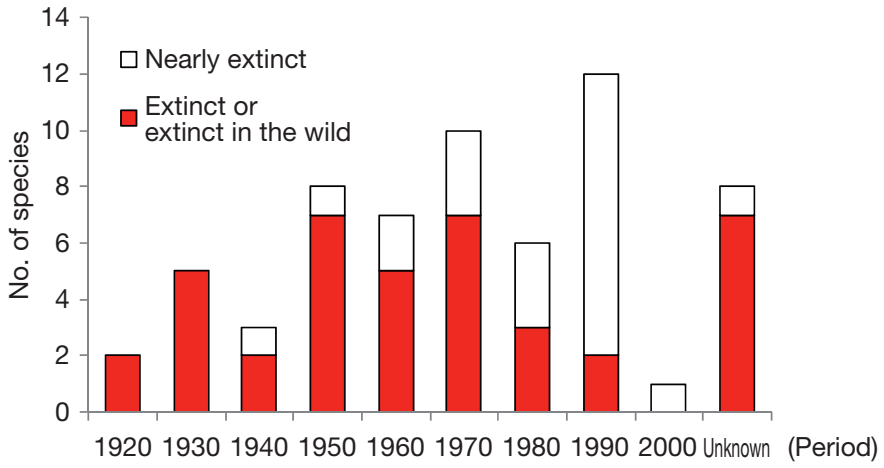
The distribution data on vascular plants shows that many endangered species live in the prefectures of Kagoshima, Okinawa and Hokkaido, where a number of endemic species also live (Data 4- ⑦ : Appendix).

No significant information is available regarding endangered species in coastal or oceanic areas, but the 1988 Data Book[28)] compiled by the Fisheries Agency listed 118 species of aquatic life as being endangered or vulnerable, of which six species are marine shellfish, 15 are marine fish, and eight are marine algae. The WWF-J report of 1996[29)] revealed that 389 species of invertebrate animals (shellfish and crustaceans) that use the tidal flat environment in Japan as their habitats were endangered species.

Table II-2 Era and name of animals already extinct or extinct in the wild (Data 4-②)

Period	Japanese endemic species or Japanese sub-endemic species	Species in wide distributions (Note 1)
1801-1900	*Pteropus pselaphon* (mammal) *Pteropus loochoensis* (mammal) *Cichlopasser terrestris* (bird) *Columba versicolor* (bird) *Chaunoproctus ferreorostris* (bird) *Nycticorax caledonicus* (bird) *Halcyon miyakoensis* (bird)	
1900s	*Canis lupus hodophilax* (mammal)	*Canis lupus hattai* (mammal)
1910s		*Tadorna cristata* (bird)
1920s	*Cettia diphone restricta* (bird) *Parus varius orii* (bird) *Porzana cinereus* (bird)	*Dryocopus javensis* (bird)
1930s	*Troglodytes troglodytes orii* (bird) *Apalopteron familiare familiar* (bird) *Columba jouyi* (bird)	
1940s	*Oncorhynchus nerka kawamurae* (freshwater/brackish water fish)	
1950s	*Rakantrechus elegans* (insect)	
1960s	*Macroplea mutica japana* (insect) *Gnathopogon elongatus suwae* (freshwater/brackish water fish) *Pungitius kaibarae* (freshwater/brackish water fish)	
1970s	*Ishikawatrechus intermedius* (insect)	
1980s		*Nipponia Nippon* (bird) *Compressalges nipponiae* (arachnid)
1990s and later		

The above lists the species already extinct or extinct in the wild, as extracted from the species groups of mammals, birds, amphibians, reptiles, insects, freshwater/brackish water fish, crustaceans, and arachnids/myriapods in the Red List issued by the Ministry of the Environment. These species were classified by era of extinction as described in the Red Data Book issued by the Ministry of the Environment.
Note 1: The extinction era of Sturgeon (a freshwater/brackish water fish species of wide distribution) is unknown.
Source: Environment Agency and Ministry of the Environment, Endangered wild animals in Japan (revised), Ministry of the Environment, A list of species of endangered wild animals in Japan



Some 40 species were already extinct or extinct in the wild, while 22 species are endangered. The average extinction ratio over the past 50 years is 8.6 species per decade.
Source: Unpublished data provided by Fujita et al. (Data were collected with the assistance of 527 researchers throughout Japan and compiled as part of the second review of the Red List issued by the Ministry of the Environment.)

Figure II-6 No. of extinct species by period (vascular plants) (Data 4-③)

Table II-3 Name and era of species already extinct or extinct in the wild (vascular plants) (Data 4-④)

Period	Name of species extinct or extinct in the wild (Note 1)		
1920s	*Euphrasia insignis subsp. insignis var. omiensis*	*Euphrasia insignis subsp. insignis var. pubigera*	
1930s	*Lespedeza hisauchii* *Cirsium toyoshimae*	*Cyperus diaphanus ssp. Setiformis* *Zeuxine boninensis*	*Fimbristylis leptoclada var. takamineana*
1940s	*Fimbristylis pauciflora*	*Magnolia pseudokobus*	
1950s	*Liparis uchiyamae* *Eriocaulon cauliferum* *Burmannia coelestris*	*Lycopodium cunninghamiodes* *Astragalus sikokianus*	*Flemingia strobilifera* *Eriocaulon seticuspe*
1960s	*Ranunculus gmelinii* *Carex disperma*	*Malus hupehensis* *Kalanchoe integra*	*Saxiglossum angustissimum*
1970s	*Hypolepis tenuifolia* *Thelypteris erubescens* *Aletris makiyataroi*	*Glaziocharis tuberculata* *Botrychium boreale*	*Renanthera labrosa* Pseudophegopteris aurita
1980s	*Viola stoloniflora*	*Dryopteris shibipedis*	Evrardia poilanei
1990s	*Eriocaulon heleocharioides*	*Cyperus procerus*	
Unknown	*Ophioglossum nudicaule* *Acanthephippium striatum* *Elatostema lineolatum var. majus*	*Tectaria dissecta* *Asplenium austrochinense* *Rubus hatsushimae*	*Euphrasia multifolia var. kirisimana*

Note 1: This list excludes species whose growth has been confirmed in recent years, and may differ from those included in the Red List issued by the Ministry of the Environment.
Source: Unpublished data provided by Fujita et al. (Data were collected with the assistance of 527 researchers throughout Japan and compiled as part of the second review of the Red List issued by the Ministry of the Environment.)

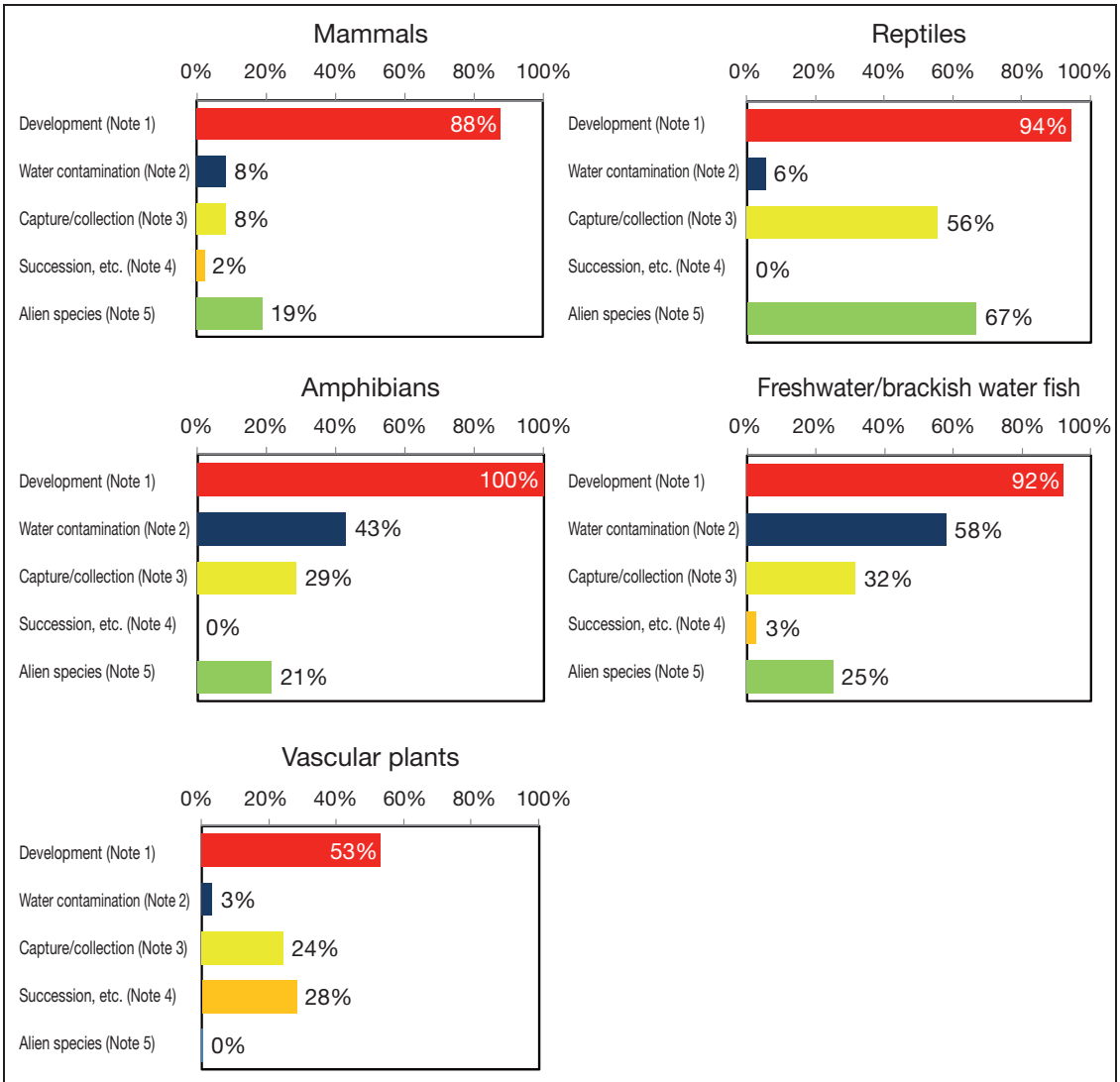
<The First Crisis as a Factor of Reducing Populations of Endangered Species>

According to the latest Red Data Book[8),9),14),15),16)] compiled by the Ministry of the Environment, there are many cases where the reduced populations of endangered species among mammals, reptiles, amphibians, freshwater/brackish water fish, and vascular plants are attributed to the first crisis (Data 4- ⑤ : Figure II-7).

In all categories, "development" (including deforestation, the development of lakes, marshlands, rivers and grasslands, and the construction of golf courses and other land development) significantly affected the environment by destroying habitats. "Development" is considered a factor behind the reduced populations of endangered species given its impact on about 90 to 100% of such species among mammals, reptiles, amphibians and freshwater/brackish water fish, and on about 50% of vascular plants. For those species relying on inland waters, "water contamination" is considered a factor behind reducing the populations of about 40% of endangered amphibian species and about 60% of endangered species of freshwater/brackish water fish. Also considered factors in reducing the populations of reptiles and vascular plants are the "capture and collection" of wildlife for decorative, horticultural and pharmaceutical purposes. For instance, Orchidaceae is the most endangered plant family. Among about 200 species now considered endangered, 110 species (or 55% of the total) are endangered due to development and 120 species (or 60% of the total) are endangered due to collection, suggesting that collection for horticultural purposes has had a serious impact. In contrast, Cyoeraceae includes 120 endangered species, among which 63 species (or 55% of the total) are also considered to be endangered due to development, but no species are endangered due to collection. The degree of collection pressure thus depends on the category.

Among all factors behind the extinction to date of the aforementioned 26 species of mammals, birds, reptiles, amphibians, freshwater/brackish water fish, and Coleopteras, the first crisis (including development, capture/collection and water contamination) is the main factor for all categories (Data 4- ⑥ : Appendix).

The WWF-J report of 1996 mentioned above listed a number of factors related to the first crisis, including reclamation, artificial bank protection, eutrophication, pollution and red clay runoff, that have resulted in the extinction of living things in tidal flats (Data 4- ⑧ : Appendix).



We classified the factors of reducing the populations of endangered species as follows: “development,” “water contamination,” “collection/capture,” “natural succession,“ and “alien species (introduced species).” The percentages represent the ratios of these factors as sources of reducing the populations of endangered species (where the total may exceed 100% when multiple factors are considered responsible).

Note 1: This includes deforestation, the development of lakes, marshlands, rivers, seashores, wetlands and grasslands, coal mining, the construction of golf courses, ski resorts, roads and dams, and the preparation of land.
Note 2: This includes water contamination and pollution caused by agricultural chemicals.
Note 3: This includes collection for horticultural purposes, capture for decorative purposes, collection for pharmaceutical purposes, and other forms of illegal collection.
Note 4: This includes the abandonment of management, the progress of succession, and changes in vegetation.
Note 5: This includes the invasion of predators, competition with naturalization, cross-breeding, and release into the wild.
Source: Environment Agency and Ministry of the Environment, Red Data Book of endangered wildlife in Japan

Figure II-7 Causes of reduced populations of endangered species by biological classification (Data 4-⑤)

BOX 2 Identification of areas where endangered vascular plants face a higher probability of extinction

From the standpoint of prioritizing conservation, it is effective to identify those areas where a larger number of endangered species live or the risk of extinction is higher. Such important conservation areas are called "hot spots" (Myers, 1989, 1990, etc.). Various methods have been suggested to identify such hot spots.

In Japan, for example, Yahara et al. suggested (in unpublished work) the C indicator (a short-term conservation indicator) and D indicator (a long-term conservation indicator) by using data on the distributions, populations and reduction rates of endangered plants in a 2nd mesh compiled for the Red List of vascular plants. The C indicator indicates how much the risk of extinction can be reduced nationwide in case all endangered species living in the mesh are conserved for the next 10 years (Figure a). The D indicator indicates how much the risk of extinction is likely to increase nationwide in case all endangered species living in the mesh are lost (Figure b). It has been suggested that this method has certain drawbacks, including a lack of available data, issues relating to assessment using a 2nd mesh, and the assessment of values for Japanese endemic species. However, the development of such a method could be expected from the standpoint of strategic evaluation of the environment, as well as the selection of conservation areas (The Society for the Studies of Species Biology, 2002).

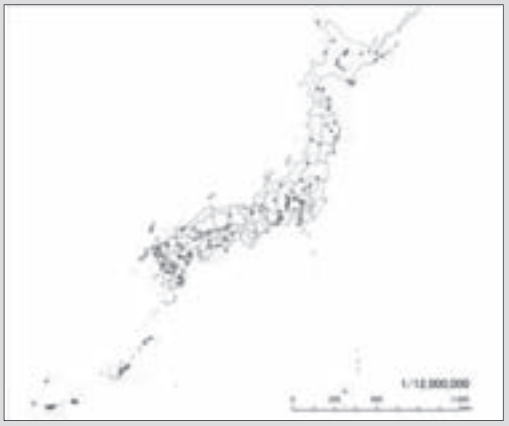


Figure a. Distribution of areas having a higher probability of extinction by using the C indicator (a short-term conservation indicator) (■ : Top 150 areas in the 2nd mesh)

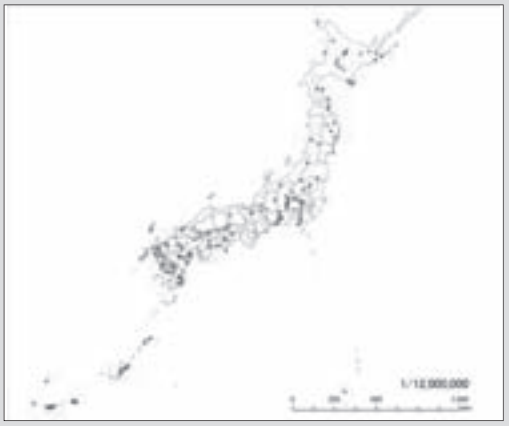


Figure b. Distribution of areas where vascular plants face a higher probability of extinction by using the D indicator (a long-term conservation indicator) (■ : Top 150 areas in the 2nd mesh)

(Source: Myers, N., 1989: Threatened biotas: "Hotspots" in tropical forests, Environmentalist, 8, 1-20.; Myers, N., 1990: The biodiversity challenge: expanded hotspots analysis, Environmentalist, 10, 243-256.; The Society for the Studies of Species Biology (ed.), 2002: Biology of conservation and restoration, Bun-Ichi. Co., Ltd., 260pp)

4. Measures for Loss

(1) Measures

With regard to biodiversity loss caused by the first crisis, the National Diversity Strategy of Japan prescribes that "it is necessary to take the stance whereby an impact caused by human activity should be properly avoided or reduced according to the characteristics and level of importance of the subjects. It is also important to strengthen the conservation of wilderness areas, as well as to thoroughly examine whether it is truly necessary to resort to excessive exploitation of natural ecosystems." It also states that "it is necessary to actively restore those ecosystems that have already been lost or seriously degraded, based on scientific knowledge."

The first crisis due to development and capture/collection has long been dealt with by designating conservation areas or establishing regulations to prohibit the capture of species.

Measures against the first crisis were strengthened during the assessment period by establishing and enhancing new regulatory frameworks related to conservation areas, controls against capturing species in the wild, restoring nature, and paying attention to environmental impact whenever a development project is implemented. However, the overall trend has yet to reach a stage where the current status of endangered species shows significant improvement.

<Conservation areas>

Conservation areas have been substantially expanded during the assessment period, as the government and local authorities established various new systems for those areas, thereby creating new conservation areas. With regard to conservation land areas designated by the Ministry of the Environment, the total area in national parks (under the Natural Parks Act), quasi-national parks (under the Natural Parks Act), wildlife protection areas (under the Wildlife Protection and Proper Hunting Act) amounted to about 32,000 km^2 around 1960. Since then, new conservation areas were established in the form of prefectural nature parks (under the Natural Parks Act), wildness areas (under the Nature Conservation Act), nature conservation areas (under the Nature Conservation Act), prefectural nature conservation areas (under the Nature Conservation Act), and natural habitat conservation areas (under the Act on Conservation of Endangered Species of Wild Fauna and Flora), thereby expanding the total area of land conservation areas to about 91,000 km^2 or more than 2.8 times the area in 2005.

Today, various types of land conservation areas that are mainly located in backbone mountain ranges account for about 20% of Japan's total land. Conversely, the equivalent for marine areas remains less than 10%, of which a majority is located within areas subject to less restrictive regulations. How marine protection areas should be from the perspective of conserving biodiversity or as a means of its sustainable use has been examined.

<Control of Capture and Conservation/Population Growth>

Controls on the capture of specific species of wildlife have been in place since the first half of the assessment period, in order to conserve wildlife, protect natural treasures, make adjustments to fishery activities, and conserve aquatic resources. For example, the use of mist nets—a hunting device to catch wild birds—has been banned since 1947 (unless the users obtain specific permission). Since 1991 selling, distributing or even owning such a net for hunting purposes has been prohibited. New regulations were established in the second half of the assessment period, including the Act on Conservation of Endangered Species of Wild Fauna and Flora, which significantly expanded the range of species prohibited to be captured throughout the country. For example, with the introduction of natural treasures under the Act on Protection of Cultural Properties (where such species are named and included with special natural treasures), the protection of rare species of domestic wild animals and plants under the Act on Conservation of Endangered Species of Wild Fauna and Flora, and regulations to protect aquatic resources, more animal species are now protected by bans on their capture or collection. Around 1960, only 35 species were designated as natural treasures; the number increased by about 3.7 times to reach 131 species in 2010. Based on the Act on Conservation of Endangered Species of Wild Fauna and Flora, it is intended not only to protect but also increase the populations of some species. More regulations and bylaws have also been enacted at the municipal level to impose similar controls over the capture and conservation of wildlife.

Certain critically endangered species such as the Leopard cat (*Prionailurus bengalensis euptailurus*) and Okinawa rail (*Gallirallus okinawae*) are apparently difficult to protect by simply trying to conserve those animals within their original habitats. For those endangered species, more efforts are therefore being made to implement systematic conservation measures outside the original habitats. For such species as the Crested ibis (*Nipponia Nippon*) and Oriental stork (*Ciconia boyciana*) that have become extinct within their original habitats, as well as the Leopard cat, it is also progressively attempting to not only protect and restore their habitats, but also return these animals to the wild.

In recent years, various segments of society including the government, municipal authorities, NGOs and local residents have also been cooperating and working together to promote projects for the restoration of nature and the environment.

BOX 3 Measures to prevent the roadkill of the Okinawa rail (*Gallirallus okinawae*)

The Okinawa rail (*Gallirallus okinawae*) is an endemic species in Okinawa and designated as one of the rare species of domestic wild animals and plants by the Act on Conservation of Endangered Species of Wild Fauna and Flora. Predation by the Indian mongoose (*Herpestes javanics*) and feral cats was the main reason for the disappearance of the Okinawa rail, but there has also been an increasing number of Okinawa rail being road-killed in recent years. In 2003, however, "a liaison conference to prevent roadkill in the Yanbaru area" was organized by institutions related to nature conservation and road management. In 2007, such roadkill totaled 23 animals, at which point a "state of emergency regarding roadkill of the Okinawa rail" was declared. The liaison conference consists of 25 institutions and is now taking various measures to prevent such roadkill. These measures include improving the road environment by erecting box culverts, no-entry fences and warning signs, and making efforts to raise awareness through a "Campaign to prevent Okinawa rail against being road-killed."

A sign showing a picture of the Okinawa rail (*Gallirallus okinawae*) as a motif

<Ecosystem Network>

There are cases where the succession of habitats cannot be maintained by simply designating conservation areas. The importance of creating an ecosystem network that ensures succession and secures appropriate locations for habitats is now being recognized. "The green corridor" of national forests and "the network of water and green" are examples of how to deal with the issue.

<Restoration of Nature>

An active attempt has been made to restore certain wetlands and rivers altered by past development. A law promoting nature restoration was enacted in 2002, and committees for nature restoration have been set up in various parts of the country. Moreover, nature restoration projects have are now being implemented with the cooperation of related government agencies, municipalities, NGOs, specialists and local residents.

<Projects with Environmental Considerations>

In recent years when the government and municipalities undertook development projects likely to change ecosystems or wildlife habitats, environmental considerations have become a factor in choosing construction methods and techniques. This is a concrete example of measures being taken to reduce such adverse impact on biodiversity.

Prior to launching a development project larger than a certain size, those responsible for the project must examine, project and assess the likely impact on the environment under the Environmental Impact Assessment Act, based on which considerations are given to how best to protect the environment. Guidelines on introducing strategic environmental assessments at the early stage of a project were compiled in 2007 for the purpose of avoiding and reducing adverse effects on the environment. This was followed by "The process guidelines for public works plans in the planning stage" issued by of the Ministry of Land, Infrastructure, Transport and Tourism in 2008, and "Guidelines for the introduction of strategic environmental assessment at the final landfill site (plan)" issued by the Ministry of the Environment in 2009, as steps to introduce assessment into the process.

<Sustainable Use>

In order to make agriculture, forestry and fishery sustainable with more emphasis on biodiversity, efforts were made to encourage a switch to environmentally-friendly farming making appropriate use of agricultural chemicals and fertilisers, and prepare a production infrastructure with considerations given to biodiversity. In forestry, projects have also been started so that artificial forests will have a longer life span before being felled, become multi-storied forests, and consist of a mixed variety of coniferous and broadleaf trees, in order to contribute to conserving the environment and respond to future requirements. Moreover, such measures as the forest certification system and a fishery certification scheme have also been introduced.

More corporations are also taking a stance to incorporate biodiversity in their activities by supporting international nature conservation projects at the source locations of raw materials, marketing products bearing eco-labels through their distribution channels, and indicating articles relating to biodiversity in their environmental reports.

<Others>

From around the second half of the assessment period, more laws on controlling water pollution and other laws concerning special measures have been enacted to control the volume of nitrogen and phosphorus discharged by factories and offices into marine areas, lakes and marshlands. Although the amounts of nitrogen and phosphorus brought into Japan through the importation of foodstuffs and animal feed remains substantial, sewage treatment facilities have been constructed in many areas, particularly in large cities where the infrastructure ratio to the population exceeds 80%.

It have been also started that collecting and examining information to verify the effects of these measures through basic research on conservation of the natural environment or projects promoting the monitoring of important ecosystem surveillance areas (e.g., the Monitoring Site 1000 project).

(2) Related indicators

The following shows the indicators used to assess the measures for loss caused by the first crisis, and the assessment result by each indicator.

Table II-4 Indicators of measures for loss as related to the first crisis and their assessment results

	Assessment					
	Long-term trend of measures		Current trend of measures			
	First half of the assessment period	Second half of the assessment period	First crisis	Second crisis	Third crisis	Climate change crisis
Indicator 5: Conservation areas	⇗	⇗	⇨			
Indicator 6: Capture/collection control, conservation and population growth projects	⇗	⇗	⇨			

Legend

Subject of assessment	Legend		
Trend of measures	Increasing	Same	Decreasing
	⇗	⇨	⇘

Note: Some elements are ignored when visual signs are indicated.

Indicator 5 Conservation areas

Explanation of the Indicator

○ The area of conservation areas or its coverage indicates measures against the first crisis.

○ Conservation areas in Japan are governed by many laws including those governing nature conservation and natural parks as mainly pertaining to the control of development projects involving deforestation and land development. The aim is to prevent ecosystems and habitats within such areas from being lost or reduced.

Assessment by the Indicator

○ The total designated area of conservation areas has been increasing on a long-term basis, and has now reached a level comparable with international standards. However, the coverage depends on the ecosystem concerned, and is particularly low in marine areas that lack many conservation areas subject to tighter restrictions, as compared to land areas.

○ The rate of designating new conservation areas has recently slowed in land areas, compared with that during the first half of the assessment period.

Reason of the Assessment

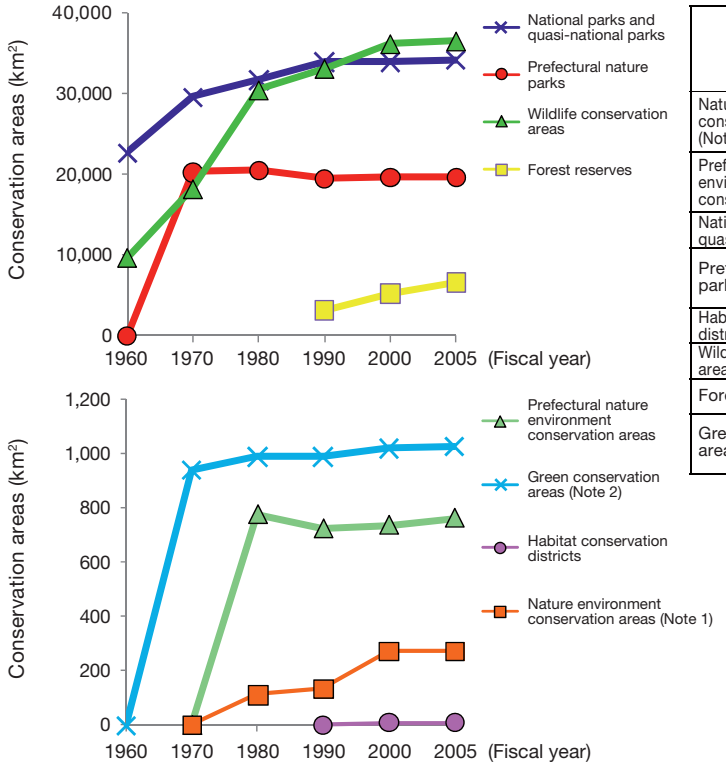
The total area of national parks, quasi-national parks and wildlife conservation areas has rapidly expanded, and the framework of conservation area locations as we now see it was formed during the period of high economic growth (around the 1960s) when there were a number of development projects in the pipeline (Data 5- ① : Figure II-8). Later in the 1970s and 1990s, new systems for conservation areas were introduced with a specific aim to conserve the natural environment, although only relatively small areas were covered (Data 5- ①).

The area of natural parks currently accounts for slightly more than 10% of the total land area, while that of wildlife conservation areas accounts for slightly less than 10%. Combining both with other conservation areas (including nature environment, habitat and forest ecosystem conservation areas) results in a land area of slightly less than 20% being designated as conservation areas (Data 5- ② : Figure II-9).

From the approximate area of 20% noted above, nearly half is designated by the government and local prefectures, respectively (Data 5- ③ : Appendix). Conservation areas subject to tighter restrictions (including those that require permission from either the government or local public offices for development) account for about 10% of the total land area (Data 5- ②).

In land areas, about 30% of the area of natural forests, natural grasslands and secondary forests very close to natural forests is designated as conservation areas, while the percentage ranges from 10% to 20% for secondary forests and artificial forests, and less than 10% for agricultural land, with both being relatively low (Data 5- ②).

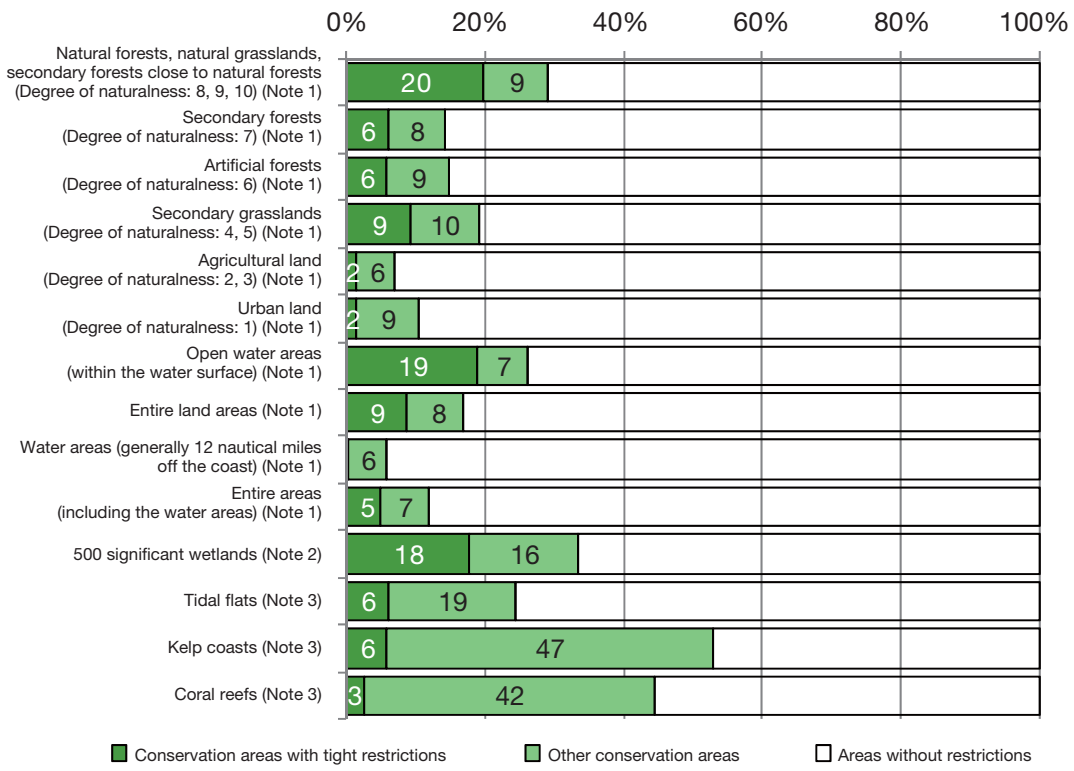
In contrast, marine areas (generally within 12 nautical miles of the coast) are less protected (under 10%) as compared to land areas, not least the conservation areas subject to tighter restrictions accounting for less than 1%. Conservation areas subject to tighter restrictions within the ecosystems of tidal flats, kelp coasts and coral reefs account for less than 10% of the total marine area (Data 5- ②). One reason for the different protection levels between land areas and marine areas may be that a majority of marine conservation areas, including national parks and quasi-national parks, have up to now been designated as buffer zones within land conservation areas.



	Area in 2005 (km²)	Ratio to the total land space (%)
Nature environment conservation areas (Note 1)	272	0.1
Prefectural nature environment conservation areas	763	0.2
National parks and quasi-national parks	34,097	9.0
Prefectural nature parks	19,590	5.2
Habitat conservation districts	9	0.0
Wildlife conservation areas	36,471	9.7
Forest reserves	6,580	1.7
Green conservation areas (Note 2)	1,024	0.3

Note 1: This refers to the total area of wilderness natural environment conservation areas and natural environment conservation areas.
Note 2: This refers to the total area of special green conservation districts, suburban special grass conservation districts, green conservation areas, and suburban green conservation districts. The special green conservation districts and green conservation districts were created after revision of the Urban Green Space Conservation Act in 2004. The data prior to 2004 represents the area of green conservation districts—the predecessor of today's special green conservation districts.
Source: Materials of the Ministry of the Environment, Forestry Agency, and Ministry of Land, Infrastructure, Transport and Tourism

Figure II-8 Trends of area in major conservation areas (Data 5-①)



The graph shows how much percentage (i.e., the coverage ratio) of area in each ecosystem is designated as a conservation area. The conservation areas are divided into two: conservation areas with tighter restrictions (requiring permission for a development project) and conservation areas (requiring a site development plan to be submitted). Any redundancy is included in conservation areas with tighter restrictions. The conservation areas in this context refer to the following: wilderness natural environment conservation areas, nature environment conservation areas, prefectural nature environment conservation areas, national parks, quasi-national parks, prefectural nature parks, national wildlife conservation districts, prefectural wildlife conservation districts, habitat conservation districts, and forest ecosystem conservation areas.

Note 1: These numbers are an aggregate of the central points shown in a 3rd mesh of each conservation area and for each ecosystem. Other numbers result from the calculation of polygon data derived from materials of the Ministry of the Environment.

Note 2: The number is used as a reference, because the boundaries of the 500 major wetlands are not definite.

Note 3: The exact sites of tidal flats, kelp coasts and coral reefs (including coral communities in the coastal areas of Honshu) correspond to those examined in the fourth and fifth basic surveys of natural environment conservation (including the sites already disappeared).

Source: Materials of the Ministry of the Environment, Ministry of Land, Infrastructure, Transport and Tourism, and Digital National Land Information

Figure II-9 Coverage ratio of conservation areas in each ecosystem (Data 5-②)

Indicator 6 Capture/collection control, conservation and population growth projects

Explanation of the Indicator

○ In our country, the capture and collection control of species, and conservation and population growth projects are implemented based on the Act on Conservation of Endangered Species of Wild Fauna and Flora, and the status of implementation mainly indicates measures against the first crisis.

○ The situation regarding species that showed dramatic decreases was improved in some cases through measures taken for the protection or management of resources, but other cases have resulted in extinction or where increases in targeted species populations have not been achieved.

Assessment by the Indicator

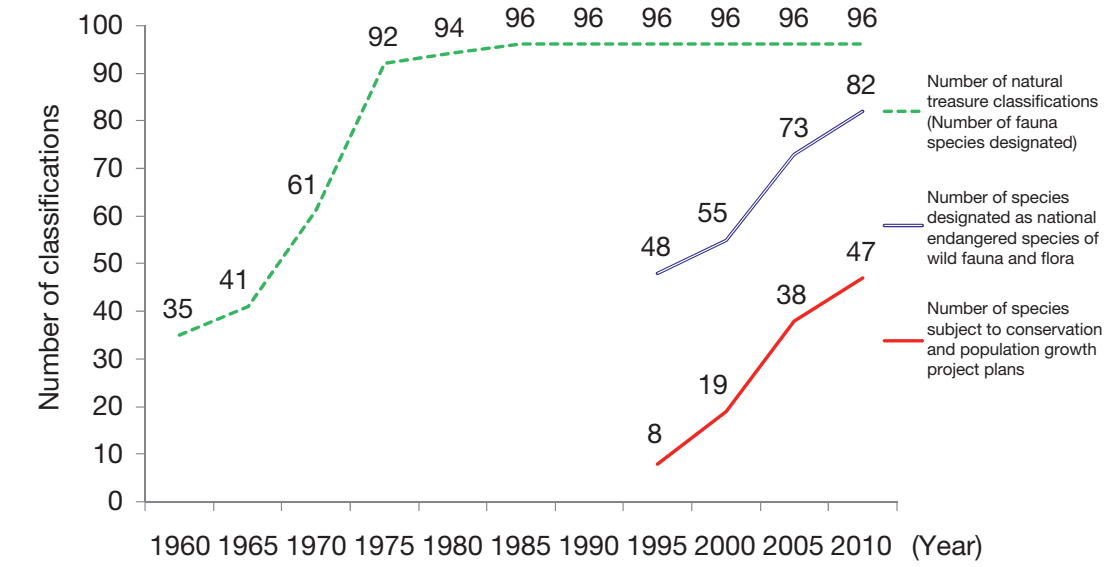
○ Measures implemented for protecting species covered by the capture and collection control of species, and conservation and population growth projects are now being expanded on a long-term basis, and show a tendency toward continued expansion in the future. Among the 3,155 endangered species currently listed in the Red List issued by the Ministry of the Environment, 82 species are designated as "national endangered species of wild fauna and flora" under the Act on Conservation of Endangered Species of Wild Fauna and Flora. Moreover, such measures are also being expanded nationwide as evidenced by each prefectural government also preparing Red Lists of their own.

Reason of the Assessment

The capture and collection control of species has been implemented since before the assessment period. During the period of high economic growth (from the 1960s to 1970s), there was a sharp increase in the number of natural treasures registered, and currently (as of 2010), 96 species of fauna have been registered, for which their capture and collection are restricted (Data 6- ① : Figure II-10). For instance, the number of Japanese serows and their habitat are increasing at present.

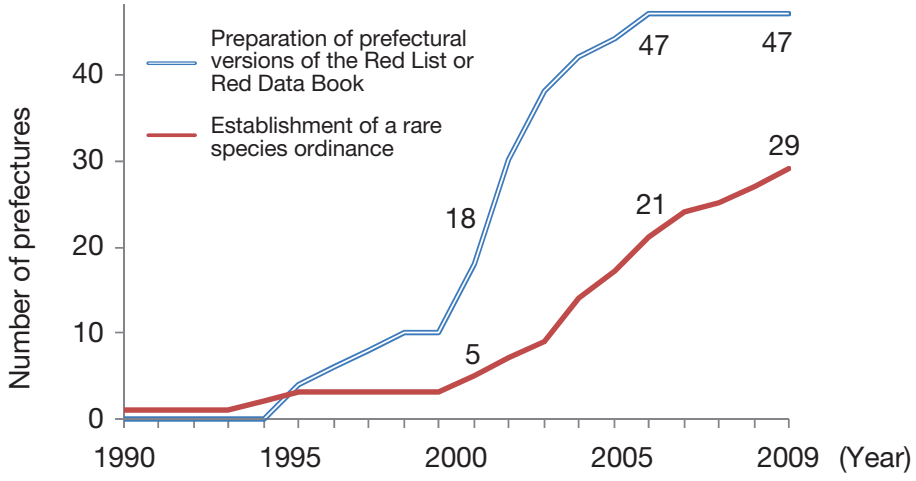
After that, the Act on Conservation of Endangered Species of Wild Fauna and Flora was enacted in 1993 to prevent extinction of species, and 48 species were designated as the national endangered species of wild fauna and flora at first. Up to now, 82 species of fauna and flora have thus been registered, for which their capture and collection are restricted (Data 6- ①). Any such species also designated as national endangered species of wild fauna and flora may also be covered by conservation and population growth projects, and currently (as of 2010), such projects are being implemented for 47 of these species (Data 6- ①). From now on, the effect of protective measures for national endangered species of wild fauna and flora must be assessed, and where the effect proves inadequate, such effective measures as analyzing the contributing factors must also be taken.

The prefectural versions of Red Lists and Red Data Books have already been completed by all prefectures (Data 6- ② : Figure II-11). Moreover, 29 prefectures (as of 2009) have established ordinances structured to designate endangered species and provide for the capture and collection control of species, designate their habitats and protection areas including habitats, and implement conservation and population growth projects, where considerable effects have already been achieved through the capture and collection control of species (Data 6- ②).



Note 1: The reversion of Okinawa to Japan (in 1972) contributed to increasing the number of natural treasure classifications during the 1970s.
Source: Data compiled by the Ministry of the Environment and Cultural Affairs Agency

Figure II-10 Transition in the numbers of natural treasures designated by species and national endangered species of wild fauna and flora (Data 6-①)



Source: Data published by prefectures

Figure II-11 Transition in the number of prefectures having prepared prefectural versions of the Red List or Red Data Book, or established rare species ordinances (Data 6-②)

References

1) Miyamoto A, and M, Sano, 2008: The influence of forest management on landscape structure in the cool-temperate forest region of central Japan, Landscape and urban planning, 86, 248-256.
2) Ministry of Internal Affairs and Communications, National Census.
3) Tamai N., 1999: Toward the natural restoration of rivers, Applied Ecological Engineering, 2, 29-36.
4) Kawaguchi Y., F. Nakamura, and Y. Kayaba, 2005: Changes in fish and their native habitats involved in the experimental re-meandering of a river implemented in the downstream area of the Shibetsu River, Applied Ecological Engineering, 7, 187-199.
5) Saito S., M. Mizuno, M. Tsuji, and Y. Kawashima 2005: On the measures to improve the aquatic terrestrial transition zone of Lake Biwa, Riverfront Research Institute Report, 16, 74-81.
6) Yamashita H., 2000: Amateurism and conservation activities in coastal biodiversity study — Taking rare shellfishes as an example —, Applied Ecological Engineering, 3, 45-63.
7) Millennium Ecosystem Assessment (ed.) Yokohama National University, 21st Century COE Translation Committee, 2007: UN Millennium Ecosystem Assessment — Ecosystem Services and the Future of Human Beings, Ohmsha, 241pp.
8) Ministry of the Environment, 2002: Revised National Endangered Wild Fauna and Flora — Red Data Book - 2 (Birds), Japan Wildlife Research Center.
9) Ministry of the Environment, 2002: Revised National Endangered Wild Fauna and Flora — Red Data Book - 1 (Mammals), Japan Wildlife Research Center.
10) Miura S., 2008: ABC of Wildlife Management — How to face Wildlife, Iwanami Shoten, Publishers, 125pp.
11) Tsujino R, and T Yumoto, 2004: Effects of sika deer on tree seedlings in a warm temperate forest on Yakushima Island, Japan., Ecological Research, 19, 291-300.
12) Takatsuki S, and T Gorai, 1994: Effects of Sika deer on the regeneration of a Fagus crenata forest on Kinkazan Island, northern Japan., Ecological Research, 9, 115-120.
13) Takatsuki S., 1989, Influence of deer on plants and vegetation, Ecological Research — Ecological Society of Japan, 39, 67-80.
14) Ministry of the Environment (ed.), 2000: Revised National Endangered Wild Fauna and Flora — Red Data Book - 3 (Reptiles and Amphibia), Japan Wildlife Research Center.
15) Ministry of the Environment (ed.), 2003: Revised National Endangered Wild Fauna and Flora — Red Data Book - 4 (Freshwater and brackish water fish), Japan Wildlife Research Center.
16) Ministry of the Environment (ed.), 2000: Revised National Endangered Wild Fauna and Flora — Red Data Book - 8 (Plants-I (Vascular plants)), Japan Wildlife Research Center.
17) Tabata M., S. Kato, A. Kawamura, J. Suzuki, and S. Suzuki, 1996: Effects of eliminating nitrogen and phosphorous in river water in phragmites planting channels, Journal of the Japan Society on Water Environment, 19, 331-338.
18) Suzuki T., 2006: Material recycling and water purification functions of tidal flat areas, Global Environment, 11, 161-171.

19) Kanematsu S., 1997: Generation of red tides and property of water quality in the Inland Sea and Lake Koji, Journal of the Japan Society on Water Environment, 20, 486-490.
20) Shiga Prefectural Office, Agricultural and Fishery Administration Department, Agricultural Land Section and Rural Development Section, 2008: Aiming at good water cycles in agricultural areas. http://www.pref.shiga.jp/g/kochi/mizujyunkan/nohai_taisaku/siryo-syu/siryo-syu.html
21) Shimamura T., N. Tokuchi, K. Ozaka, M. Ito, N. Ohte, and Y. Takekado, 2009: Comprehension of spatial distribution of water quality for water quality management of Mizorogaike Pond, Japanese Journal of Conservation Ecology, 14, 153-163.
22) Ministry of the Environment, 2006: Red List of birds. http://www.env.go.jp/press/file_view.php?serial=8929&hou_id=7849
23) Ministry of the Environment, 2006: Red List of reptiles. http://www.env.go.jp/press/file_view.php?serial=8930&hou_id=7849
24) Ministry of the Environment, 2006: Red List of amphibia. http://www.env.go.jp/press/file_view.php?serial=8931&hou_id=7849
25) Ministry of the Environment, 2007: Red List of mammals. http://www.env.go.jp/press/file_view.php?serial=9941&hou_id=8648
26) Ministry of the Environment, 2007: Red List of freshwater and brackish water fish. http://www.env.go.jp/press/file_view.php?serial=9944&hou_id=8648
27) Ministry of the Environment, 2007: Plants-I Red List of Vascular Plants. http://www.env.go.jp/press/file_view.php?serial=9947&hou_id=8648
28) Fisheries Agency (ed.), 1998: Data Book on National Endangered Wild Aquatic Life, Japan Fisheries Resource Conservation Association.
29) World Wide Fund for Nature Japan, 1996: WWF Science Report, Vol. 3, Special Feature: Status quo of tidal flat coasts in Japan and benthic organisms inhabiting there, World Wide Fund for Nature Japan.

Section 2 Assessment of the Second Crisis

This section assesses the extent and trends of the impact of "the second crisis" as a factor causing biodiversity loss during the assessment period (from the second half of 1950s to the present), as well as the tendency of implementing related measures.

1. The Second Crisis

○ Unlike the first crisis, the second crisis refers to the impact of human activity on nature resulting in the loss or reduction of nature. In concrete terms, the declining use and management of forest and farmland biodiversity in Satochi-Satoyama areas (i.e., farmland and neighboring mountainous areas forming part of a local community) have caused the scale and quality of biodiversity to decline. Incidentally, "Satoumi areas" (i.e., marine and coastal areas forming part of a local community)" are not addressed in this report.

2. Assessment of Loss Factors of the Second Crisis

○ The impact of the second crisis strongly affected forest and farmland biodiversity during the assessment period from the second half of 1950s to the present, and shows a tendency toward getting stronger on a long-term basis.

○ In line with changes in the socioeconomic situation during the first half of the assessment period, the traditional use of Satochi-Satoyama areas has declined. Although such declining use has lessened the scale of grasslands during the first half of the assessment period, it has not significantly reduced the scale of all Satochi-Satoyama areas that are part of forest and farmland biodiversity during the second half of the assessment period.

○ During and after the second half of the assessment period, our dependence on biomass from abroad has been increasing, while human activity on domestic farmland and in forests has been declining.

○ Given the progress in the transition of vegetation due to such declining use, some mosaic patterns of farmland, secondary forests, secondary grasslands, and other land that form traditional Satochi-Satoyama areas are being lost.

○ As Satochi-Satoyama areas provide living and growth environments for fauna and flora that depend on natural disturbances and floodplains relative to their habitats, it is concerned about that the possibly declining quality of biodiversity and reductions in the populations and distributions of fauna and flora living and growing there, although the specific impact that would be imposed by the progress of transitions is debatable.

3. Reason of the Assessment

The following lists the indicators used in the assessment that represent the causes of loss due to the second crisis, and describes the assessment by each indicator.

Table II-5 Indicators representing the factors of loss due to the second crisis and their assessment

	Assessment					
	Long-term trend of impact		Degree of impact during the assessment period and current trends			
	First half of the assessment period	Second half of the assessment period	First crisis	Second crisis	Third crisis	Climate change crisis
Indicator 7: Use of Satochi-Satoyama areas						
Indicator 4 (listed again): Factors of reduction in endangered species (the second crisis)						

Legend

Subject of assessment	Legend			
Degree of impact during assessment period	Weak	Medium	Strong	Very strong
				
Long-term trend of impact and current trends	Decreasing	Same	Increasing	Increasing rapidly
				

Note: Some elements are ignored when visual signs are indicated.
Note: The dashed lines for assessing the degree of impact indicate insufficient data.

Indicator 7 Use of Satochi-Satoyama areas

Explanation of the Indicator

○ The use of Satochi-Satoyama areas is an indicator of the factors of loss as related to the second crisis.

○ The ecosystems in farmland and surrounding grasslands, secondary forests and other areas were originally the habitats and growth environments of fauna and flora that depended on environmental disturbances, and have been maintained in a stable condition through human activity to obtain firewood and charcoal, for mowing and grazing, and other purposes. Although the specific impact is debatable, it is concerned about that the possibly reduced scale and declining quality of these ecosystems due to the reduced use of Satochi-Satoyama areas.

Assessment by the Indicator

○ Throughout the assessment period, grasslands and farmland that constitute Satochi-Satoyama areas decreased, with the impacts of the first crisis (development and renovation) and second crisis (declining use) forming the background.

○ The decreasing scale of all Satochi-Satoyama areas including secondary forests was not particularly significant during the second half of the assessment period, but the declining use of secondary and artificial forests, and the abandonment of farming continued to occur. Although the specific impact is debatable, the transition of vegetation has apparently had adverse effects on the diversity of specific groups of fauna and flora.

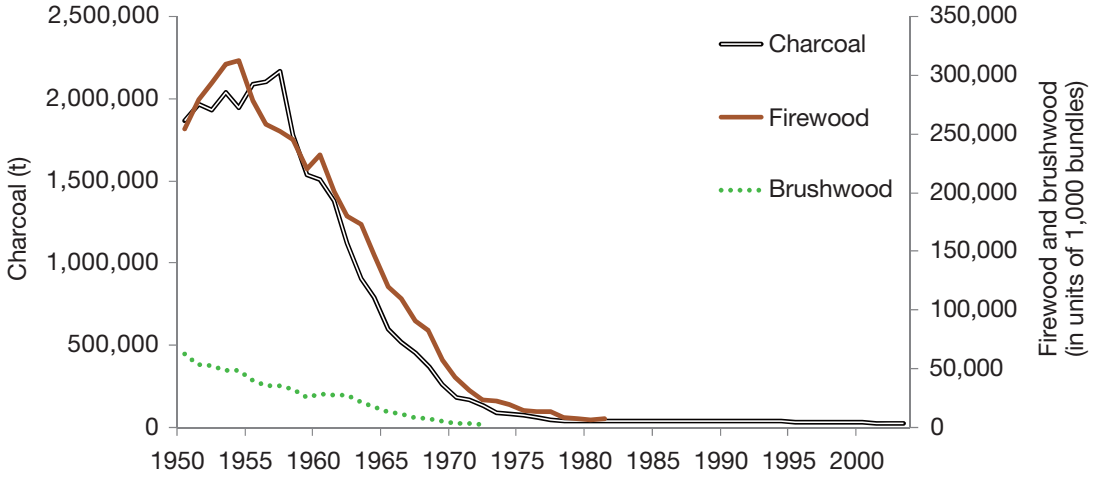
Basis of the Assessment

<Satochi-Satoyama Areas>

Satochi-Satoyama areas are characterized by a unique natural environment formed through various human activities over a long history, thereby creating mosaic patterns of farmland surrounding villages, irrigation channels, holding ponds, secondary forests, artificial forests, and grasslands. In this assessment, Satochi-Satoyama areas partially coincide with forest and farmland biodiversity, and occupy parts of secondary forests totaling about 80,000 km^2 and farmland of about 70,000 km^2, accounting for about 40% of Japan's total land area.

<Decrease Use and Management of Secondary Forests such as fuelwood forests and agricultural forests>

During the period of high economic growth in the first half of the assessment period (from the second half of 1950s to the first half of 1970s), the socioeconomic situation changed drastically, such as greater dependence on fossil fuels as the main energy source, rapid industrialization, the migration of population from rural areas to cities, and widespread use of agricultural chemicals and chemical fertilizers. These changes reduced the value of firewood and charcoal, compost, and green manure. After 1970, the production of firewood and charcoal thus saw a rapid decrease (Data 7- ① : Figure II-12), and the use and management of many secondary forests previously used as agricultural forests and sources of firewood and charcoal probably declined. It has been pointed out that secondary forests were neglected and consequently reverted to brush along with the wild growth of bamboo or sasa genus, or evolved into evergreen broadleaf forests with dark forest floors, thereby diminishing flora and fauna that prefer a light-filled, open environment.[1)] Along with the declining use and management of pine forests, deadwood was left to stand, resulting in greater blight damage being caused by pinewood nematodes, and also possibly causing certain changes in the forest floor environment. It is also concerned about that expanding bamboo forests due to the lack of use and management attributed to less demand for bamboo as a material for constructing fences and other uses, as a factor in creating a monotonous environment where environmental quality declined as pertaining to habitats and growth environments for fauna and flora (see Box 4).



Note 1: For charcoal, the figures are based on fiscal year surveys up to 1960, and on calendar year surveys from and after 1961. For firewood, the figures are based on calendar year surveys from and after 1960, and on fiscal year surveys from 1950 to 1959.
Source: Ministry of Internal Affairs and Communications, Historical Statistics of Japan, Ministry of Internal Affairs and Communications, Historical Statistical Series of Japan

Figure II-12 Production of firewood and charcoal (Data 7-①)

<Decrease Use and Management of Secondary Grasslands such as "Kayaba" and Grazing Land>

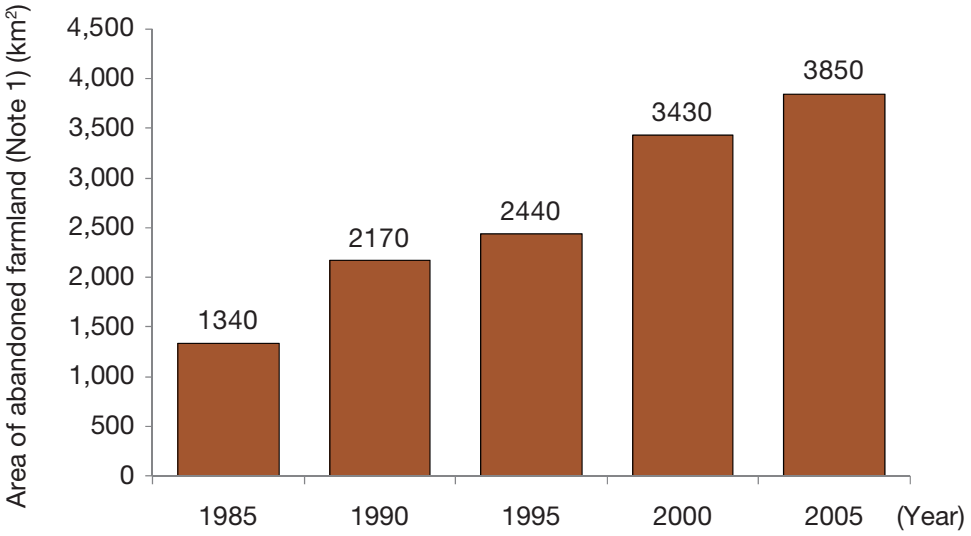
The secondary grasslands including fields of Miscanthus sinensis or "kayaba" that were previously a main constituent factor of Japanese vegetation and grazing land are considered to have declined due to changes in the social structure, agriculture and agricultural methods occurring in the period of high economic growth prior to the assessment period. For instance, secondary grasslands had been maintained as grazing land for cows used for plowing farmland, and the declining number of those animals (Data 7- ② : Appendix) possibly expedited the transition of secondary grasslands. This decrease of secondary grasslands and the introduction of exotic meadow grass are considered factors in the dramatic reduction of certain grassland-dependent fauna such as birds like Latham's snipe (Gallinago hardwickii) and butterflies like Fabriciana nerippe and Shijimiaeoides divinus.[2),3)]

<Decreased Management of Artificial Forests>

The total area of artificial forests was widely expanded through large-scale afforestation during the first half of the assessment period to currently occupy 27% of Japan's total land area (Data 1- ① : Figure I-1). Artificial forests provide habitats and growth environments for forest-dependent wild fauna and flora, though not at the high extent as that of "more natural" forests (wildwood and secondary forests), but the management of expanded artificial forests involving such tasks as thinning trees became neglected due to less profitability, and resulted in curtailed forestry production activities. It has been pointed out that the planned tree thinning of artificial forests helps to increase the overall number of species and the populations of fauna and flora that live and grow there, and also contributes to the conservation of biodiversity to some extent.[3),4),5)] Consequently, the reduced thinning of trees is considered to further deteriorate the quality of artificial forests as habitats and growth environments for fauna and flowers.

<Decreased Use of Agricultural Land, Holding Ponds, and Irrigation Channels>

It has been noted that rice paddies, irrigation channels, and holding ponds previously functioned as alternative habitats and growth environments for fauna and flora that lived and grew on floodplains and in other areas subject to natural disturbances.[6] As more cultivated fields were abandoned mainly during the second half of the assessment period, however the use of such agricultural irrigation facilities as irrigation channels and holding ponds also declined. For instance, the area of abandoned farmland that totaled about 1,300 km^2 in 1985 increased to about 4,000 km^2 by 2005, marking about a threefold increase (Data 7- ③ : Figure II-13). Thus, the deteriorated quality of these environments as habitats and growth environments is pointed out.[7]



Note 1: This refers to former farmland that has not been cultivated for at least one year in the past, and is clearly not to be cultivated again in several years to come.
Source: Ministry of Agriculture, Forestry and Fisheries, Agricultural Census, Summary of successive-year agricultural census and past statistics

Figure II-13 Transition of abandoned farmland (Data 7-③)

<Deteriorated Quality of Satochi-Satoyama Areas>

During the assessment period, the scale of farmland and grasslands (e.g., wild lands, mowing/grazing lands) as a constituent factor in the composition of Satochi-Satoyama areas was dramatically reduced (Data 1- ① : Figure II-1, 1- ② : Figure II-2, 19- ① : Figure III-6, Appendix, 19- ④ : Figure III-6, Appendix). In particular, the reduction of grasslands during the first half of the assessment period was believed to have been influenced by the conversion of Satochi-Satoyama areas into artificial forests, as well as the declining use of Satochi-Satoyama areas. Conversely, no significant changes were seen due to the second crisis such as the conversion of farmland (cultivated land) into secondary forests, secondary forests into natural forests (Data 1- ⑤ : Appendix), or significant changes in Satochi-Satoyama areas including those in secondary forests during the second half of the assessment period from the 1980s to the 1990s (Data 7- ④ : Appendix). It is more concerned that the declining use of Satochi-Satoyama areas in recent years has become a factor in deteriorating the quality of Satochi-Satoyama areas as ecosystems, than about the decreasing scale of such areas.

Box 4 Expanding bamboo forests

In recent years, the distributions of bamboo forests have largely expanded in various regions of Japan, thereby posing a serious problem in terms of conserving biodiversity in Satochi-Satoyama areas. For instance, the total area of bamboo forests in Shizuoka Prefecture increased 1.3 times between 1988 and 2000. Bamboo has been a familiar plant to the Japanese people since ancient times, being cultivated and maintained as a source of bamboo sprouts for consumption, as a material for agricultural use, and as a material for fishing poles and daily utensils. The use of domestic bamboo has dramatically declined in recent years, however, due to increased imports of less expensive bamboo sprouts and articles made of bamboo. At the same time, secondary and artificial forests have been expanded, with more cultivated land lacking proper management in line with the modernization of lifestyles and agricultural methods. Consequently, there is growing competition between bamboo and other plants, resulting in the quick-growing bamboo expanding their distributions and displacing surrounding vegetation. Bamboo forests are thus expected to continue expanding their distributions unless such measures as cutting down bamboo forests are taken.

Bamboo forest without proper management in which trunks went off due to accumulation of snow during winter

<Damage to Agriculture and Forestry, and Deteriorated Quality of Ecosystems due to Expanded Distributions of Medium-size and Large Mammals>

After the 1980s during the second half of the assessment period, the populations and distributions of certain medium-size and large mammals such as deer, monkeys, and wild boars have continued to expand. For instance, between 1978 and 2003, the distribution of deer increased by about 70%, that of monkeys by about 50%, and that of wild boars by about 30%. It has been pointed out that the background behind this expansion is less human activity in Satochi-Satoyama areas due to the depopulation and aging of residents in rural areas, including the abandoned management of environments that previously served as buffer zones between wildlife and humans resulting from more abandoned farmland.[8] Moreover, such complex causes as the declining death rates of such wild animals as deer and many bird species due to unusually warm winters with less snowfall, and less capture pressure being exerted due to fewer and aging hunters are believed to have also affected the situation. Thus, there has been greater impact in recent years on ecosystems, including damage to agriculture and forestry caused by the expanded distributions of medium-size and large mammals, other conflicts between wildlife and humans, and more damage to vegetation in a situation that continues today.[9),10)] In particular, vegetation has been seriously damaged by the feeding behavior of deer (Cervus Nippon) in many forest zones.[11),12)] Wild boars have also significantly damaged vegetation in western Japan.

Indicator 4 (listed again) Indicator 4 (listed again) Factors of reduction in endangered species (as related to the second crisis)

Explanation of the Indicator

○ The ratio of extinct or endangered wildlife species to the total species in Japan indicates that the loss and reduction of species was caused by all of the following factors: “the first crisis,” “the second crisis,” “the third crisis” and “the climate change crisis.” Indicator 4 here assesses these factors as related to the second crisis.

Assessment by the Indicator

○ Although the first crisis has caused decreases in the populations of species in many taxonomical groups, the second crisis has also had adverse impact as a factor of loss.

Basis of the Assessment

<The Second Crisis as a Factor of Loss for Endangered Species>

Satochi-Satoyama areas have become the habits and growth environments for endangered species. For instance, 49% of the areas where endangered fauna species are concentrated (i.e., areas inhabited by five or more endangered fauna species within the second mesh of 10 km^2), and 55% of the areas where endangered flora species are concentrated (i.e., areas where five or more endangered flora species grow within the mesh) are distributed within the scope of the second mesh in Satochi-Satoyama areas.

As previously mentioned, 26% of mammals, 15% of birds, 32% of reptiles, 34% of amphibia, 37% of freshwater and brackish water fish, and 25% of vascular plants are considered extinct or are threatened with extinction according to the latest Red List issued by the Ministry of the Environment[13),14),15),16),17),18)] (Data 4- ① : Appendix).

The factor of loss for about 30% of the endangered species of vascular plants is "natural transition" (i.e., abandonment of management, progress of transition, changes in vegetation) (Data 4- ⑤ : Figure II-7). Those species divided by family include many species of families familiar to us in daily life such as Gentianaceae, Apiaceae, Lamiaceae, Brassiscaceae, Plygonaceae, Scrophulariaceae, Eriocaulaceae, Compositae, and Cyperaceae.

4. Measures for Loss

(1) Measures

With regard to biodiversity loss due to the second crisis, the National Biodiversity Strategy states that it is "necessary to promote the formation of a structure for more effective conservation and management in response to the natural and social characteristics of target areas under the current socioeconomic situation." Although certain measures are now being taken in various regions, those measures apply to individual locations, and have yet to be expanded to cover wide areas or afford coverage on a nationwide basis.

The socioeconomic requirements for using the so-called wide Satochi-Satoyama areas as used in the past have been reduced in recent years, and in line with the ongoing depopulation and aging of residents in rural areas, it is considered difficult to use and manage all Satochi-Satoyama areas by expending considerable manpower as was done in the past.

In terms of how the secondary forests constituting Satochi-Satoyama areas should be, the matter needs to be fully deliberated, including making a comprehensive determination of how to promote management appropriate for secondary forests, or how to facilitate the transition thereof to forests that can demonstrate the functions inherent in forests, with natural transition as the underlying idea. In particular, it is considered appropriate to conserve and manage Quercus crispula forests and Castanopsis cuspidata coppice woodlands based on a method of leaving such areas to natural transition, depending on the local situation.

Thus, in view of drastic changes in the socioeconomic situation including the shift to a less populated and aging society as the most important factor, various measures have been taken to strengthen human approaches to nature, with certain results being achieved for conserving and managing birds and animals, and maintaining secondary nature. Hereafter, it is deemed necessary to further enhance and strengthen such measures over a wide range, including the formation of a new structure to rebuild the practical relationship between humans and nature, given and based on such drastic changes in social structure as future decreases in population.

<Conservation and Management of Wildlife>

In recent years, the management of wildlife including the population control of species based on the specified wildlife conservation and management plans formulated by prefectural governments, and measures based on the Act on Special Measures for Prevention of Damage Related to Agriculture, Forestry and Fisheries Caused by Wildlife have been implemented in order to prevent damage to agriculture and forestry. Moreover, measures have been taken to disseminate methods of forming communities where the segmentation of habitats for man and wildlife is possible, and with leaders being fostered to implement the conservation and management of wildlife. As for birds and animals distributed over wide areas that encompass different prefectures, those prefectures must simultaneously implement the same measures to achieve intended effects, including the management of medium-size and large mammals such as deer and wild boars, and other animals and birds having high mobility, thereby requiring the promotion of broad-based conservation and management practices (see the column titled Present stage of specified wildlife conservation and management plans).

<Conservation, Population Growth and Nature Restoration>

With the endangered wildlife species in Satochi-Satoyama areas being targeted, conservation and population growth measures with considerations given for conserving biodiversity are being promoted by those engaged in agriculture and forestry. Nature restoration measures are also being promoted in secondary nature, such as the restoration of grassland in Aso.

<Use and Management of Natural Resources from the Perspective of Biodiversity>

In addition to environment-friendly agriculture being promoted in recent years, the methods of using and managing natural resources based on the conservation of biodiversity are also being discussed, as seen in environmental education, eco-tourism and the use of biomass. Moreover, attempts are being made to effectively use deer, wild boars, and other animals captured to control their populations. The formation of local networks of those engaged in agriculture, forestry and fisheries, NGOs and others concerned, and the networking of local public agencies, corporations, urban residents, and others are also being promoted for maintaining and managing Satochi-Satoyama areas. In Satochi-Satoyama areas near the suburbs of cities, NGOs and urban residents are proceeding with such conservation activities as promoting conservation and management utilizing the suburban green conservation scheme.

A proposal has also been presented under the title of the "SATOYAMA Initiative" to promote the sustainable use and management of natural resources in secondary natural environments on a global scale, based on the experience gained at many locations throughout the world, including Japan.

BOX 5 SATOYAMA Initiative

There are many secondary natural environments like Satochi-Satoyama areas that have been formed and maintained through such sustainable and long-term human activities as agriculture, forestry and fisheries in various part of the world. These environments are also endangered due to such circumstances as urbanization, industrial development, and high increases or decreases in local populations. In order to conserve biodiversity while using and managing natural resources in a sustainable manner, an awareness of the importance of maintaining and conserving such secondary natural environments must also be shared, as well as taking measures that suit such local characteristics as climate, geography, culture, society, and the economy, and realizing a "society in harmony with nature." Japan proposed the SATOYAMA Initiative and is taking various measures in cooperation with United Nations University, along with the support of the Secretariat of the United Nations Environment Program (UNEP), other international organizations, and related countries.

<Promotion of Agriculture, Forestry and Fisheries, and Revitalization of Agricultural Communities>

To cope with the lack of improvement and inadequate conservation efforts as seen in the declining use of agricultural forests, more abandoned farmlands and insufficient tree thinning, measures are now being taken to realize agriculture, forestry and fisheries based on the viewpoint of attaching more importance to the conservation of biodiversity. These measures must be taken on an ongoing basis by using well-established methods in each locality, and in collaboration with the many parties concerned, such as administrative agencies, local community residents, those engaged in agriculture, forestry and fisheries, NGOs, landowners, and corporations.

(2) Related indicators

The following shows the indicators used to assess the measures for loss caused by the second crisis, and the assessment result.

Table II-6 Indicators of measures for loss as related to the second crisis and their assessment results

	Assessment					
	Long-term trend of measures		Current trend of measures			
	First half of assessment period	Second half of assessment period	First crisis	Second crisis	Third crisis	Climate change crisis
Indicator 8: Scientific conservation and management of wildlife	⇨	⇗		⇗		

Legend

Subject of assessment	Legend		
	Increasing	Same	Decreasing
Trend of measures	⇗	⇨	⇘

Note: Some elements are ignored when visual signs are indicated.

Indicator 8 Scientific conservation and management of wildlife

Explanation of the Indicator

○ The implementation status of the scientific conservation and management of wildlife mainly indicates the measures taken against the second crisis.

○ After 1980, certain conflicts between humans and wildlife have occurred as seen in the expanding distributions of medium-size and large mammals, resulting in serious damage to agriculture and forestry in areas where human activities have declined or been abandoned altogether. Such conflicts are expected to be resolved or mitigated through the scientific protection and management of wildlife pursuant to the Wildlife Protection and Proper Hunting Act.

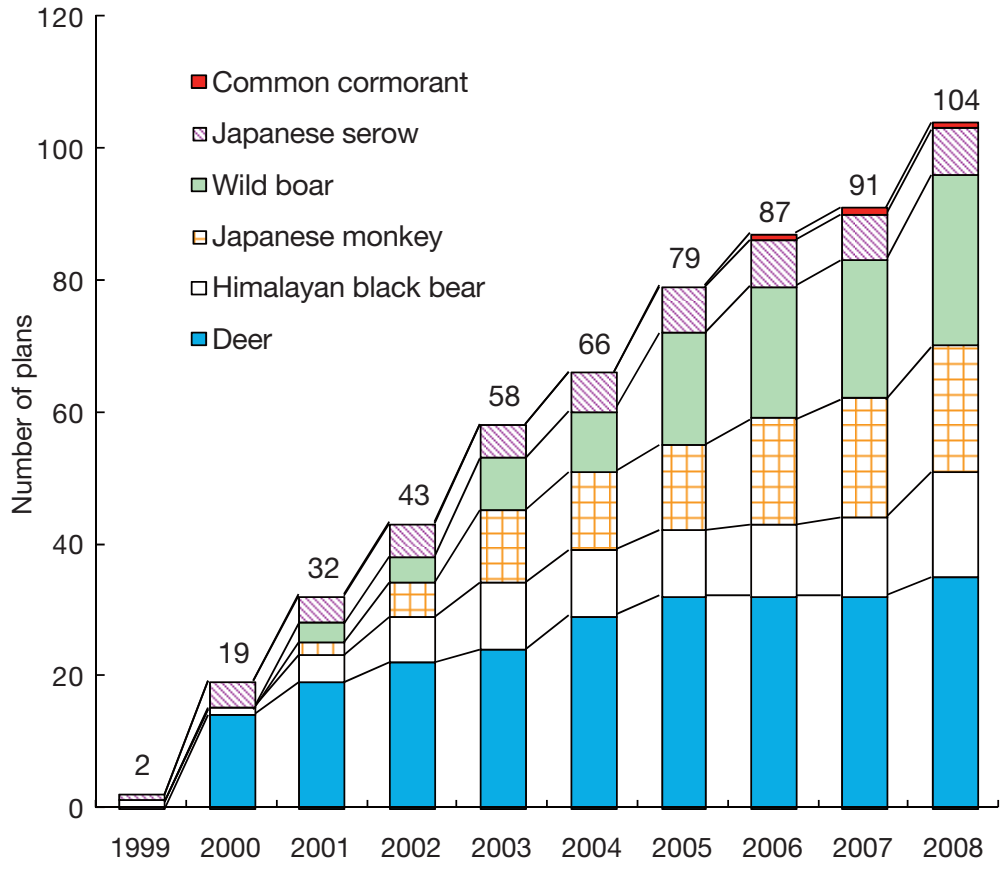
Assessment of the Indicator

○ Although there is no long-term time-line data relating to the scientific protection and management of wildlife, since the scheme of specified wildlife conservation and management plans was established at the end of 1990s, there has been a tendency to expand the measures necessary.

○ At present, the plans have been formulated by all prefectures except Okinawa.

Reason of the Assessment

The Wildlife Protection and Proper Hunting Act and the scheme of specified wildlife protection project plans were established in the 1960s. At that time, the populations of wild animals and birds were showing a decline with limited conflicts with humans, but since the 1980s, the increasing damage caused by wildlife to agriculture and forestry plus vegetation became a social problem. It has been recently confirmed that the distributions of deer and certain other medium-size and large mammals have expanded nationwide (Data 15- ④ : Appendix). Deer (Cervus Nippon) have also caused browsing damage to some rare and alpine plants in certain regions. In view of such circumstances, the scheme of specified wildlife conservation and management plans was established in 1999 for controlling the local populations of wildlife species showing significant increases or decreases. The number of species targeted by such plans including deer, wild boar and the Japanese monkey (Macaca fuscata) that have mainly caused damage to agriculture and forestry has increased, and as of April 1, 2009, 104 plans have been formulated by 46 prefectures for six specific wildlife species (Data 8- ① : Figure II-14).



Source: Data compiled by the Ministry of the Environment

Figure II-14 Transition in the numbers of occasions for formulating specified wildlife conservation and management plans (Data 8-①)

Column: Present stage of specified wildlife conservation and management plans

The scheme of specified wildlife conservation and management plans was established upon revision of the Act on Conservation of Endangered Species of Wild Fauna and Flora in 1999. This scheme was a link in the measures to transfer control over most conservation and management work previously done by the government to local public agencies, and designed for implementing scientific and aforethought conservation and management of certain specified wildlife species such as deer that are likely to cause conflict particularly with local community residents. The number of occasions for formulating such plans has increased each year, and thus far, a total of 104 plans have been formulated to deal with deer, wild boar, and other animals. This is obvious proof of the fact that the damage caused by wildlife to agriculture and forestry has increased nationwide, and remains impossible to restrain.

The points of such plans are to (1) set goals for conserving and managing targeted species, (2) take comprehensive measures to improve natural habitats, prevent damage and control wildlife populations, (3) verify and feedback results of a specific plan by monitoring populations and damage, and (4) make the formulation of a plan transparent and reach a consensus, with its essential feature of being a scientific method applied in all stages from setting goals to implementation and evaluation. This method marked a great advance in pursuing the scientific conservation and management of wildlife, instead of the conventional method of simply capturing damaging wildlife as previously practiced in a manner akin to symptomatic treatment. Although no examples of successfully controlling such wildlife populations or density in line with the goals set for such plans have yet to be seen, there are many areas where such plans have functioned effectively, resulting in less damage caused by wildlife. Conversely, there are some areas where, despite the formulation of a plan, it became a mere façade without any monitoring or feedback being implemented. As for the reasons, we can point out a lack of budget and funding for expenses, insufficient development and standardization of survey techniques for measuring populations and effects, and also an absolute lack of professionals needed to proceed with such plans on an ongoing basis.

It should be noted that in response to such a situation, some local public agencies have developed new organizations and are trying to enhance monitoring methods and assign or foster more professionals. Therefore, scientific conservation and management can only be considered to have taken root once the operational, technical and human resource basis has been enhanced in addition to formulating a specific plan.

Although this scheme is intended for each prefecture to formulate its own plan, in many cases the targeted animal or bird species is distributed over a wide area extending over multiple prefectures. To cope with this issue, plans must be formulated in an integrated manner, irrespective of the principle of decentralized authority; however, the lack of a sufficiently developed common forum or activity in which the government can also positively participate remains a serious problem. From now on, in line with the trend toward depopulation and aging in rural communities, more farmland will certainly be abandoned, and there will be fewer hunters. The areas of wildlife distributions and populations will expand, and the damage caused by wildlife to agriculture and forestry will reach an unprecedented high level. Under the circumstances, the scheme of specified wildlife conservation and management plans will undoubtedly play an increasingly important role. The government must also positively participate in and provide cooperation for related activities so that this scheme will function effectively.

Originally, the conservation and management of wildlife was not intended to be implemented solely based on such standards as whether any specific plans are formulated or the extent of achieving the set targets. Therefore, such measures as preventing damage and controlling wildlife populations must be undertaken on an ongoing basis. And this means implementing wildlife management in the real sense of the term.

(Shingo Miura, Committee member)

References

1) Maefuji K. and H. Makihara, 1999: Changes in entomofauna involved in the secondary transition after a clear cutting of a deciduous forest in a temperate zone, Japanese Journal of Entomology New Series, 2, 11-26.
2) Murata K., K. Nohara, and M. Abe, 1998: Impacts upon the development of Shijimiaeoides divinus caused by field-burning, Japanese Journal of Entomology New Series, 1, 21-33.
3) Yui M., 2007: Aquila chrysetos and forestry in Kitakami Highland, Japanese Journal of Ornithology, 56, 1-8.
4) Hisatomo T, T Inoue, H Tanaka, H Makihara, M Sueyoshi, M Isonoe., and K Okabe, 2010: Responses of community structure, diversity, and abundance of understory plants and insect assemblages to thinning in plantations, Forest Ecology and Management, 259, 607-613.
5) Yamaura Y., 2007: Mitigation of impacts upon birds caused by the segmentalization of broadleaf forests — proposing management by artificial forest matrix – Journal of Japanese Forestry Society, 89, 416-430.
6) Washitani I., Loss and restoration of floodplain swamps: Endeavor to utilize swamps as rice paddies, Global Environment, 12, 3-6.
7) Mori J., S. Mizutani, and S. Matsuzawa, 2006: Material recycling in agricultural biodiversity from the viewpoint of the food web, Electronic Monograph of the Terrestrial Environment Research Center, University of Tsukuba, 2, 39-46.
8) Honda T., 2007: Factors affecting the occurrence of damage by wild boars: Analysis utilizing the agriculture and forestry census, Japanese Journal of Forestry Society, 89, 249-252.
9) Iwasaki N., E. Kurita, and T. Mineda, 2008: Conflicts arising in the border area between agricultural villages, cities and mountain land, and nature restoration, Journal of the Association of Rural Planning, 271, 32-37.
10) Ueda H. and C. Jan, 2004: Utilization of wild boars in fruit orchards and abandoned fruit orchards, Mammalian Science, 44, 25-33.
11) Takatsuki S. and T Gorai., 1994: Effects of Sika deer on the regeneration of aFagus crenata forest on Kinkazan Island, northern Japan, Ecological Research, 9, 115-120.
12) Tsujino R. and T Yumoto., 2004: Effects of sika deer on tree seedlings in a warm temperate forest on Yakushima Island, Japan., Ecological Research, 19, 291-300.
13) Ministry of the Environment, 2006: Red List of birds.
http://www.env.go.jp/press/file_view.php?serial=8929&hou_id=7849
14) Ministry of the Environment, 2006: Red List of reptiles.
http://www.env.go.jp/press/file_view.php?serial=8930&hou_id=7849
15) Ministry of the Environment, 2006: Red List of amphibia.
http://www.env.go.jp/press/file_view.php?serial=8931&hou_id=7849
16) Ministry of the Environment, 2007: Red List of mammals.
http://www.env.go.jp/press/file_view.php?serial=9941&hou_id=8648
17) Ministry of the Environment, 2007: Red List of freshwater and brackish water fish.
http://www.env.go.jp/press/file_view.php?serial=9944&hou_id=8648

18) Ministry of the Environment, 2007: Plants-I Red List of Vascular Plants.
http://www.env.go.jp/press/file_view.php?serial=9947&hou_id=8648

Section 3 Assessment of the Third Crisis

This section assesses the extent and trends of the impact of the "the third crisis" as a factor causing biodiversity loss during the assessment period (from the second half of 1950s to the present) using three indicators, as well as the tendency of implementing related measures.

1. The Third Crisis

○ The third crisis refers to the impact of things that have been taken in as humans began living a modern life. Exotic species and chemicals have become factors that cause a deteriorated quality of ecosystems, reduce the populations or distributions of species living and growing in certain areas, and other effects.

2. Assessment of Loss Factors of the Third Crisis

○ The impact of the third crisis during the assessment period from the second half of 1950s to the present has been particularly strong due to invasive alien species that tend to intensify on a long-term basis.

○ It has been pointed out that some invasive alien species reduce the populations and distributions of native species through predation and competition. More invasive alien species have been recorded throughout the assessment period, and in recent years, certain alien species have settled and are rapidly expanding. Therefore, it is very concerned about the impact of such invasive alien species.

○ As for the impact of chemicals, although highly residue-prone chemicals that do not easily dissolve in the environment and are apt to be accumulated in the bodies of fauna and flora may possibly have a long-term impact, the actual impact remains unknown. Since regulations on chemicals have been introduced during and after the 1970s in the second half of the assessment period, such impact may have possibly been reduced.

3. Reason of the Assessment

The following lists the indicators used in the assessment that represent the causes of loss due to the third crisis, and describes the assessment by each indicator.

Table II-7 Indicators representing the factors of loss due to the third crisis and their assessment

	Assessment					
	Long-term trend of impact		Degree of impact during the assessment period and current trends			
	First half of assessment period	Second half of assessment period	First crisis	Second crisis	Third crisis	Climate change crisis
Indicator 9: Invasion and settling of alien species						
Indicator 10: Impact of chemicals on fauna and flora						
Indicator 4 (listed again): Factors of reduction in endangered species (the third crisis)						

Legend

Subject of assessment	Legend			
Degree of impact during assessment period	Weak	Medium	Strong	Very strong
				
Long-term trend of impact and current trends	Decreasing	Same	Increasing	Increasing rapidly
				

Note: Some elements are ignored when visual signs are indicated.
Note: The dashed lines for assessing the degree of impact indicate insufficient data.

Indicator 9 Invasion and settling of alien species

Explanation of the Indicator

○ Any alien species brought into our country that subsequently escapes, invades an ecosystem, and then settles there may reduce the populations or distributions of native species, and deteriorate the quality of that ecosystem. Therefore, the numbers and distributions of invasive alien species in our country can be considered an indicator showing the factors of loss as relating to the third crisis.

Assessment by the Indicator

○ The numbers and distributions of invasive alien species showed a tendency toward expanding throughout the 20th century.

○ At the start of the 21st century, the measures taken against new invasive species are progressing, but the expanded distributions of certain invasive species already settled in our country have yet to be restrained.

Reason of the Assessment

<Factors of Increasing Numbers of Invasive Alien Species>

Beginning around 1900, the numbers of exotic insect or exotic weed species have increased over the years, and then rapidly increased particularly during and after the 1950s (Data 9- ① : Appendix). Some of those alien species were intentionally introduced for use as food or as pets, or for appreciation, greening and agricultural use. However, some species were unintentionally brought in as being mixed in or clinging to imported cargo.[1)] Another unintentional introductory route is the ballast water used for stabilizing vessels, and which is refilled when ships call at ports.[2),3)] The background behind this increase of invasive alien species was a situation of wider exchanges of people and goods across national borders that took place after the period of high economic growth.

<Expansion of Populations and Distributions of Alien Species>

Any live animal or plant brought into our county gives rise to the possibility of that animal or plant invading our domestic ecosystems. Although time-series data on the numbers of "live animals" imported during the full assessment period is lacked, the quantities of fish for appreciation rapidly declined from the second half of the 1990s, while import of other "live animals" has increased in the 1990s. However, the import of fish for appreciation largely decreased in the second half of the 1990s, and import of other "live animals" has slowly declined since 2000 (Data 9- ② : Figure II-15). Such measures as establishing the Invasive Alien Species Act in 2005 have been taken, and the importation of some classification groups is now on the decline (Data 9- ③ : Figure II-16).

Exotic species invade and settle in ecosystems after having escaped into an open area and bred there. The significantly expanded distributions of certain invasive alien species during the assessment period have had a heavy impact on native species.[1)]

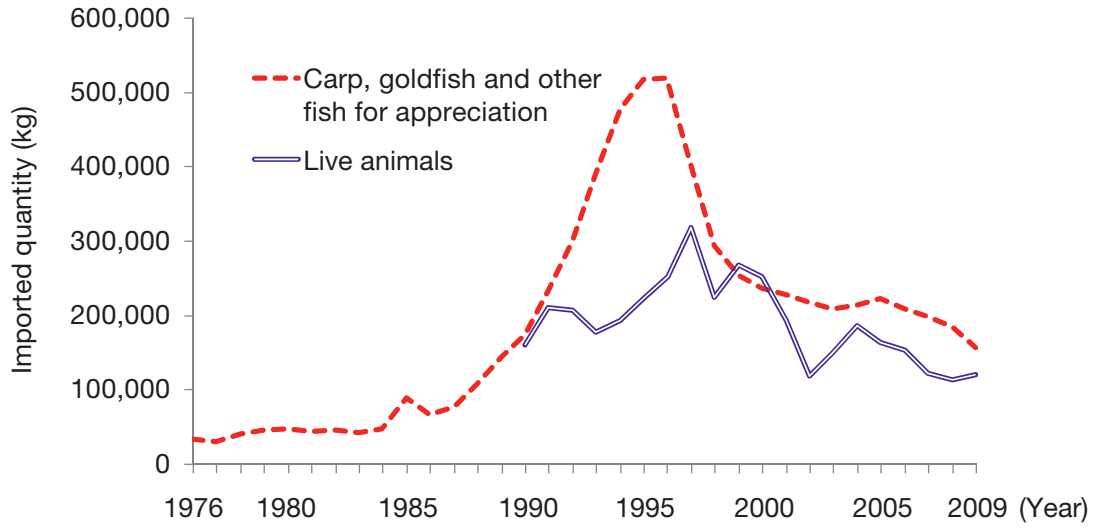
Largemouth bass impose a great impact on the ecosystems of lakes and holding ponds through the predation of native species.[4)] This species was originally introduced as a live aquatic resource and its inhabitation had already been confirmed in five prefectures during the 1950s. During the 1970s, its habitats rapidly expanded through intentional release, and in the 1990s its inhabitation was confirmed in all prefectures except Hokkaido. The inhabitation of largemouth bass in Hokkaido was later confirmed in 2001, but its disinfestation was completed in 2007 (Data 9- ④ : Figure II-17).

Sicyos angulatus—a species of vine—reproduced dramatically in riverbeds and along the fringes of forests, and imposes a heavy impact on river and other ecosystems.[5),6)] Its growth in an open area was confirmed in 1952 at Shimizu Port in Shizuoka Prefecture. This species is believed to have entered Japan unintentionally upon being mixed in soybeans or other food products and imported as part of feedstuff. Its growth was confirmed in 42 prefectures in the 1990s, and then in 45 prefectures in the 2000s (Data 9- ④).

The common raccoon also imposes a heavy impact on the ecosystems of forests and farmland through its predation of native species.[7),8)] This species had originally escaped from a feeding facility in Aichi Prefecture in 1962, and then into open areas throughout the country, such as in Hokkaido Prefecture in 1979, and Kanagawa Prefecture in 1988. The species then settled in these places and spread, and in the 2000s, its inhabitation was confirmed in 36 prefectures (Data 9- ④).

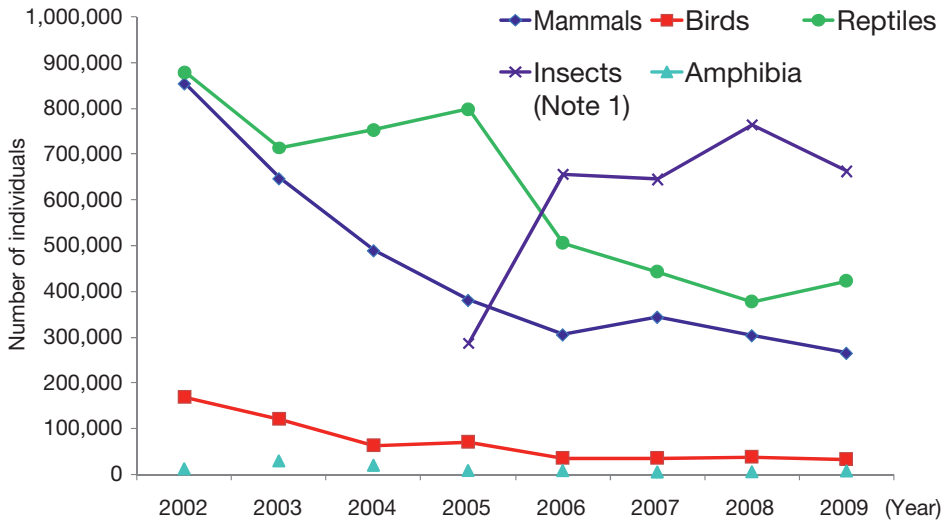
In addition to the cases described above, many cases of impact caused by invasive alien species have been reported, such as the competition between Bombus hypocrite (a bee imported for pollinating in greenhouses before escaping and settling here) and Bombus ardens, a native species.[1),9)] Incidentally, similar problems occur when introducing fauna or flora from a different region of the same country. In addition to such cases as Martes Zibellina brachyura in Hokkaido Prefecture and Martes malampus malampus brought in from the mainland, the impact on lizards caused by Mustela itatsi introduced from the Nansei Islands and the Izu Islands is well known.[10)]

Although measures are taken to control species that adversely impact ecosystems or cause damage to agriculture and forestry, it is no easy task to curtail the already expanded distributions of alien species, except for cases on small islands. For instance, more common raccoons are being captured each year, reaching a total of 10,000 animals in 2006 (Data 9- ④ Reference: Appendix).



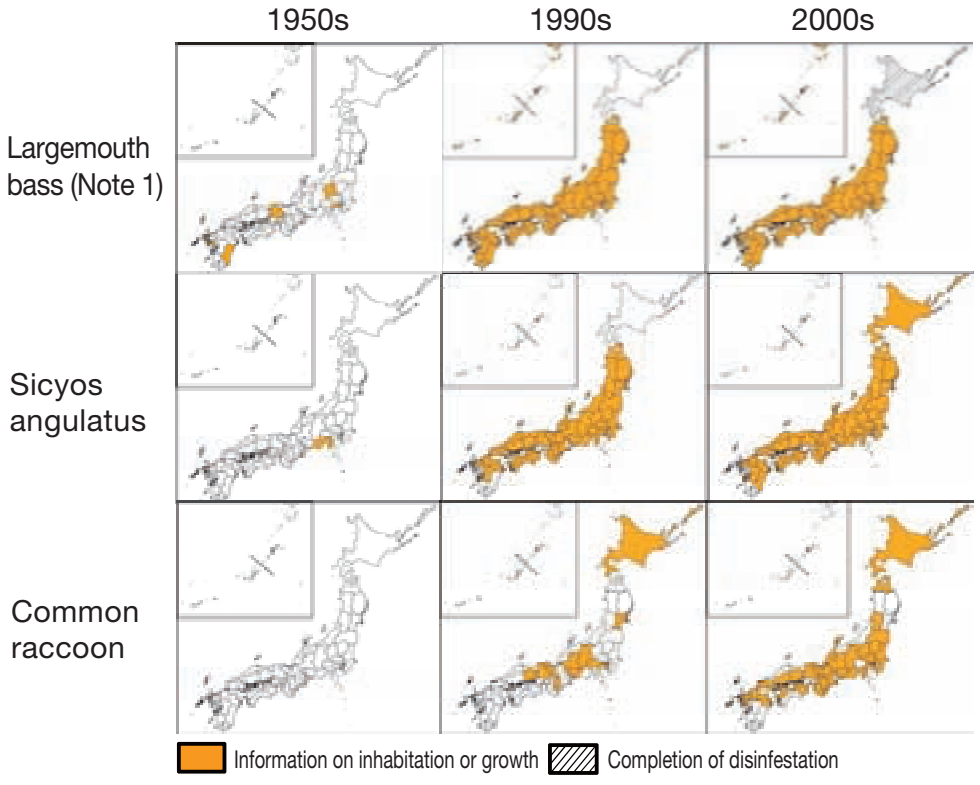
Any cargo imported into or exported from Japan must be declared at customs pursuant to the Customs Act, and thereby become cargo statistics. However, trade statistics do not include cargo of low value (up to ¥200,000).
Note 1: Live animals (except for dogs, monkeys, and honey bees)
Source: Ministry of Finance -- Monthly return of Japan's foreign trade

Figure II-15 Transition in the numbers of "live animals" imported from abroad (Data 9-②)



Note 1: Insects are denoted in units of 1000.
Source: Ministry of Finance -- Monthly return of Japan's foreign trade

Figure II-16 Transition in the numbers of "live animals" imported from abroad in recent years (Data 9-③)



Note 1: In Hokkaido, the inhabitation of largemouth bass was confirmed in 2001, but its disinfestation was completed in 2007.
Source: Y. Kaneko and T. Wakabayashi, 1998: Anglers' Novels, Ministry of the Environment, Basic Survey on the Natural Environment, Ministry of Land, Infrastructure, Transport and Tourism, National Census on River Environment; T. Yodo and K. Iguchi, 2004: History and background of the issue of largemouth bass, Bulletin of Fisheries Research Agency No. 12, 10-24

Figure II-17 Expanded distributions of invasive alien species (Data 9-④)

Indicator 10 Impact of chemicals on fauna and flora

Explanation of the Indicator

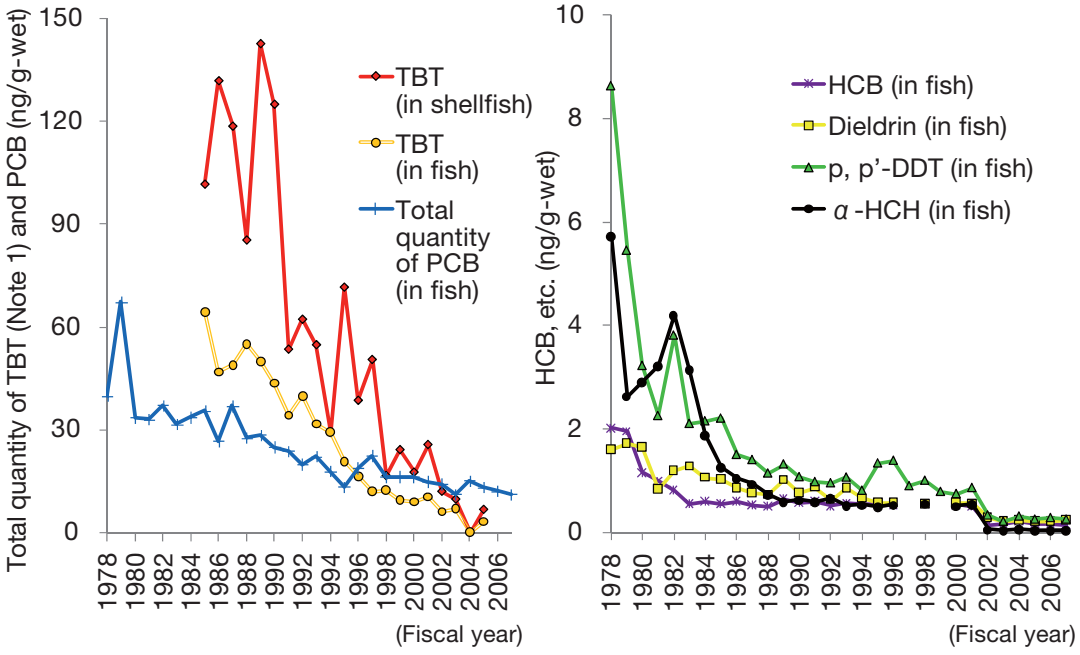
○ Many ecosystems are considered to be exposed to various chemicals for long periods, and some such chemicals are pointed out as having an adverse impact on ecosystems. Therefore, the impact of chemicals on fauna and flora can be deemed an indicator of the third crisis as a factor of loss.

Assessment by the Indicator

○ Although only limited data are available on the impact of chemicals on fauna and flora during the first half of the assessment period, the situation may have gradually showed some improvement from the 1970s.

Reason of the Assessment

Along with the evolution of science and technology, many new chemicals have been introduced and new methods of applying existing chemicals devised, making chemicals indispensable in our daily lives. At the same time, however, a situation has arisen where the risks imposed on the human body and wildlife by certain chemicals not easily dissolved have been pointed out. After the 1960s, the manufacture and use of PCB, DDT, HCH, dieldrin, HCB, TBT (tributyltin compounds) and other chemicals used in agriculture and in coating materials were restricted from the 1970s to 1990s by legislation including the "Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc." due to the characteristics of not being easily dissolved when released into the environment and being easily cumulated in living bodies. Although the level of major pollutants detected in fish has generally declined since 1978, such pollutants are still being detected today (Data 10- ① : Figure II-18), with the long-term residue of chemicals in the environment being widely recognized.[11] Moreover, the inappropriate use of agricultural chemicals and chemical fertilizers on farmland has adversely impacted both farmland and the wildlife living there. Although production of these chemicals has declined (Data 19- ③ : Figure III-7) since 1975, related impact is still being pointed out even today.[12] Much of the impact caused by chemicals remains unexplained. For instance, the relation between the reproductive abnormalities of wildlife observed at various worldwide locations and the exposure to certain chemicals has been pointed out, and the endocrine-disrupting influence of chemicals has come under closer scrutiny.



The manufacture, import and use of PCB, DDT, HCH, dieldrin and HCB were restricted in principle by legislation enacted from the 1970s through the first half of the 1980s. The manufacture and import of TBT (tributyltin compounds) were restricted by law in FY 1988.
Note 1: With regard to TBT (tributyltin compounds), the status of its detection in fish as well as in shellfish is indicated.
Source: Data compiled by the Ministry of the Environment (Survey on actual conditions of chemical substances and environment)

Figure II-18 Transition of the status of detecting major pollutants over the years (in fish and shellfish) (Data 10-①)

Indicator 4 (listed again) Factors of reduction in endangered species (as related to the third crisis)

Explanation of the Indicator

○ The ratio of extinct or endangered wildlife species to the total species in Japan indicates that the loss and reduction of species was caused by all of the following factors: "the first crisis," "the second crisis," "the third crisis" and "the climate change crisis." Indicator 4 here assesses these factors as related to the third crisis.

Assessment by the Indicator

○ In many classification groups, the first crisis acted as a major factor of loss, but the third crisis has also had impact as a factor of loss.

Reason of the Assessment

<Third crisis as factors of reduction in endangered species>

According to the latest Red List issued by the Ministry of the Environment[13),14),15),16),17),18)], 26% of mammals, 15% of birds, 32% of reptiles, 34% of amphibians, 37% of freshwater/brackish water fish, and 25% of vascular plants are already extinct or endangered (Data 4- ① : Appendix). The ratio of "introduced species" that indicates an alien species corresponding to the third crisis among the factors of loss for each classification group of fauna and flora is particularly high (at about 70%) for reptiles, and ranges from 20% to 30% for other classification groups (Data 4- ⑤ : Figure II-7). Some invasive alien species may cause ecological or hereditary disturbances through such interspecies interaction as preying on native species and engaging in competition or hybridization with native species, spreading infectious diseases, or destroying inhabitation environments, and consequently may reduce the populations native species or cause them to become extinct.[1)] In particular, given the small-scale ecosystems of islands that include many

endemic species, it is highly feared that invasive species could adversely adverse impact those endemic species. In fact, many actual cases have been reported.[19),20),21)] For instance, there are concerns about the impact of Herpestes javanicus on Pentalagus furnessi and Gallirallus okinawae on the Nansei Islands.

4. Measures for Loss

(1) Measures

Measures matching various stages of an invasion by invasive alien species due to the third crisis must be taken, including (1) the prevention of invasion, (2) the detection of and taking measures at the initial stage of an invasion, and (3) the disinfestation and management of invasive alien species that have settled in a given location.

In 2005, import restrictions and other measures to prevent the invasion of alien species designated as "invasive alien species" or "undetermined alien species," and the control of invasive alien species already settled in Japan were promoted by establishing the "Invasive Alien Species Act," thereby activating measures by local public agencies and private organizations. Thus, the measures to prevent any new entry of invasive alien species have been reinforced, and on some islands certain effects have been achieved, such as successful disinfestation and curtailing population growth. However, more effective capturing techniques must be developed to deal with invasive alien species already settled in Japan that are expanding their distributions.

As for chemicals, measures are being taken, as seen in restrictions imposed by the Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc. that was introduced in the second half of the assessment period.

<Restrictions on the Import, Feeding, etc. of Alien Species>

The import of certain alien species has been restricted by the Invasive Alien Species Act enforced in 2005, and by the Plant Protection Act and the Act on Prevention of Infectious Diseases and Medical Care for Patients Suffering Infectious Diseases enacted before 2005. Based on the model established under the Invasive Alien Species Act that restricts the feeding, cultivating, keeping, transporting and releasing of invasive alien species, some local public agencies have implemented related schemes by ordinance. And with regard to living modified organisms (LMOs) that may possibly affect biodiversity, such measures as requiring a prior risk assessment regarding the impact of LMOs on biodiversity caused by the use thereof are mandated under the Act on the Conservation and Sustainable Use of Biological Diversity through Regulations on the Use of Living Modified Organisms (the Cartagena Act).

<Control of Invasive Alien Species>

With regard to invasive alien species already settled in Japan that are causing an adverse impact, the Ministry of the Environment is implementing control measures from the standpoint of eliminating problems related to the natural restoration, conservation and population growth of endangered species in such areas as islands that are considered important to protect. And as a link to river and road management, the related ministries and agencies are taking measures for the disinfestation and other controls of alien greening plants. In addition, local public agencies, NPOs and local community residents in various areas throughout Japan are taking measures for controlling such wildlife as the common raccoon and largemouth bass.

<Restrictions on Chemicals>

The Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc. established in 1973 mandates the obligation to report new chemical substances and imposes restrictions on the manufacture, import and use of chemical substances not easily dissolved, mainly from the standpoint of chemical impact on humans. Beginning in 2009, the impact of chemicals on fauna and flora has also been considered, and certain chemical substances including those that easily dissolve became subject to restrictions. In addition to the Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc., the Agricultural Chemicals Control Act (established in 1948 and revised in 2003), the Act on Special Measures against Dioxins (established in 1999), and other legislations also provide for such restrictions.

(2) Related indicators

The following shows the indicators used to assess the measures for loss caused by the third crisis, and the assessment result.

Table II-8 Indicators of measures for loss as related to the third crisis and their assessment results

	Assessment					
	Long-term trend of measures		Current trend of measures			
	First half of assessment period	Second half of assessment period	First crisis	Second crisis	Third crisis	Climate change crisis
Indicator 11: Restrictions of the import and control of alien species	⇨	⇗			⇗	

Legend

Subject of assessment	Legend		
Trend of measures	Increasing	Same	Decreasing
	⇗	⇨	⇘

Note: Some elements are ignored when visual signs are indicated.

Indicator 11 Restrictions of the import and control of alien species

Explanation of the Indicator

○ Since the invasion or settlement of alien species in our country runs the risk of imposing a significant impact on the biota and ecosystems inherent to respective areas, it is important to take import restrictive measures in order to prevent entry at the water's edge and control those species already settled in Japan. Accordingly, the status of import restrictions and the control of alien species indicates measures against the third crisis.

Assessment by the Indicator

○ There is a trend toward measures being expanded as evidenced by the Invasive Alien Species Act established in 2005, in addition to the measures previously taken.

Reason of the Assessment

The import of fauna and flora from abroad used to be restricted under the Plant Quarantine Act, the Protection Against Infections Act and other legislation, but in 2005, the Invasive Alien Species Act was enforced to prescribe measures against species designated as invasive alien species from the standpoint of preventing damage as pertaining to ecosystems, agriculture and forestry. Under the Act, 97 invasive alien species have been designated, with the feeding and import of such species prohibited, and the import of undetermined fauna and flora species restricted (Data 11- ① ; Table II-9). Moreover, any alien fauna or flora not designated as invasive alien species or undetermined alien species that may adversely impact ecosystems are listed as suspicious invasive alien species, and 148 species in this category from among each classification group have been publicized by 2009 (Data 11- ①).

Regarding the control of alien species already settled in Japan, measures are now being taken mainly by local public agencies and private-sector organizations (e.g., NGOs, fisheries cooperative associations). The Invasive Alien Species Act provides for a system whereby the government confirms and certifies the control activities to be implemented by local public agencies and private-sector organizations, and as of February 2010, more than 400 control activities have been confirmed and certified by the government (Data 11- ② : Appendix). The government is also directly implementing control measures on some islands where certain endangered species inhabit or grow. There have been examples of success on some islands having limited distributions of invasive alien species, in terms of eradicating or reducing the populations of those species, but measures to control alien species with already expanded distributions must be continued by various parties into the future.

Table II-9 Number of invasive alien species, undetermined alien species and suspicious invasive alien species (Data 11-①)

Category	Mammals	Birds	Reptiles	Amphibia	Fish	Insects	Invertebrate species (Note 1)	Plants	Total
Invasive alien species	21	4	13	11	13	8	15	12	97
Undetermined invasive alien species	11	1	5	10	14	1	10	2	54
Suspicious invasive alien species (Note 2)	3	6	9	2	21	7	16	84	148

Note 1: This refers to the total number of invertebrate species other than insects.
Note 2: Suspicious invasive alien species are not those prescribed under the Invasive Alien Species Act, but are selected for the purpose of promoting public awareness.
Note 3: As of February 2009
Source: Data compiled by the Ministry of the Environment

References

1) Yamada F., 1998: The 41st Symposium on "Verification from wild mammals of the 20th century — on environmental impacts," Status quo and issues of introduced mammals in our country, Mammalian Science, 38, 97-105.
2) Iwasaki K., 2007: On the alien marine organisms introduced to Japan and damages caused by them to native ecosystems and industries, Nippon Suisan Gakkaishi, 73, 1121-1124.
3) Otani M., 2004: On the marine organisms introduced to Japan and the process of introduction, Japanese Association of Benthology, 59, 45-57.
4) Minobe H. and K. Kuwamura, 2001: Changes in fish fauna in the endorheic lakes around Lake Biwa and analysis of native habitat — toward the restoration of ecological functions of places for native fish to breed and inhabit, Ecology and Civil Engineering, 4, 27-38.
5) Ministry of Land, Infrastructure, Transport and Tourism, Hokuriku Regional Development Bureau, Chikumagawa Office of River, 2003: Sicyos angulatus on the Chikuma River and the Sai River, Survey Section, Chikumagawa Office of River, Hokuriku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism.
6) Miyawaki S. and I. Washitan, 2004: Invasive alien plant species in riparian areas of Japan: The contribution of agricultural weeds, revegetation species and aquacultural species, Global Environmental Research, 10, 89-101.
7) Ikeda T., 2006: Issues in the measures against raccoons, Mammalian Science, 46, 95-97.
8) Agetsuma-Yanagihara Y., 2004: On the process of raccoons running wild in Aichi Prefecture and how the future measures should be, Mammalian Science, 44, 147-160.
9) Washitani I., 1998: Issue of invasion of Bombus hypocrita from the viewpoint of conservation ecology, Journal of the Ecological Society of Japan, 48, 73-78.
10) Hasegawa M., 1997: Invasion of organisms into islands and changes in biota, Inheritance, 9, 86-94.
11) Watanabe I., 2008: Ecological assessment of pollutant, Attempt to apply clarification of the impact on wildlife, Mammalian Science, 48, 169-174.
12) Jinguji H., T. Ueda, and K. Goka, 2009: Impacts on larva and eclosion of Sympetrum frequens caused by insecticide for seedling nursery box containing fipronil and imidacloprid, Collected Papers of the Japanese Society of Irrigation, Drainage and Rural Engineering, 77, 35-41.
13) Ministry of the Environment, 2006: Red List of birds.
http://www.env.go.jp/press/file_view.php?serial=8929&hou_id=7849
14) Ministry of the Environment, 2006: Red List of reptiles.
http://www.env.go.jp/press/file_view.php?serial=8930&hou_id=7849
15) Ministry of the Environment, 2006: Red List of amphibia.
http://www.env.go.jp/press/file_view.php?serial=8931&hou_id=7849
16) Ministry of the Environment, 2007: Red List of mammals.
http://www.env.go.jp/press/file_view.php?serial=9941&hou_id=8648
17) Ministry of the Environment, 2007: Red List of freshwater and brackish water fish.
http://www.env.go.jp/press/file_view.php?serial=9944&hou_id=8648

18) Ministry of the Environment, 2007: Plants-I Red List of Vascular Plants.
http://www.env.go.jp/press/file_view.php?serial=9947&hou_id=8648
19) Tsuneda K., 2006: Successful experience in eliminating wild goats in Ogasawara and future issues, Mammalian Science, 46, 93-94.
20) Yamada F., 2006: Issues in eradication of Herpestes edwardsi, Mammalian Science, 46, 99-102.
21) Abe T., K. Wada, and N. Nakagoshi, 2008: Extinction threats of a narrowly endemic shrub, Stachyurus macrocarpus (Stachyuraceae) in the Ogasawara Islands, Plant Ecology, 198, 169-183.

Section 4 Assessment of the Climate Change Crisis

This section assesses the extent and trends of the impact of "the climate change crisis" as a factor causing biodiversity loss during the assessment period (from the 1950s to the present) by using two indicators, as well as the trend of implementing related measures.

1. The Climate Change Crisis

○ The climate change crisis refers to the impact on biodiversity caused by global warming. Global warming will become a factor in reducing the scale and deteriorating the quality of ecosystems, as well as the populations and distributions of organism species.

2. Assessment of Loss Factors of the Climate Change Crisis

○ The climate change crisis has been suggested as being a factor of long-term loss during the assessment period from the second half of the 1950s to the present.

○ Although its causal relation with global warming is debatable, some case examples suggest that climate change has caused certain changes in the distributions of fauna and flora, as well as adversely impacting ecosystems.

○ Climate change including rising temperature is expected to expand from now on, and its impact is now considered to be intensifying.

3. Reason of the Assessment

The following lists the indicators used in the assessment that represent the causes of loss due to the climate change crisis, and describes the assessment by each indicator.

Table II-10 Indicators representing the factors of loss due to the climate change crisis and their assessment

	Assessment					
	Long-term trend of impact		Degree of impact during the assessment period and current trends			
	First half of the assessment period	Second half of the assessment period	First crisis	Second crisis	Third crisis	Climate change crisis
Indicator 12: Impact on organisms caused by global warming						
Indicator 4 (listed again): Factors of reduction in endangered species (the climate change crisis)						

Legend

Subject of assessment	Legend			
Degree of impact during assessment period	Weak	Medium	Strong	Very strong
				
Long-term trend of impact and current trends	Decreasing	Same	Increasing	Increasing rapidly
				

Note: Some elements are ignored when visual signs are indicated.
Note: The dashed lines for assessing the degree of impact indicate insufficient data.

Indicator 12 Impact on organisms caused by global warming

Explanation of the Indicator

○ The impact of global warming on organisms includes changes in phenology and shows the climate change crisis as a factor of loss.

○ It is feared that as global warming intensifies, some fragile ecosystems that are vulnerable to climate changes such as alpine flora and coral reefs will be damaged.

○ The environmental changes caused by global warming also cause changes in the phenology of organisms including breeding and seasonal migration, and such changes may occur along the migration routes and in the distributions of organisms having high migration ability.

Assessment of the Indicator

○ Given the limited data indicating the direct relation between global warming and the changes in ecosystems, it is often difficult to clearly separate global warming as a direct impact. Although the transition during the assessment period is unknown, judging from the long-term time-series data on multiple classification groups, changes in the distributions and phenology of species are becoming apparent.

○ Some ecosystems are reportedly being affected by phenomena relating to global warming, and its impact suggests a tendency toward expanding.

Reason of the Assessment

The 4th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) states that the average world temperature has rapidly risen over the past 50 years, and very likely caused by increasing amounts of greenhouse gases being emitted through human activity.[1)]

The speed of ongoing rapid climate change due to the human-induced increase of greenhouse gases is exceeding the speed at organism species and ecosystems can adapt, and the trend of an ongoing rise in temperature into the future raises the risk of extinction for many organisms.[1),2)]

It is feared that the environment will be changed by global warming to an extent not favorable to the inhabitation and growth of native species of organisms. And since the reaction to temperature changes by organisms that inhabit and grow in one ecosystem is known to differ depending on the species or classification group of organisms,[3),4)] it has been pointed out that certain aberrations may be caused by global warming in the interspecies interactions of various organisms, such as the predator-prey relationship, pollination and seed dispersal by animals, and parasitism among insect species.[3),4)]

Such changes in habitats and aberrations in interspecies interactions run the risk of causing changes in ecosystems, including the widespread extinction of certain species and reduced populations of related species, as well as the replacement of one species by another new one.[4)]

The rising average temperature in Japan has been observed nationwide, particularly during the second half of the assessment period, and research is now being conducted on the impact caused by global warming on biodiversity[3),4)]. And although the causal relation with global warming remains debatable, some case examples of the reduced scale and deteriorated quality of certain alpine flora and coral reef ecosystems have been reported.[5)] As will be discussed later, the northward movement of the distribution limits of certain insects, ocean fish and benthic organisms, the changes in certain bird populations, changes in the phenology of plants such as budding, flowering and defoliation, and changes in the breeding periods of birds and amphibia in certain areas have been reported, mainly during the second half of the assessment period.

There may also be other cases where the impact on fauna and flora caused by global warming and other human-induced impact interact, and thereby impose an even greater impact on ecosystems, such as changes in the distribution of deer (Cervus Nippon) due to less snow cover, and a growing deer population due to fewer hunters.

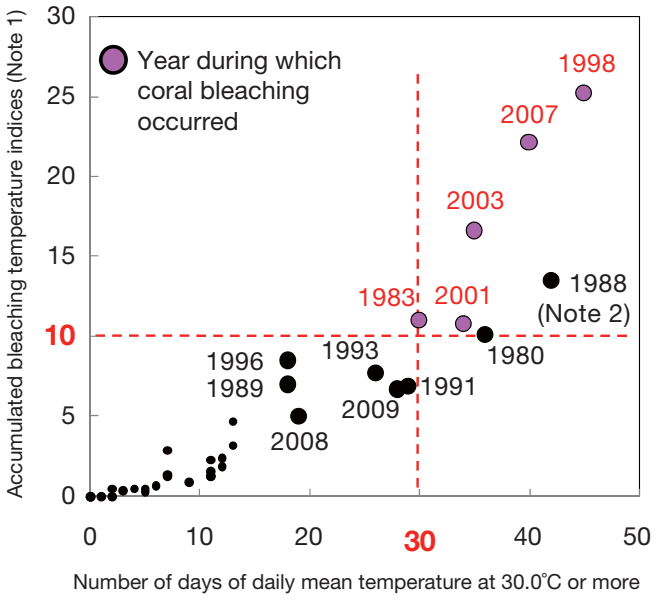
<Reduction and Loss of Ecosystems>

As species constituting an ecosystem are affected by global warming, the entire structure or scale of that ecosystem can be changed.

As a case example of the impact of a substance on the environment, it is suggested that the decreasing amount of sea ice in the Sea of Okhotsk initially observed in 1979 relates to surface temperature changes in the Far East region of the Eurasian continent that have served as a weather gauge for the sea (Data 12- ① : Appendix). Rising temperature has thus weakened vertical ocean circulation and thereby curtailed the production of photo plankton, raising concerns about the impact on marine ecosystems. The impact of global warming on vertical circulation is also feared to have occurred in such lakes as Lake Ikeda and Lake Biwa.[6),7)]

As a case example that may relate to the extinction or decline of organisms, coral in the coral reef marine areas of the Nansei Islands has reportedly been bleached since the 1980s due to rising seawater temperature associated with global warming. In the Sekisei Lagoon, which has the widest coral reef area in Okinawa Prefecture, serious bleaching phenomena has occurred more frequently beginning in 1998, resulting in declining coral coverage (Data 12- ② : Figure II-19). Moreover, such changes as the northward movement of the distribution of certain corals have also been reported.[8)]

As a case example of an ecosystem being reduced, it has been reported that the alpine meadows on Mt. Apoi in Hokkaido Prefecture has rapidly declined due to the invasion of woody plant flora after the 1970s, which is also related to global warming (Data 12- ③ : Appendix). At the same time, it has been also pointed out that deer, wild boars and monkeys are invading the alpine belts in various regions, along with declining snow cover[9)], which is also considered to be one cause of the regression of alpine flora vegetation.[10),11)]



Note 1: "Bleaching temperature index" is defined as the total figure of values exceeding 30.0 , where 30 is set as the deduction temperature for the occurrence of bleaching.
Note 2: The year 1988 is also within the risky range, but this year the predation by crown of thorns starfish has caused hardy any coral damage.
Source: Okamoto M, S Nojima and Y Furushima, 2007: Temperature environments during coral bleaching events in Sekisei Lagoon, Bulletin of the Japanese Society of Fisheries Oceanography, 71 (2), 112-121., etc.

Figure II-19 Relation between coral bleaching and temperature in the Sekisei Lagoon (Data 12-②)

<Changes in the Distributions of Fauna and Flora>

The distribution of each species of organism is considered to be fixed in accordance with the ecological characteristics of that species, and therefore, changes in the distribution of a species due to global warming may impact distributions overlapping those of related species or the interactions between organisms and existing species or others.

During the period from the first half of the assessment period to the present, the distribution limits of some species including butterflies, dragonflies, and stink bugs were confirmed as having moved northward, and attributed to global warming. For instance, the northern habitat limit of Papilio memnon was Yamaguchi Prefecture in the 1940s, but the species was later observed in Hiroshima Prefecture and on Shikoku in 1950, and today its distribution has expanded to include the Tokai and Kanto regions (Data 12- ④ : Appendix). Moreover, Ictinogomphus pertinax was known to have come from Shikoku during the 1970s, passing over the Seto Inland Sea to Awaji Island, and reaching the southern tip of Okayama Prefecture and the western tip of Kii Peninsula. In the 1990s, this species reached Lake Biwa via the Osaka Plain (Data 12- ⑤ : Appendix). The distribution of Nezara viridula, which cannot settle where the lowest monthly mean temperature is not high enough, was only limited to some prefectures in Kyushu, Shikoku and the Kinki region at the beginning of the 1960s, but later expanded to include all of Kyushu and a wider range of Shikoku and the Kinki region by the beginning of the 2000s. It was also confirmed to have extended to the Tokai region. These expanded distributions of species are pointed out as having been changed in line with a rising mean temperature (Data 12- ⑥ : Appendix).

In addition to insects, the distributions of some fish, crustaecea and shellfish in marine areas have reportedly moved northward. For instance, a survey on fish fauna in the coastal areas of the Sea of Chikuzen revealed increases since 1986 among certain species originating in southern waters. The seawater temperature in those coastal areas during winter was found to be rising at an annual rate of about 0.1℃ since the 1980s, thereby suggesting a relation between a rise in the lowest seawater temperature and the movement and settling of fish originating in southern waters (Data 12- ⑦ : Appendix).

<Changes in Populations>

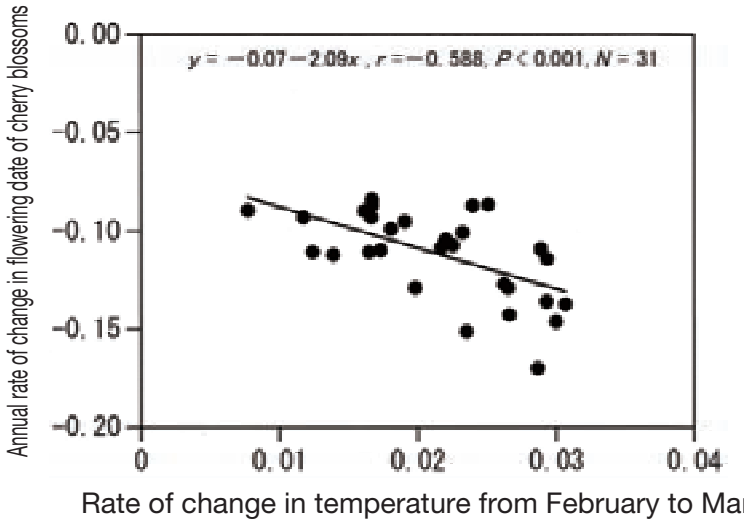
The populations of organisms are limited by the environmental capacity of their habitats and growth environments. Any significant increase in the population of a given species may impose an excessively heavy load on the local environment and adversely impact the inhabitation and growth of other species.

For instance, a nationwide survey on the inhabitation of geese and ducks revealed that the population of tundra swans sharply increased during and after the 1980s in the second half of the assessment period (Data 12- ⑧ : Appendix). One contributing factor for this increase has been pointed out to be the increased population of chicks and their enhanced survival rate due to rising temperature in the breeding areas, transit sites and wintering places.

<Changes in Phenology>

It is said that the life cycles of many organisms are related to temperature and the length of days; note that flowering time is especially sensitive to temperature. With regard to the flowering time of a plant or breeding season of a bird, aberrations may arise between the phenology of that species and that of another species through interaction, thereby causing some disorder in maintaining the related ecosystem.

During the period from the second half of the assessment period to the present, certain changes such as flowering, budding and defoliation in the phenology of some plants have been confirmed, and the relation thereof with global warming is pointed out. For instance, phenological observations conducted by the Meteorological Office revealed that the flowering dates of cherry blossoms (Somei-Yoshino) at 31 out of the 81 sites throughout Japan are tending to occur earlier than before during the period from the 1950s to the present (Data 12- ⑧ : Appendix). Similarly, it is known that the flowering dates of ume during the same period have occurred earlier than before, and it is pointed out that temperature rise during winter (January to March) rather than the amount of snowfall has influenced flowering of ume. Gingko also shows earlier budding and later defoliation than before, and all of those phenomena suggest a close correlation with the chronological changes in temperature (Data 12- ⑨ : Figure II-20). And similar to the cases of plants, changes have been noted in the breeding seasons of birds and reptiles in certain areas. For instance, the annual egg-laying season of chestnut-cheeked starlings in the city of Niigata came 0.73 day earlier on average than in every preceding year (from 1978 to 1998), suggesting the impact of global warming (Data 12- ⑩ : Appendix).



The extent of rises in temperature and earlier flowering dates are shown as annual rates of change, respectively. The annual rate of change is the sloping straight line when both temperature and flowering date process in line with the linear regression method against the year.
Source: Higuchi et al., 2009: Impacts cause by warming upon phenology, distributions populations, Global Environment, 14 (2), 189-198

Figure II-20 Relation between flowering dates of cherry blossoms (Somei-Yoshino) and temperature (Data 12-⑨)

Indicator 4 (listed again) Factors of reduction in endangered species (as related to the climate change crisis)

Explanation of the Indicator

○ The ratio of extinct or endangered wildlife species to the total species in Japan indicates that the loss and reduction of species was caused by all of the following factors: “the first crisis,” “the second crisis,” “the third crisis” and “the climate change crisis.” Indicator 4 here assesses these factors as related to the climate change crisis.

Assessment of the Indicator

○ Sufficient data have yet to be obtained for determining the scale and current trend of the impact of global warming during the assessment period (see the column titled "Impact of global warming: May we wait until it becomes visible?").

4. Measures for Loss

(1) Measures

To cope with the climate change crisis, measures must be taken in terms of two aspects as follows: First, measures must be taken to mitigate global warming (i.e., reducing greenhouse gas emissions), followed by measures to adapt to global warming (i.e., responding to environmental and ecological changes caused by global warming).

As for measures to mitigate the impact of global warming, it is important to take measures that will help promote both the conservation of ecosystems and the mitigation of warming effects. Such measures are being deliberated or implemented as part of efforts to conserve ecosystems including forests, marshlands and grasslands that absorb and store carbon dioxide, employ agriculture methods that will reduce greenhouse gas emissions, promote the use of grassy and woody biomass, and the use of lumber as a housing material.

As the measures for adaption, other human-induced impact that would accelerate the impact of global warming must be curtailed. For instance, in order to enable the movement of fauna and flora as a natural process even under global warming, the formation of ecosystem networks is being deliberated and implemented. Moreover, related data are being monitored and utilized on an ongoing basis. For example, fixed-point observations began in 2003 as part of the Monitoring Site 1000 project for coral reefs and then for alpine regions starting in 2009, in order to quickly comprehend the changes in ecosystems caused by global warming. The atmospheric data from the 1950s and phenological observation data collected by the Meteorological Office are being utilized by many researchers, thereby helping to elucidate the impact of global warming on biodiversity.

(2) Related Indicator

No related indicator is established.

Column: Impact of global warming: May we wait until it becomes visible?

The earth has often experienced large-scale climate changes in its long history. The present time is in the midst of the ice age that began about 40 million years ago. During the ice age, particularly cold glacial periods and comparatively mild interglacial periods are repeated in alternate cycles, and during the past several million years, these periods have been repeated in 40,000- to 100,000-year cycles. The latest glacial period (called the last glacial period) ended about 10,000 years ago, and the present time is an interglacial period. Although temperature differs depending on the location on earth, during the coldest time in the last glacial period, the temperature is considered to have been about several degrees (centigrade) lower than at present, and the sea level more than 100 meters lower.

Such environmental changes have significantly impacted organisms. In addition to physical changes in the inhabitation and growth environments of organisms, such as the expansion or contraction of glaciers, and the transition from a seabed to dry land and vice versa, changes in climate and precipitation have also had great impact. An analysis of fossils and pollen has confirmed that the distribution ranges of organisms moved in accordance with climate change.

Due to CO_2 and other greenhouse gases emitted by human activities, rapid rises in temperature as high as several degrees per 100 years are projected to occur from now on. This is global warming. When looking back at past history, we know that global warming always impacts organisms.

Incidentally, biological phenomena that occur each season are collectively known as phenology. For instance, the flowering of cherry blossoms in spring and foliage turning red in autumn are easy to understand. The timing of such phenomena is directly affected by the climate of each year. The flowering of cherry blossoms earlier in the year than on average is likely to be attributable to global warming, but more precisely, it merely reflects a warmer spring of that year. If the climate tends to become warmer on a long-term basis, the flowering time will naturally become earlier, but arguing about whether global warming has an impact solely from the flowering time in a given year would be inappropriate.

The distributions of organisms are conversely subject to the accumulated impact of climate change over a long term. Given the random change of climate such as warm or cold weather each year, however, it is not easy to detect a long-term trend from short-term data. The scale of dispersions from year to year exceeds the rate of temperature change in a year caused by expected warmer climate by tens to hundreds of times. If climatic conditions are to determine the distribution limits of organisms, the distributions may widely vary from year to year, and such slow-moving creatures as snails or even trees may be recovering from a state to which they withdrew in search of a warmer place during a particularly cold period in the past. In any case, changes corresponding to the long-term trend of a warmer climate can hardly be clearly observed.

Even if we cannot immediately detect any impact of global warming, it does not mean that there is no impact or such impact can be ignored. If we consider global warming on a time scale of several tens to several hundreds of years, we would never be able to conclude that there will be no impact at all. In such a situation, it is necessary to assume that events unfavorable to mankind will occur, such as deteriorated ecosystem services and an irrevocable, irreversible change such as the extinction of a species, and then take whatever measures possible to prevent such events and changes.

(Akio Takenaka, Committee member)

References

1) IPCC, 2007: Climate change 2007: Impact, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge Univ. Press, 976pp.
2) Nakamura H., 2007: Lagopus mutus japoicus, Japanese Journal of Ornithology, 56: 93-114.
3) Primack R., I. Ibanez, H. Higuchi, S-D Lee, AJ Miller-Rushing, AM Wilson, and JA Silander, 2009: Spatial and interspecific variability in phenological responses to warming temperatures, Biological Conservation, 142, 2569-2577.
4) Higuchi H., S. Koike, and M. Handa, 2009: Impacts of global warming on phenology, distributions and populations of organism species, Global Environment, 14, 189-198.
5) Yasuda M., H. Daimaru, and S. Okitsu, 2007: Detecting the vegetation changes in mountain wetlands by chronological comparison of ortho aerial photographs, Geographical Review of Japan, 80, 842-856.
6) Kumagai M., K. Ishikawa, and J. Chunmeng, 2002: Dynamics and biogeochemical significance of the physical environment in Lake Biwa, Lake and Reservoir, 7, 345-348.
7) Ohtaka A., M. Nishino, T. Kobayashi, 2006: Disappearance of deep profundal zoobenthos in Lake Ikeda, southern Kyushu, Japan, with relation to recent environmental changes in the lake, Limnology, 7, 237-242.
8) Precht WF, and RB Aronson, 2004: Climate flickers and range shifts of reef corals, Frontiers in Ecology and the Environment, 2, 307-314.
9) Nagaike T., and T. Kamitani, 1999: The influence of forest management on landscape structure in the cool-temperate forest region of central Japan, Landscape and Urban Planning, 43, 209-216.
10) Chubu Regional Forest Office, 2007: Fiscal 2006 Survey Report on damage by deer in the Southern Alps Forest Reserve, 109pp.
11) Chubu Regional Forest Office, 2008: Fiscal 2007 Survey Report on damage by deer in the Southern Alps Forest Reserve, 101pp.

Section 5 Basis of Measures for Loss

This section assesses the widespread recognition of biodiversity by the general public as a basis for taking measures against biodiversity loss, transferring technology and providing funding to other countries in the area of biodiversity.

In this section, the indicators used to show the basis of measures for loss and assessment by those indicators are as follows:

Table II-11 Indicators and assessment showing the "basis of loss"

	Assessment		
	Long-term transition		Present situation and trend
	First half of the assessment period	Second half of the assessment period	
Indicator 13: Recognition of biodiversity		?	⇗ * 1
Indicator 14: Transfer of technology and provision of funding to other countries		⇗	⇗

Legend

Subject of assessment	Legend		
	Increasing	Same	Decreasing
Trend of measures	⇗	⇨	⇘

Note: Some elements are ignored when visual signs are indicated.
Note: "*" indicates that there are multiple factors and data related to the indicator in question, as well as existing factors and data showing trends that differ from assessments of the overall trends.
*1: Refer to the assessment of Indicator 13.

Indicator 13 Recognition of biodiversity

Explanation of the Indicator

○ The degree of recognizing the term "biodiversity" in society does not indicate the measures against any specific factors of loss, but does indicate the formation of a social basis to take measures for loss.

○ In order to take measures for loss, wide-ranging segments of the general public must recognize the importance of conserving biodiversity, with the entire society addressing the issue.

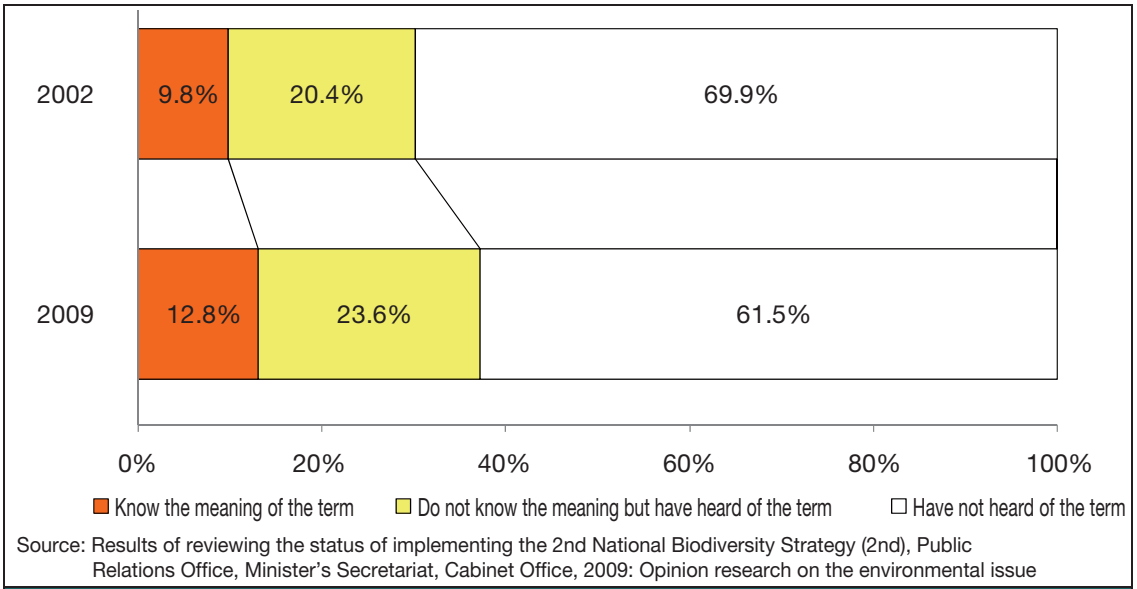
Assessment of the Indicator

○ There is no data on the recognition of biodiversity recorded in and before the 1990s. The recognition after 2004 when the target for 2010 was adopted has shown a slight increase, but still remains at a low level.

*1 (See Table II-11.): Given the slight increase in recognition, it is therefore necessary to pay special attention regarding whether it is reasonable to assess that the basis of measures has been reinforced.

Reason of the Assessment

The results of the 2002 questionnaire survey conducted by the Ministry of the Environment revealed that only 10% of respondents knew the meaning of "biodiversity," while 30% knew the meaning of the term or had heard of it, but did not know its meaning. The results of the 2009 questionnaire survey conducted by the Cabinet Office showed that 13% of respondents knew the meaning of the term, and 36% knew its meaning or had heard of it, but did not know its meaning (Data 13- ① : Figure II-21).



Source: Results of reviewing the status of implementing the 2nd National Biodiversity Strategy (2nd), Public Relations Office, Minister's Secretariat, Cabinet Office, 2009: Opinion research on the environmental issue

Figure II-21 Recognition of biodiversity (Data 13-①)

Indicator 14 Transfer of technology and provision of funding to other countries

Explanation of the Indicator

○ The Convention on Biological Diversity mandates that technology be transferred and funding provided to other countries in the area of biodiversity, which indirectly indicate our country's measures against biodiversity loss.

○ Our national life largely depends on the use of biomass supplied from outside Japan. This dependence can be considered to help mitigate the load of the first crisis on biodiversity in our country.

○ Animals that have a high migration ability such as migratory birds constitute part of our country's ecosystems, but these animals cannot be conserved by simply taking measures within our country.

○ Global warming is predicted to affect the biodiversity in Japan, but simply taking measures within our country is not sufficient.

Assessment by the Indicators

○ The scale of technology transfers and the provision of funding were gradually being enhanced in the second half of the assessment period.

○ With regard to providing funding to other countries, new actions have also been taken in recent years as seen in higher ratios of contribution to the funding as relating to the conservation of biodiversity, in addition to environmental ODA.

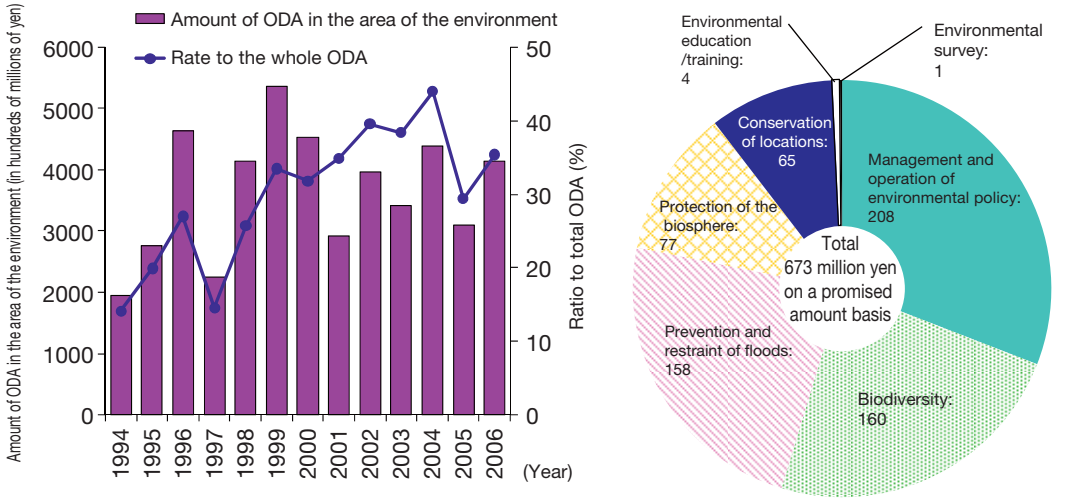
○ Concerning the transfer of technology to other countries, the government's technology transfer project has been expanded and is now being implemented in Latin America and Africa, in addition to the Asia-Pacific region. In recent years, projects have also been launched by private corporations, non-profit organizations, and researchers.

Reason of the Assessment

<Official Development Assistance Provided by the Government for Biodiversity>

The government has been expanding its official development assistance in the area of the environment (i.e., environmental ODA), of which a certain portion accounts for assistance related to biodiversity. The amount of environmental ODA tended to increase throughout the 1990s, and thereafter has amounted to 300 to 400 billion yen per year. Its ratio to the total amount of ODA increased during and after the 1990s, marking about a 30 to 40% increase in recent years (Data 14- ① : Figure II-22). Of the total amount (673 million dollars) of our country's contribution in the form of environmental ODA from 2003 to 2005, 160 million dollars were provided for various aspects of "biodiversity" and 77 million dollars for "protection of the biosphere."

The activities made possible by environmental ODA include technical cooperation projects for providing equipment and materials on a long-term basis, dispatching specialists and receiving trainees from counterpart countries based on plans worked out after repeated consultations with those countries, development surveys for supporting the formulation of public utilities plans that will contribute to socioeconomic development of the counterpart countries, and the implementation of other actions.

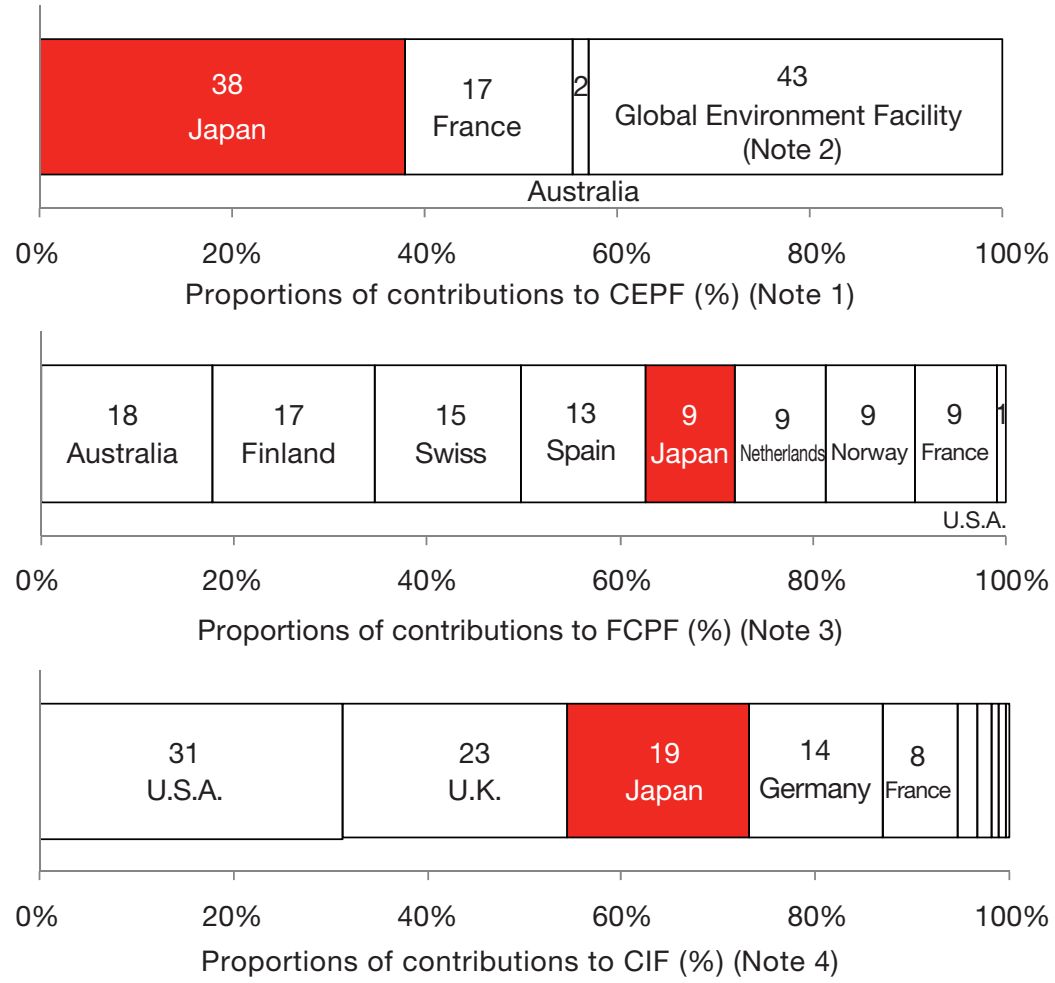


Note 1: This refers to the total for 2003 to 2005 (on a promised amount basis).
This includes free financial aid, financial aid for value and technical cooperation.
Japan has been reporting the results of technical cooperation to DAC (OECD Development Assistance Committee) since 2003.
Total amounts may not conform due to rounding up or off.
In the general environmental area in DAC statistics, environmental subjects that can be included in the other areas are omitted.
Source: OECD/DAC data, OECD/DAC-CRS online database.

Figure II-22 Transition of ODA amounts in the area of the environment in Japan and the ratios of biodiversity-related amounts to the total (Data 14-①)

<Ratios of Japan's Contributions to Major Funds>

The proportions of Japan's contributions paid to major funds related to the conservation of biodiversity are high. With regard to the CEPF (Critical Ecosystem Partnership Fund) that subsidize private organizations implementing conservation activities at biodiversity hot spots (i.e., areas having high biodiversity but many endangered species, and which face a critical situation) in developing countries, the amount of Japan's contribution is equal to 38% of the total amount of contributions, representing the second largest contribution (total amount for 1999 to 2009) following the Global Environment Facility (Data 14- ② : Figure II-23). As for the FCPF (Forest Carbon Partnership Facility of the World Bank) that promotes projects for reducing greenhouse gas emissions in developing countries, our country's contribution accounts for 9%, representing the fifth largest donor (in 2009) following Australia and other countries (Data 14- ②). For the CIF (Climate Change Investment Fund) that supports developing countries by addressing measures against climate change in line with development, Japan's contribution totals 19%, or the third largest following the UK and the USA (Data 14- ②). With regard to GEF (Global Environment Facility)—a multilateral aid for supporting activities to conserve the global environment in developing countries—our country has been contributing ever since the pilot phase was inaugurated, and Japan's contribution in all phases from GEF 1 to 4 was the second largest after that of the United States.



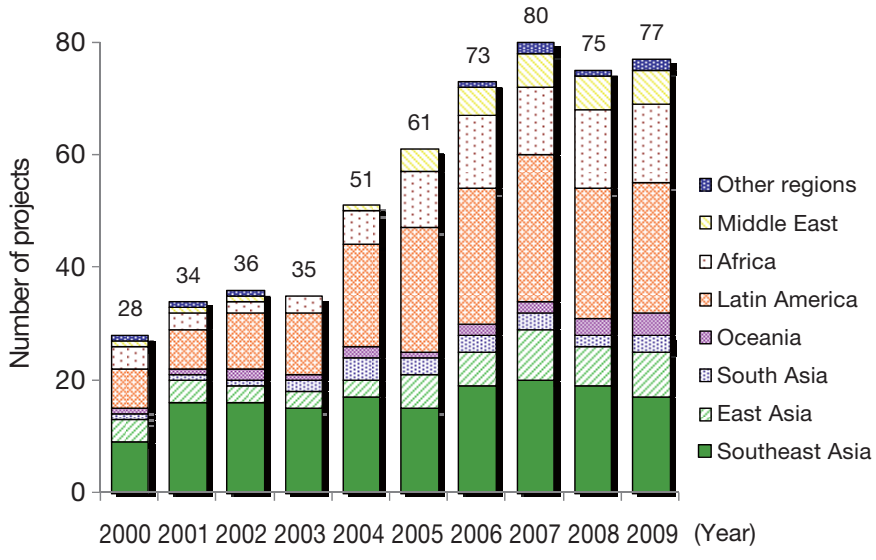
Note 1: CEPF: Critical Ecosystem Partnership Fund (total for 1999 to 2009)
This supports programs to conserve hot spots in developing countries.
Note 2: The Global Environment Facility is a funding mechanism utilizing existing organizations including the World Bank, UNDP, and UNEP.
Note 3: FCPF: Forest Carbon Partnership Facility (2009)
The FCPF supports the reduction of greenhouse gas emissions due to the loss and degradation of forests in developing countries.
Note 4: CIF: Climate Change Investment Fund (2009)
This fund includes additional syndicated loans for developing countries to address measures against climate change including the adaption to climate change, loss of forests, dissemination of clean technologies, and shifting to a low-carbon economy.
The countries whose proportion of contribution ranks 6th place or lower are: Australia (2%), Sweden (1%), The Netherlands (1%), Norway (1%), and Switzerland (0.3%).
Source: Conservation International data, FCPF data, World Bank data

Figure II-23 Japan's proportions of contributions to funding related to the conservation of biodiversity (Data: 14-②)

<Technical Cooperation in the Area of Biodiversity>

Japan has enhanced its technical cooperation in the area of biodiversity. There were about 30 technical cooperation projects conducted per year in the area of biodiversity by the Japan International Cooperation Agency (JICA) during the first half of the 2000s, but this total increased from 70 to 80 in the second half of the decade (Data 14- ③ : Figure II-24). Many Southeast Asian countries were targeted during the first half of the 2000s and the majority of projects were implemented in the Asia-Pacific region including East Asia, South Asia and Oceania, but in the second half of the same period, more projects were implemented in Latin America and Africa.

As for the contents of these projects, wide-ranging activities were included, such as the development of policy and research conducted on the conservation of biodiversity, conservation of endangered species, such conservation-related activities as the protection and management of national parks, activities related to sustainable utilization such as agro-forestry and agriculture oriented toward conserving the environment, measures taken against global warming and invasive alien species, eco-tourism, seed banks, and the fostering of human resources. For instance, with regard to the "Conservation Plan for Biodiversity in Indonesia" implemented in cooperation with the Indonesia Institute of Science and Forest Department for 16 years from 1992 to 2008, such results as developing a sample preservation system and database, conducting environmental surveys and preparing management plans for national parks, promoting communities around national parks, and enhancing the capability of researchers and administrative officials have been achieved.



Note 1: (1) Protection of biodiversity, (2) Sustainable utilization of natural resources, (3) Mitigation of threats to biodiversity (including measures against global warming), (4) Maintenance of properties and services for residents, (5) Maintenance of traditional knowledge and customs in local communities, (6) Equal sharing of benefits from genetic resources, (7) Technical cooperation projects that fall under the seven areas of enhanced personal, scientific and technical capabilities for the conservation of biodiversity.
Note 2: Any projects for which even part of the year is included in the assessment period were counted in the total number.
Source: Japan Wildlife Research Center, 2010: Report on the analysis of example cases of cooperation in the area of biodiversity and the deliberation of business deployment (project research) toward CBD COP10

Figure II-24 Number of technical cooperation projects for each region in the area of biodiversity by the Japan International Cooperation Agency (JICA) (Note 1, Note 2) (Data 14-③)

Chapter III
Assessment of the Status of Biodiversity Loss

This chapter assesses the degrees and trends of biodiversity loss in each ecosystem during the assessment period (from the second half of 1950s to the present), as well as assessing the responses made to biodiversity loss in each ecosystem.

Section 1 Assessment of Forest and Mountain Systems

This section assesses the degrees and trends of biodiversity loss in forest and mountain systems during the assessment period (from the second half of 1950s to the present) by using four indicators, as well as assessing the measures taken for biodiversity loss.

1. Assessment of Biodiversity Loss in Forest and Mountain Systems

○ Losses in forest and mountain systems that occurred during the assessment period from the second half of 1950s to the present are likely to deteriorate on a long-term basis.

○ The overall size of a forest apparently does not make a large difference, but natural forests have diminished through conversion into artificial forests. The connectivity of forests has also been decreasing. [First crisis]

○ During the latter half of the assessment period, the rate of deterioration of natural forests slowed down, while the quality of ecosystems in secondary forests and artificial forests has declined. [Second crisis]

○ Recently, as deer populations have increased and their distribution expanded, the damage to trees and underlying vegetation has become evident. There are also reports of a negative influence on alpine plants probably due to global warming. [Second crisis and climate change crisis]

○ Presently, the impact on forests by development has been reduced due to changes in the socioeconomic situation, but ongoing influence raises concerns.

2. Reason of the Assessment

The table below lists the indicators of the status of biodiversity loss in forest and mountain systems, and an assessment of each indicator:

Table III-1 Indicators and assessments representing the status of biodiversity loss in forest and mountain systems

	Indicator	Assessment		
		Long-term trend		Current loss and trend
		First half of the assessment period	Second half of the assessment period	
Indicators of forest and mountain systems	Indicator 15: Scale and quality of forest and mountain systems	↓	↘	→ *1
	Indicator 16: Continuity of forest and mountain systems	↘	→	→
	Indicator 17: Populations and distributions of species living in forest and mountain systems	↘	↘	↘ *2
	Indicator 18: Use and maintenance of artificial forests	→	↘	↘

Note: The assessment is based on a comparison with the status of ecosystems at the beginning of the assessment period (in the second half of 1950s).

Legend

Subject of assessment	Legend			
Degree of loss	Not Lost	Not significantly lost	Lost	Significantly lost
Trend of state	Recovering	Same	Being lost	Being rapidly lost
	↗	→	↘	↓

Note: Some elements are ignored when visual signs are indicated.
Note: The dashed lines for assessing the degree of loss indicate insufficient data.
Note: "*" indicates that there are multiple factors and data related to the indicator in question, as well as existing factors and data showing trends that differ from current assessments of the degrees, effects and trends of overall loss.
*1: Refer to the assessment of Indicator 15.
*2: Refer to the assessment of Indicator 17.

Indicator 15 Scale and quality of forest and mountain systems

Explanation of the Indicator

○ The scale and quality of forest and mountain systems are an indicator that mainly represents the status of biodiversity loss as related to "the first crisis," "the second crisis," "the third crisis," and "the climate change crisis."

○ The development of forests reduce the total forest area, the area of highly natural forests, and the areas of different types of forests that characterize the region (the first crisis).

○ The underuse and lack of management of secondary forests resulting from reduced human activities degrade the quality of secondary forests as ecosystems (the second crisis). Conversely, abandoned secondary forests sometimes shift toward natural forests through vegetation succession.

○ The introduction of alien species (the third crisis) and the effects of global warming (the climate change crisis) degrade the scale and quality of forest and mountain systems.

Assessment by the Indicator

○ While the total area of forests is maintained, the area of highly natural forests (natural forests and secondary forests) is on a downward trend.

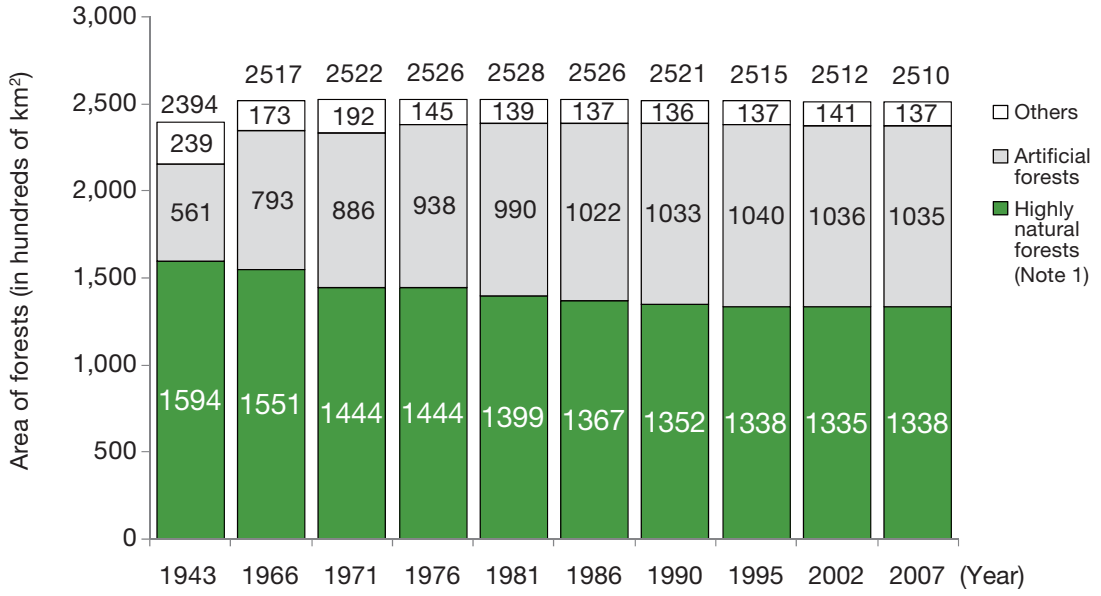
○ As for "the first crisis," while nationwide development pressure is currently reduced, small-scale or local development continues. In the long run, the declining quality of ecosystems in secondary forests and artificial forests caused by "the second crisis" will raise concerns.

*1 (See Table III-1): Please note that the scale of natural forests during the first half of the assessment period may indicate different trends from the overall assessment.

Reason of the Assessment

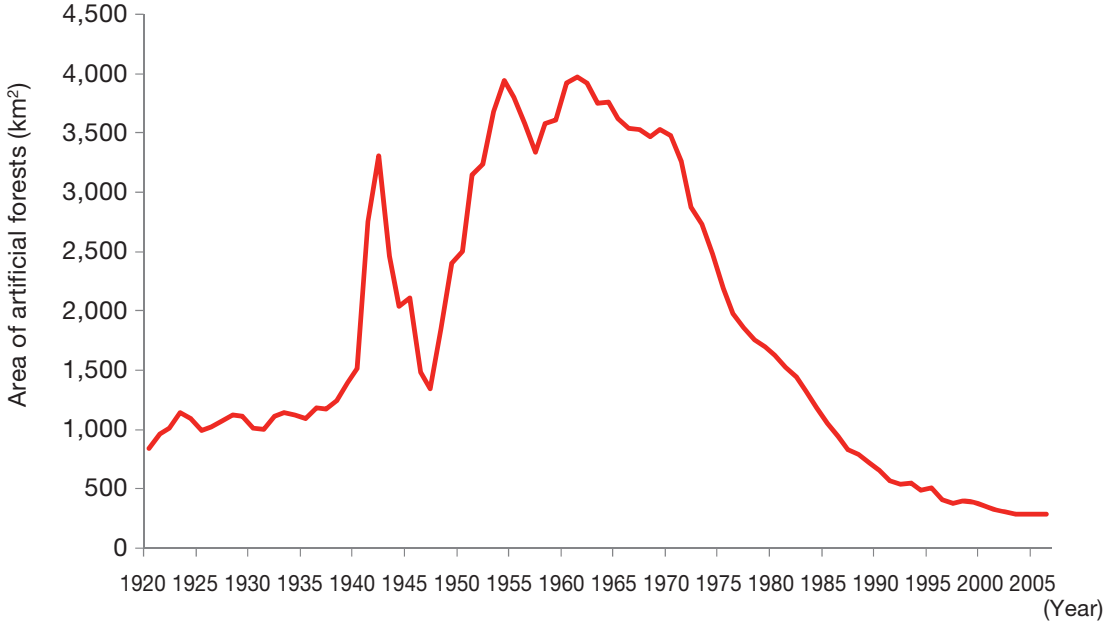
<Alteration of Highly Natural Forests>

Forests in Japan account for an area of approximately 250,000 km^2 or about 67% of Japan's total land area. The forest area in 1966 (during the first half of the assessment period) increased from that in 1943 (before the assessment period), and has been maintained through the rest of the assessment period, while the area of highly natural forests (natural forests and secondary forests) tended to decrease significantly from 1943 through the 1980s (Data 15- ① : Figure III-1). One reason for this decline is that the demand for timber increased immediately after World War II, leading to large-scale deforestation, followed by expanded forestation of such single species as cedar and Japanese cypress (Data 15- ② : Figure III-2). In addition, during the high economic growth period of the 1960s and the bubble economy of the second half of 1980s, forests decreased in area through conversion into farmland, housing areas, factories, and leisure facilities. (Data 1- ⑦ : Appendix). In western Japan where forests have been largely altered throughout history, only small portions of natural forests (evergreen broadleaf forests) remain, and the effects of these changes on some rare species dependent on secondary forests in the plains are indicated.[1)]



Note 1: Highly natural forests exclude artificial forests and include natural/secondary forests.
Source: Forestry Agency, Forest Resource Monitoring Survey, and Forestry Agency, Annual Survey on Land Area of Forests

Figure III-1 Transition of forest area (highly natural forests/artificial forests) (Data 15-①)



Source: Statistics Bureau, Ministry of Internal Affairs and Communications, Summary of Japanese Long-term Statistics, and Forestry Agency, Handbook of Forest and Forestry

Figure III-2 Transition of artificial forest area (Data 15-②)

<Reduced Forest Management>

Since the 1960s, the production of firewood and charcoal has sharply decreased over the course of the energy revolution that converted the primary energy source to fossil fuels (Data 7- ③ : Figure II-12), and as a result, many secondary forests lost economic value and were left unattended.

Decreased human activities transformed many secondary forests previously used as firewood forests and which had bright forest floors into dark areas with a dense growth of bamboo grass and littered with old trees and dead bamboo. It has been noted that the declining quality of secondary forests due to reduced proper management degraded the quality of living environments for organisms that comprise forest and mountain systems.[2)]

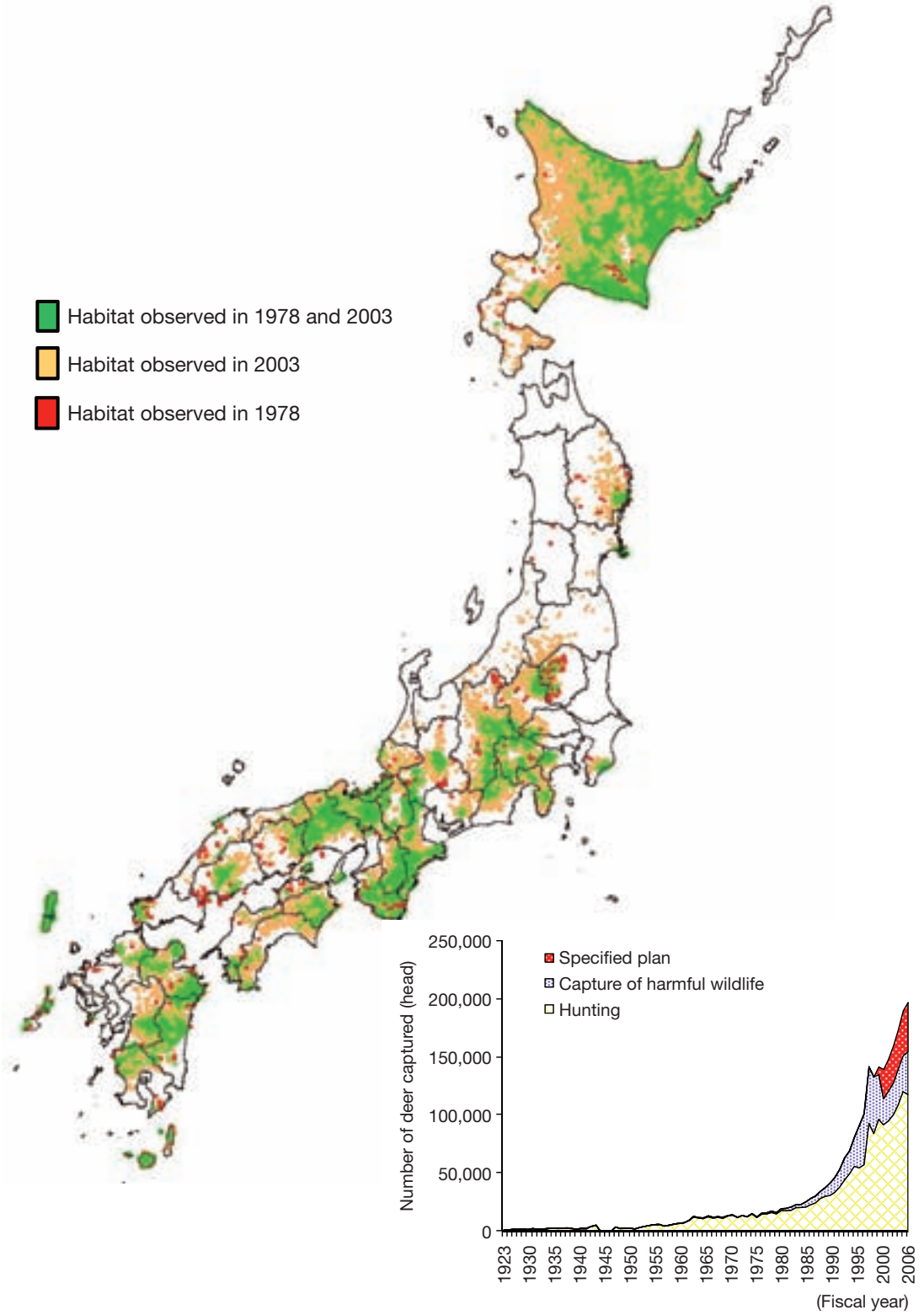
<Damage to Vegetation by Japanese Deer>

The 5-km meshes of Japanese deer distribution increased substantially from 4,220 meshes in 1978 to 7,344 in 2003 (Data 15- ③ : Figure III-3). Lower deer hunting pressure due to fewer and aging hunters, and the declining in death rates in winter attributed to less winter precipitation are cited as reasons for this increase.[3)] The rapid increases in deer population and distribution have caused overpressure through deer feeding on understory vegetation and trees (bark) in natural forests,[4)] and the same kind of impact has been indicated on artificial forests and farmland, as well as on moorland vegetation and alpine vegetation.[5),6)] Moreover, the expansion of deer distribution and their increased concentrations are considered to be a factors in soil runoff and the destruction of slopes,[7),8)] thereby inhibiting reforestation and disturbing forest and mountain systems,[9),10)] and resulting in significant nationwide loss.

BOX 6 Effect of Japanese deer on vegetation, and related measures

Though there was once concern over the possible extinction of Japanese deer, the nationwide population of Japanese deer has grown significantly in recent years. This population growth now poses the problem of devastation by deer feeding on forest-floor vegetation in many areas.

For example, deer in the Tanzawa area of Kanagawa Prefecture began causing damage in the 1980s. Since the 1990s, bamboo grass on the forest floor in high-elevation natural forest areas disappeared and such plants as Culver's physic have become endangered species. Therefore, comprehensive environment research was conducted in the 1990s and 2000s, along with such nature restoration measures as controlled hunting to adjust deer populations and constructing fences in certain areas to prevent the intrusion of deer. Thanks to such measures, endangered species such as the wheel lily have been restored within the fences in some areas.



Note 1: The year indicates the fiscal year when research was conducted and does not necessarily reflect the actual situation of that year. "1978" refers to data from FY 1978 research; "2003" refers to data from FY 2000-2004 research.
Source: Environment Agency, 2nd Animal Distribution Survey of National Survey on the Natural Environment; Ministry of the Environment, Biodiversity Survey (Mammal Distribution Survey), 6th National Survey on the Natural Environment; Forestry Agency, Environment Agency, and Ministry of the Environment, Statistics for Birds and Animals

Figure III-3 Changes in the distribution of Japanese deer, and transition in number of deer captured (Data 15-③)

<Damage Caused by Forest Pests>

It has been shown that the aging of secondary forests and the neglect of deadwood resulting from reduced use and management could expand the damage caused by oak wilt disease, which is induced by the fungus Raffaelea quercivora spread by the Ambrosia beetle (*Platypus quercivorus*), and pine wilt disease, which is induced by the forest pest Bursaphelenchus xylophilus (Steiner & Buhrer) Nickle that was unintentionally introduced from North America in the early 1900s.[11] Damage caused by pine wilt disease sharply increased after 1950, especially around 1980. Although less damage has occurred since the second half of 1980s, the level of damage remains higher than that before 1980 (Data 15- ④ : Appendix). It has also been indicated that global warming is influencing the growing damage caused by forest pests, causing infected vector insects to invade already temperate areas, and expanding potentially dangerous zones for pine wilt disease in cold regions.[12] For example, about 70% of the damage caused by Bursaphelenchus xylophilus (Steiner & Buhrer) Nickle occurred in western Japan in 1980, but damage in the Tohoku and Hokuriku regions has been increasing ever since 1985 (Data 15- ④ : Appendix).

<Global Warming>

The effects of global warming on forest and mountain systems in mountainous regions are raising concerns. The expanded distribution of organisms from low-elevation areas to high mountain areas, the reduction and deterioration of cool-temperate natural forests such as beech forests and of alpine vegetation in low-altitude mountainous regions or at lower latitudes, and the impact on species characteristic of high mountainous regions are especially of great concern.[13),14)]

Indicator 16 Continuity of forest and mountain systems

Explanation of the Indicator

○ For both highly natural forests (natural forests/secondary forests) and artificial forests, the fragmentation of forests caused by development prevents the migration and interaction of living organisms thriving in forests by reducing continuity. Therefore, the continuity of forest and mountain systems is an indicator that mainly represents the status of biodiversity loss as related to "the first crisis."

Assessment by the Indicator

○ Forests along the rim of mountainous backbones are currently fragmented by other uses of land.

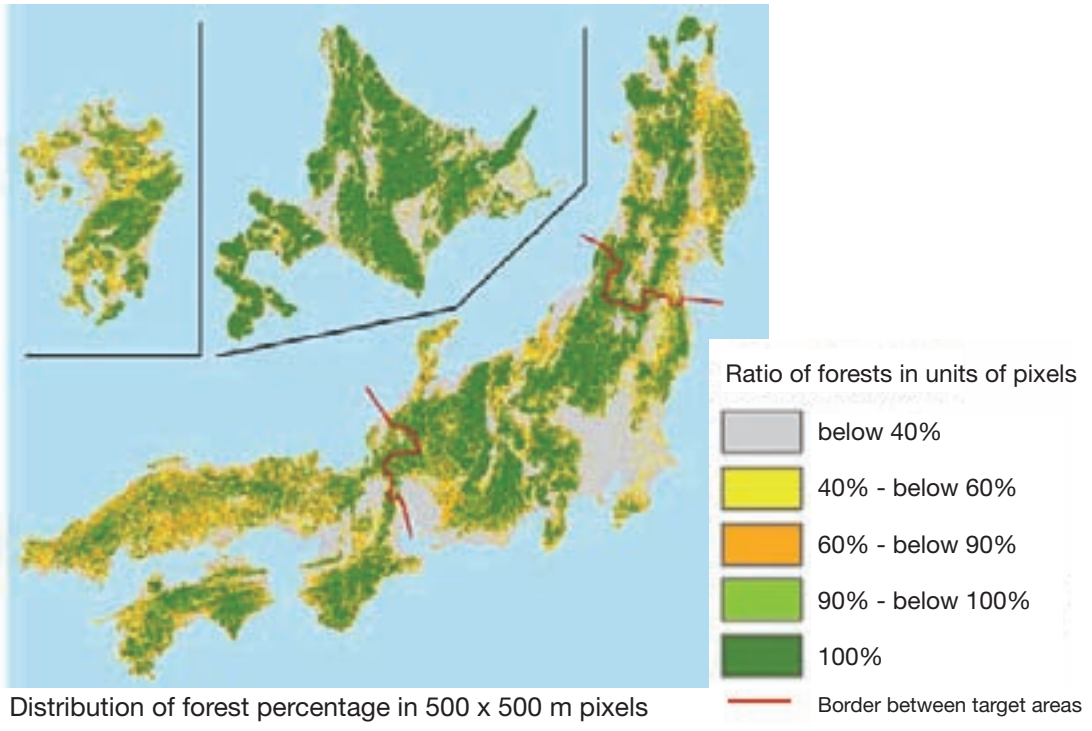
○ Despite the lack of long-term data on trends of this indicator, said continuity is estimated to be on a downward trend. Because development pressure has decreased nationwide, this downward trend may have been alleviated.

Reason of the Assessment

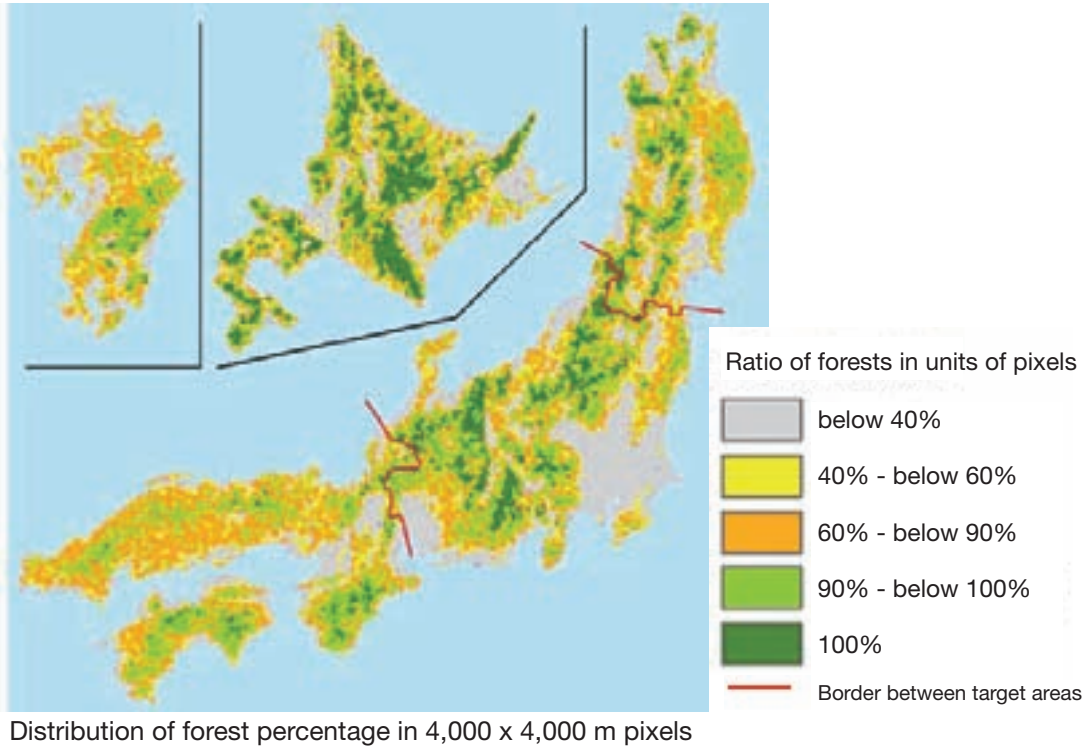
Because the reduced continuity of forests prevents the migration and interaction of living organisms, its effect on biodiversity has been of great concern.

At present, there are relatively continuous forests along mountainous backbones that are surrounded by forests fragmented by other land uses such as farmland, urban areas and roads. The degrees of fragmentation are low in the Hokkaido, Tohoku and Chubu regions, and high in the Kansai, Chugoku and Kyushu regions (Data 16- ① : Figure III-4).

Although the fragmentation process has been considered slowed somewhat due to less development pressure, the progress of deforestation and large-scale replacement by rapidly growing artificial forests has fragmented highly natural forests since the high economic growth period.[1),17)]



Distribution of forest percentage in 500 x 500 m pixels



Distribution of forest percentage in 4,000 x 4,000 m pixels

The figures above are created by dividing the total area of the country into square pieces called "pixels" and coloring each pixel according to each area's percentage of forest cover. The lower the degree of forest fragmentation, the higher the forest percentage per remaining pixel after pixel enlargement.
Source: Forestry Agency, 2009: Report on the Analysis of Dynamic Change with Forest Resource Assessment Data

Figure III-4 Status of forest fragmentation (Data 16-①)

Indicator 17 Populations and distributions of species living in forest and mountain systems

Explanation of the Indicator

○ The populations and distributions of species living in forest and mountain systems are an indicator representing the status of biodiversity loss as related to "the first crisis," "the second crisis," "the third crisis," and "the climate change crisis."

○ The reduction and fragmentation of forests caused by development (the first crisis), direct exploitation of wildlife such as capturing and gathering (the first crisis, etc), the degradation of ecosystem quality resulting from reduced human activities (the second crisis, etc), and the impact of alien species (the third crisis) reduce the population and distribution range of wildlife species living in forests.

Assessment by the Indicator

○ In some regions and for certain taxonomic groups, the populations or distributions of species living in forests are declining.

*2 (See Table III-1.): Note that there are different trends depending on taxonomic groups and species, and different data from those of the overall assessment on the degree of biodiversity loss and related trends.

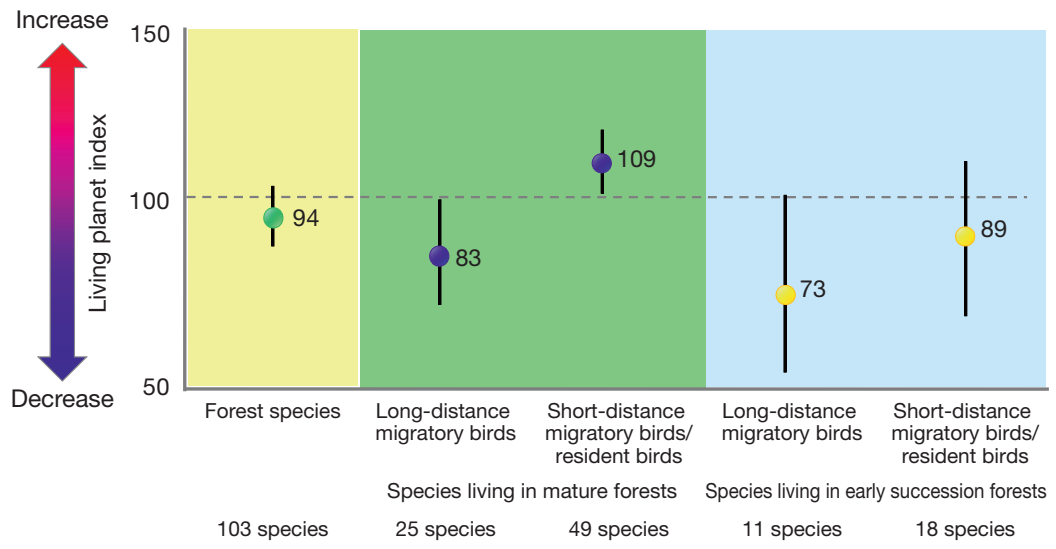
Reason of the Assessment

<Changes Resulting from the Reduction and Fragmentation of Forests>

The reduction, change in quality, and fragmentation of highly natural forests (natural forests and secondary forests) are among the factors that influence the composition, distributions, and populations of species of fauna living in the forest.[18),19),20)]. For example, during the high economic growth period (in the first half of the assessment period), the reduction of large-diameter trees and the simplification of tree species resulting from the deforestation of highly natural forests (natural forests and secondary forests) have been shown to cause a decrease of forests species using natural tree hollows,[1),21)] and plant species such as epiphytic plants and forest floor moss thriving in natural forests.[22)] Brown bears and black bears, which need large habitats, have been expanding their distribution range in the Hokkaido and Tohoku regions since the 1980s, while in some parts of the Kii Peninsula and in Shikoku where populations are isolated by artificial forests, bear populations have become endangered (Data 17- ① : Appendix). Although development pressure had decreased by the second half of the assessment period, there are still concerns about the isolation and restricted migration,[23)] declining reproduction rates, and the loss of genetic diversity among forest species due to the reduction and fragmentation of highly natural forests (natural forests and secondary forests), such as broadleaf deciduous forests that are suitable habitats for these species.[24)]

<Changes Caused by Infrequent Use of Forests>

It has been shown that environmental changes in secondary forests and artificial forests resulting from reduced use and management influence the distribution of species living in those forests.[25),26), 27)] For example, the changing distribution range of forest bird species from 1997 to 2002 relative to the figure in 1978 represented by the "Living Planet Index" (LPI)[28)] suggests a marked decrease in the distribution range of species that live in an early succession environment (Data 17- ② : Figure III-5). The distribution range of species that migrate from abroad (such as from Southeast Asia) also shows a downward trend (Data 17- ②). Moreover, it has been shown that the discontinuation of regular logging and replanting have influenced the reproduction of Golden eagles.[29)]



The distribution in 1978 is indicated as a reference point in "index 100." LPI indicates the relative rate of change from the reference point. Modification by Yamamura et al. 2009
Source:

Figure III-5 Living Planet Index (LPI)
Changes in the distribution range of bird species from 1997 to 2002 relative to 1978 (Data 17-②)

<Effects of Overexploitation and Illegal Digging of Species for Ornamental Use>

As the level of people's living has improved since the high economic growth period, the demands for pets and gardening have rapidly increased, resulting in the overexploitation and illegal digging of some forest species such as rare species (insects and orchid species) for ornamental use.

<Effects on Mountainous Regions>

The progress of removing vegetation from along climbing trails on some mountains used for mountaineering, and the effects of growing deer populations on alpine vegetation have been indicated,[5), 6)] while it is believed that alpine vegetation could change into forests as a result of the complex effects of global warming, such as rising temperatures and changes in rainfall levels.

BOX 7 Measures for removing vegetation from mountain trails—Overhaul of mountain trails in Daisetsuzan

Given the boom to visit "Japan's 100 famous mountains" since the 1990s, mountaineers have rushed to selected famous mountains, leading to soil erosion on mountain trails and the destruction or loss of surrounding vegetation. Moreover, after mountain trails were improved to deal with the concentration of mountaineers and prevent the trails from becoming ruined, some trails were criticized as being overly improved and unsuited to surrounding landscapes. In response to this situation, the Ministry of the Environment established the "Review Conference on the Well-being of Mountain Trails" from FY 1999 to FY 2001, and considered ways to classify the levels of maintaining and managing mountain trails, as well as environmentally friendly measures for trail maintenance. Consequently, in Daisetsuzan National Park, for example, standards have been established for mountain trail management by using ROS (Recreation Opportunity Spectrum)* (a recreation management tool) and mountain trails are now being maintained by using a nature-oriented construction method (traditional stone masonry).

Maintenance of mountain trails using a nature-oriented construction method

*ROS: A framework for designing and managing recreational space in which areas are classified according to the quality of space, taking into account the visitors' recreational experience, and setting management goals for each area.[30)]

Indicator 18 Use and maintenance of artificial forests

Explanation of the Indicator

○ The reduced use and lack of management for artificial forests brought about by reduced human activities lower the quality of ecosystems and have negative impacts on the status of biological resources in forests (the second crisis). Therefore, the status of the use and management of artificial forests can been regarded as an indicator that represents the status of biodiversity loss as related to "the second crisis" in forest and mountain systems.

Assessment by the Indicator

○ The reduced use and lack of management for forest resources in artificial forests following expanded forestation might have led to the reduced quality of these ecosystems.

Reason of the Assessment

<Stagnant Forestry Production Activities>

The forest wood biomass—the volume of wood in forests—doubled from about 1.89 billion m^3 in the 1960s to about 4.04 billion m^3 today due to more artificial forests (Data 15- ② : Figure III-2, 18- ① : Appendix). The reason for the increase in forest biomass through the second half of the assessment period is that while the growth rates of trees in artificial forests are high, the consumption of wood produced in domestic secondary forests and artificial forests began to decrease when wood imports were liberalized in 1960, and imports of wood from foreign countries have subsequently met domestic demand.

At the beginning of the assessment period (in the second half of 1950s), the demand for building materials increased along with high economic growth, leading to the large-scale deforestation of domestic coniferous forests and broadleaf forests, and the self-sufficiency rate of industrial wood rose as high as about 90% (Data 18- ② : Appendix). However, after the import liberalization in the 1960s, wood imports sharply increased, stabilizing between about 600 to 900 million m^3 since the second half of 1980s (Data 18- ② : Appendix). Both the self-sufficiency rate of industrial wood and the production of wood materials have dropped sharply since the 1960s to about 20% and about 50%, respectively, after the second half of 1990s (Data 18- ② : Appendix). Conversely, the diminishing of forests among Japan's wood import trading partners is indicated as a problem (Data 18- ③ : Appendix), as well as the negative impacts of deforestation and distribution of materials logged illegally in the forest and mountain systems of wood exporting nations.[31)]

With domestic forest biomass increasing, artificial forests in an age class requiring such maintenance tasks as thinning, planting and clearing underbrush have been increasing; however, forestry work such as thinning is considered insufficient.[32)] The abandoned management of artificial forests is believed to have resulted in deteriorated understory vegetation and fewer habitats for plant-eating species and species adapted to open lands.[32)] The lower profitability of the forestry industry is cited as the reason for reduced management.[32)] In recent years, as part of forest protection projects including the conservation of biodiversity, such projects as the "National Movement for Fostering Beautiful Forests" aimed at thinning 33,000 km^2 of forests in six years and creating diverse forests have been promoted since FY 2007, and an area of approximately 5,210 km^2 was subjected to thinning in FY 2007.

3. Measures for Loss

In forests, the strengthening of conservation efforts by designating and managing conservation areas, taking measures for establishing ecological networks to ensure the continuity of forests, conducting forestry operations, and fostering efforts focused on forests as wildlife habitats have been successful to some extent. However, it is apparently necessary to further strengthen efforts to enhance measures for restoring the lower level of forest management.

<Conservation Areas in Forests>

For forest and mountain systems in Japan, some conservation efforts have been in progress since the 1960s, particularly in forests with especially high naturalness, such as those distributed in mountainous backbones. In addition, nature restoration projects in such forests as on the Moriyoshi submontane plateau in Akita Prefecture and Odaigahara on the Kii Peninsula, and efforts to ensure the continuity of forests such as establishing ecological networks connecting fragmented forests, including "Green Corridors" in national forests, have been under way. On the other hand, such secondary forests as in Satochi-Satoyama areas and some highly natural forests that cover most of the northern part of Okinawa's main island and the evergreen broadleaf forests on the island of Amami Oshima are not designated as conservation areas.

<Conservation and Management of Organisms Living in Forests>

For some forest-living species whose living conditions are of concern, hunting is being regulated and efforts are being fostered under the Wildlife Protection and Hunting Law and the Law for the Conservation of Endangered Species of Wild Fauna and Flora. Moreover, to prevent damage to forests by overpopulated species, population control is being implemented by capturing wildlife and protective facilities are being installed.

<Consideration of Biodiversity and Sustainable Use>

In addition to establishing forest reserves and green corridors, operations considering the living environment for wild plants and animals are being promoted under the management of national forests. Moreover, forestry technology and forest operations that give consideration to ecosystems and biodiversity are now being introduced. For example, in order for forests to fulfill diverse functions that include conserving biodiversity, forestry technologies that consider biodiversity, such as multi-tiered operations classified under the Basic Plan for Forest and Forestry, are being introduced, along with efforts to diversify forests, such as promoting thinning work, conversion to broadleaf forests and a longer rotation of forest management. In implementing these operations, such approaches as acquiring forest certification for forests with appropriate forest management and sustainable forest management have been taken (see BOX 8).

BOX 8 Forest certification system

The forest certification system is one in which independent third-party institutions standardize forest management, and then assess and verify whether the standards are met. The system helps forest environment conservation, benefits local societies, and certifies wood produced in an economically sustainable manner. Certified wood and wood products are labeled with the certifying authority's logo mark, and by widely distributing those goods, both forest managers and consumers who purchase goods with a certified logo mark indirectly contribute to forest conservation. According to the Forest Stewardship Council (FSC), the leading forest certification institution, 991 areas encompassing 1,156,056 km^2 in 82 countries worldwide have acquired forest management certificates from the Council as of September 2009. In Japan, 32 forest areas encompassing 3,667 km^2 have acquired forest management certificates as of March 2010.

(Source: Forest Stewardship Council, 2010: The State of FM Certification in Japan; Forest Stewardship Council, 2010: The State of Certification Worldwide. http://www.forsta.or.jp/fsc/)

<Revitalizing Forestry and Mountain Villages>

In order to deal with lower management standards resulting from discontinued forestry production activities by revitalizing forestry and mountain villages, efforts are being made to promote the use of domestic wood, secure new workers, enhance interactions between cities and mountain villages, and promote new settlements. More local governments have begun introducing water resource and forest environment taxes for promoting thinning work and other tasks related to artificial-forest management and ecosystem conservation.

<Surveys and Enhanced Information on Forest and Mountain Systems>

The National Survey on the Natural Environment and other surveys have supported research efforts and provided sufficient information on forests and high mountain areas. The research sites dubbed "forest and grassland" and "alpine regions" of the "Monitoring Site 1000" project, which conducts long-term monitoring of representative ecosystems in Japan, have begun gathering data on an ongoing basis.

References

1) Yasuda, M., 2007: Threatened arboreal squirrels in Kyushu, southwestern Japan: Mammalian Science, 47, 195-206.
2) Maeto, K. and H. Makihara, 1999: Changes in Insect Assemblages with Secondary Succession of Temperate Deciduous Forests after Clear-cutting, Japanese Journal of Entomology New Series, 2, 11-26.
3) Li, Y., N. Maruyama, M. Koganezawa, and N. Kanzaki, 1996: Range expansion of Sika dear in Nikko in relation to global warming, Wildlife Conservation Japan, 2, 23-35.
4) Nagata, K., 2005: Home Range Characteristic of Sika Deer in Fudakake of Tanzawa Mountains, Mammalian Science, 45, 25-33.
5) Chubu Regional Forest Office, 2007: Survey Report on Deer Damage in Protected Forests of the Southern Alps (FY 2006), 109pp.
6) Chubu Regional Forest Office, 2008: Survey Report on Deer Damage in Protected Forests of the Southern Alps (FY 2007), 101pp.
7) Koizumi, T., T. Yabe, and S. Inoue, 2006: Effects of Deer Feeding on Changes of Sasamorpha borealis, Kyushu Forest Studies, 59, 90-93.
8) Wakahara, T., Y. Ishikawa, K. Shiraki, H. Toda, T. Miya, F. Kataoka, M. Suzuki, and Y. Uchiyama, 2008: Seasonal Changes in the Amount of Litter Layer and Soil Erosion on the Forest Floor – An Impoverished Understory by Deer Impact at Doudaira, Tanzawa Mountains, Journal of the Japanese Forest Society, 90, 378-385.
9) Takatsuki, S. and T. Gorai, 1994: Effects of Sika deer on the regeneration of a Fagus crenata forest on Kinkazan Island, northern Japan, Ecological Research, 9, 115-120.
10) Tsujino, R. and T. Yumoto, 2004: Effects of sika deer on tree seedlings in a warm temperate forest on Yakushima Island, Japan, Ecological Research, 19, 291-300.
11) Fukuda, K., 2008: Frontiers of research and prevention of Japanese oak wilt, Forestry Technology, 790, 36-37.
12) Fujita, K., 2005: Effects of global warming on the prevalence of pine wilt disease, Forestry and Forest Products Research Institute Research Information, 4, 1-6.
13) Nakamura, H., 2007: Rock Ptarmigan Lagopus mutus japonicus. Japanese Journal of Ornithology, 56, 93-114.
14) Tanaka, N., T. Yagihashi, H. Sugita, K. Fujita, T. Hayashi, and H. Togeta, 2003: Effects on forest and mountain systems and forest management, Heredity, 17, 109-118.
15) Miyamoto, A. and S. Makoto, 2008: The influence of forest management on landscape structure in the cool-temperate forest region of central Japan. Landscape and Urban Planning, 86, 248-256.
16) Saion, T., S. Yoshida, and M. Imada, 2000: Changes in the Distribution of Fir and Hemlock Forests in the Kirishima Mountains, Kyushu Branch of the Japanese Forest Society, 53, 17-19.

17) Nagaike, T. and T. Kamitani, 1999: Factors affecting changes in landscape diversity in rural areas of the Fagus crenata forest region of central Japan, Landscape and Urban Planning, 43, 209-216.
18) Yamaura, Y., S. Ikeno, M. Sano, K. Okabe, and K. Ozaki, 2009: Bird responses to broad-leaved forest patch area in a plantation landscape across seasons, Biological Conservation, 142, 2155-2165.
19) Iida, S. and T. Nakashizuka, 1995: Forest fragmentation and its effect on species diversity in suburban coppice forests in Japan, Forest Ecology and Management, 73, 197-210.
20) Yamaura, Y., 2007: Mitigating effects of broadleaved forest fragmentation on birds: proposal of plantation matrix management, Japanese Forest Society, 89, 416-430.
21) Yasui, S., T. Kamijo, M. Shigeta, and Y. Sato, 2000: Distribution of the Ikonnikov's Whiskered Bat, Myotis ikonnikovi OGNEV and Its Relationship to the Habitat Type in Tochigi Prefecture, Japan, Mammalian Science, 40, 155-165.
22) Environment Agency, 2000: Revised List of Endangered and Threatened Species in Japan - Red Data Book-9 (Plants II other than vascular plants), Japan Wildlife Research Center.
23) Ise, H. and H. Mitsuhashi, 2006: Habitat evaluation of the tree frog and its application for conservation planning in Japan, Ecology and Civil Engineering, 8, 221-232.
24) Yamane, A,, 1999: Genetic process of extinction in mammals, Mammalian Science, 39, 45-53.
25) Okubo, S., A. Kamiyama, T. Kitagawa, and K. Takeuchi, 2003: Plant Species Composition of the Herbaceous Layer of Secondary Woodlands and their Verges in Relation to Micro-scale Landform in the Tama Hills, journal of the Japanese Institute of Landscape Architecture, 66, 537-542.
26) Yamaura, Y., K. Katoh, G. Fujita, and H. Higuchi, 2005: The effect of landscape contexts on wintering bird communities in rural Japan, Forest Ecology and Management, 216,187-200.
27) Maeto, K. and H. Makihara, 1999: Changes in Insect Assemblages with Secondary Succession of Temperate Deciduous Forests after Clear-cutting, Japanese Journal of Entomology, New Series, 2, 11-26.
28) Loh, J., R. E. Green, T. Ricketts, J. Lamoreux, M. Jenkins, V. Kapos, and J. Randers, 2005: The Living Planet Index: using species population time series to track trends in biodiversity, Phil. Trans. R. Soc. B, 360, 289-295.
29) Yui, M., 2007: The Golden Eagle (Aquila chrysaetos) and forestry in the Kitakami Plateau, Japanese Journal of Ornithology, 56, 1-8.
30) Yamaki, K., J. Hirota, S. Ono, Y. Shoji, T. Tsuchiya, and K. Yamaguchi, 2003: A method for classifying recreation area in an alpine natural park using Recreation Opportunity Spectrum, Journal of the Japanese Forestry Society, 85, 55-62.
31) Hembery, R., A. Jenkins, G. White, and B. Richards, 2007: Illegal logging: Cut it Out, WWF-UK.
32) Committee on Promote Policy of Conservation and Sustainable Use of Biodiversity in Forests, 2009: Promotion Policy of Conservation and Sustainable Use of Biodiversity in Forests, Forestry Agency.

Section 2 Assessment of Cultivated Systems

This section assesses the degrees and trends of biodiversity loss in cultivated systems during the assessment period (from the second half of 1950s to the present) by using three indicators, as well as assessing the measures for biodiversity loss.

1. Assessment of Biodiversity Loss in Cultivated systems

○ Losses occurred in cultivated systems during the assessment period from the second half of 1950s to the present and are likely to deteriorate on a long-term basis.

○ The development of residential land mostly in the first half of the assessment period, as well as changes in agriculture and agricultural methods, contributed to a smaller scale and lower quality of cultivated systems. [First crisis]

○ The reduced use of fields, mostly in the first half of the assessment period, as well as less use of agricultural land, mostly in the second half of the assessment period, contributed to a smaller scale and lower quality of cultivated systems. [Second crisis]

○ Presently, there is less impact of development on cultivated systems, as well as changes in agriculture and agricultural methods due to changes in the socioeconomic situation, but an ongoing influence raises concerns. It is also concerned about the increasing influence of the lower use and control of agricultural land.

2. Reason of the Assessment

The table below lists the indicators of the status of biodiversity loss in cultivated systems and the assessment of each indicator:

Table III-2 Indicators and assessments representing the status of biodiversity loss in cultivated systems

	Indicator	Assessment		
		Long-term trend		Current loss and trend
		First half of the assessment period	Second half of the assessment period	
Indicators of cultivated systems	Indicator 19: Scale and quality of cultivated systems	↓	↘	↘ *1
	Indicator 20: Populations and distributions of species living in cultivated systems	↘	↘	↘ *2
	Indicator 21: Diversity of agricultural products and farm animals	↘	↘	↘

Note: The assessment is based on a comparison with the status of ecosystems at the beginning of the assessment period (in the second half of 1950s).

Legend

Subject of assessment	Legend			
Degree of loss	Not Lost	Not significantly lost	Lost	Significantly lost
	▒	■	■	■
Trend	Recovering	Same	Being lost	Being rapidly lost
	↗	→	↘	↓

Note: Some elements are ignored when visual signs are indicated.
Note: The dashed lines for assessing the degree of loss indicate insufficient data.
Note: "*" indicates that there are multiple factors and data related to the indicator in question, as well as existing factors and data showing trends that differ from current assessments of the degrees, effects, and trends of overall loss.
*1: Refer to the assessment of Indicator 19
*2: Refer to the assessment of Indicator 20

Indicator 19 Scale and quality of cultivated systems

Explanation of the Indicator

○ The scale and quality of cultivated systems are an indicator that mainly represents the status of biodiversity loss as related to "the first crisis," "the second crisis," and "the third crisis."

○ The development of farmland and grassland that comprise cultivated systems reduces the scale of cultivated systems. The deterioration of water quality in irrigation ponds and channels degrades the quality of cultivated systems (the first crisis).

○ Reduced human activities in cultivated systems decrease the scale and quality of ecosystem components, such as farmland and grassland that make up the mosaic landscape (the second crisis).

Assessment by the Indicator

○ Over the long term, this indicator has been on a downward trend due to the development of housing land, reduced area of farmland and grassland caused by underuse, and changes in agriculture and farming methods. As for "the first crisis," while nationwide development pressure is currently reduced, small-scale or local development continues. The declining quality of farmland and nearby secondary forests in Satochi-Satoyama areas due to reduced management is of concern, though such trend is not often applicable to Hokkaido, where the history of land use by humans is relatively short.

*1 (See Table III-2.): Keep in mind that the loss of biodiversity in irrigation ponds and channels—two components of cultivated systems—may be greater than that in the overall assessment.

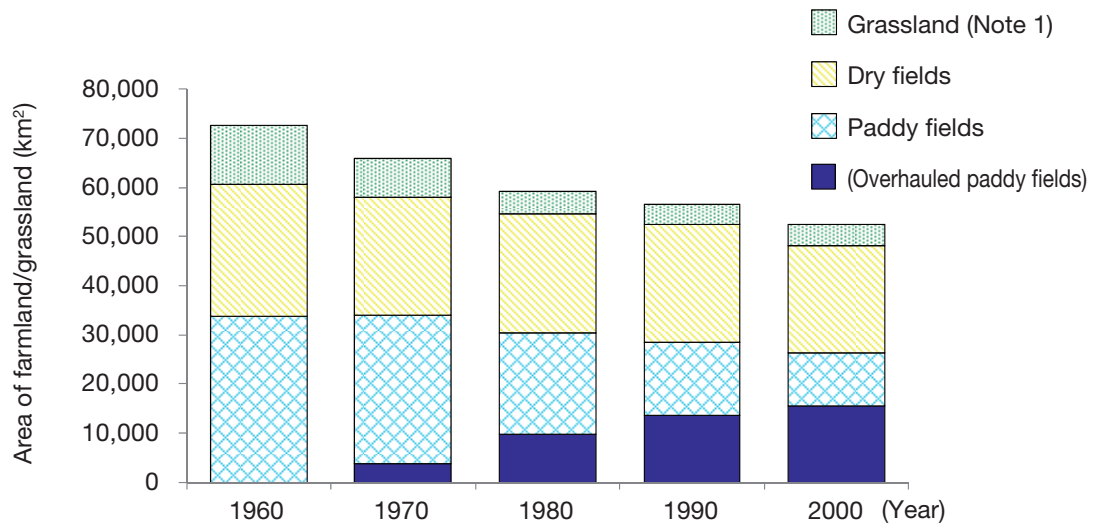
Reason of the Assessment

<Reduced Agricultural Land>

During the assessment period, the area of agricultural land significantly decreased. (Data 19- ① : Figure III-6, Appendix). The area of agricultural land totaled about 61,000 km^2 around 1960. Except in Hokkaido, however, the area of agricultural land, especially paddy fields, has continued to decrease and fell below 50,000 km^2 in the 2000s. Dry fields have also begun decreasing since the 1980s, and the area of farmland in Hokkaido has decreased since the 1990s. These decreases are attributed to the conversion of farmland into housing land and industrial sites during the high economic growth period and bubble economy period, and recent declines in the number of farmers and agricultural laborers.

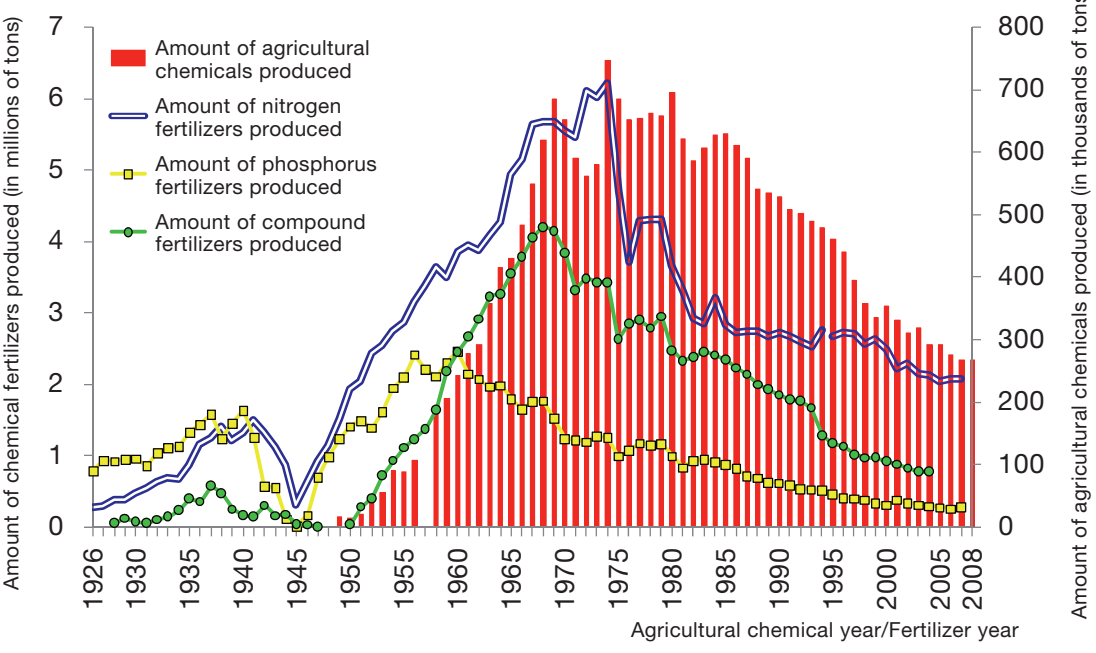
<Changes in Agriculture and Farming Methods>

Since the first half of the assessment period, farmland and irrigation channels have been overhauled for enhancing the economic efficiency of agricultural production. The area of overhauled paddy fields sharply increased particularly from the 1960s to the second half of 1970s, and the ratio of overhauled fields reached 60% in the 2000s. (Data 19- ② : Figure III-6, Appendix). More area has been overhauled in eastern Japan. It is indicated that said overhaul focused on economic efficiency has, for example, prevented living things from migrating freely in rivers, channels, irrigation ponds, and paddy fields,[1),2),3),4),5)] and the expansion of readjusted areas has reduced irrigation channels and damaged the diversity of growth environments,[1),3),6),7)] leading to fewer food sources for species on higher trophic levels.[8),9)] Moreover, the improper use of agrochemicals and fertilizers has influenced living things thriving on farmland and in surrounding areas. Although the production of such chemicals has decreased especially since the 1990s (Data 19- ③ : Figure III-7), the effects are still of concern.[10)]



Note 1: For grassland, the values of vegetated areas (wild grasslands) other than forests in the forestry census (2003) are used. Wild grasslands other than forests (including permanent pastures, degenerated pastures and abandoned areas turned into wild grassland) and bushes are included. Riverbeds, field ridges, banks, roadsides and golf courses are not included even though vegetated.
Source: Ministry of Agriculture, Forestry and Fisheries: Statistics on Cultivated Land and Planted Area, Forestry Census Cumulative Statistics (1960-2000), Census of Agriculture and Forestry, Land Use and Infrastructure Survey, Statistical Survey of Agricultural Land Construction Services

Figure III-6 Changes in the area of farmland and grassland (Data 19-①, 19-②, 19-④)



Note 1: Data on the amount of nitrogen fertilizers produced in FY 1994 and FY 1995 are not continuous due to changes in statistics.
Source: Agriculture, Forestry and Fisheries Productivity Conference, Japan Agricultural Statistics. Japan Plant Protection Association, Handbook of Agricultural chemicals. Ministry of Agriculture, Forestry and Fisheries, Handbook of Fertilizers

Figure III-7 Transition in the production of agricultural chemicals and chemical fertilizers (Data 19-③)

<Reduced Use of Agricultural Land Areas>

Throughout the assessment period, the loss of mosaic environments due to the degraded quality and smaller scale of cultivated systems caused by the reduced use of ecosystem components, such as paddy fields and dry fields, channels and irrigation ponds, forests for agriculture, and pastures and grasslands, has been of great concern.[11] (Refer to the column "Mosaic Ecosystems in Satochi-Satoyama Areas.")

It has been shown that secondary forests (used for agriculture) surrounding farmland, which had been previously used for gathering manure, are longer being used due to the widespread use of chemical fertilizers since the first half of the assessment period.[12]

Though grasslands are estimated to have encompassed 25,000 to 45,000 km^2 of area in the early 20th century,[13] it had dropped sharply to about 12,000 km^2 by the 1960s (in the first half of the assessment period), and to about 4,000 km^2 by the 1980s, (Data 19- ④ : Appendix).

It is indicated that grasslands decreased due to the use of secondary grasslands (Japanese silver grass, daylily, etc) for roofing, and grazing decreased mainly due to changes in agriculture and farming methods during the first half of the assessment period. The use of oxen in agriculture significantly decreased from the 1950s through the 1960s (Data 7- ④ : Appendix).

By the second half of the assessment period, the use of farmland had decreased and abandoned arable land increased (Data 7- ② : Figure II-13).

Irrigation ponds are relatively small and regularly churned by water reduction and drainage for agricultural use; therefore, these ponds are important habitats for waterweeds and aquatic insects.[11] The number of irrigation ponds decreased by about 100,000 (about 25%) from the 1950s through the second half of 1980s (Data 19- ⑤ : Appendix). The effects of eutrophication of water and at the bottom of irrigation ponds are also indicated.[15]

Column: Mosaic Ecosystem in Satochi-Satoyama Areas

Before the development of modern civil engineering, paddy fields were developed in river valleys and alluvial floodplains by taking advantage of natural conditions. In Japan—a country blessed by a variety of land features and abundant precipitation—many large and small ponds, wetlands such as temporary pools, and clear spaces were formed on floodplains, with diverse environments being maintained. When paddy fields were created, fish, aquatic insects, and aquatic plants expanded their habitats to paddy fields, irrigation ponds, and channels. On floodplains, there were lakeside forests and wet grasslands along with stagnant water zones.

After rice farming became an important vocation, irrigation ponds and channels for water as well as brush and grasslands (*yama*), many of which were managed as common lands and used for fertilizers, fuel and timber, were created around paddy fields and dry fields (*nora*) where there were complex cultivated systems consisting of diverse environments. In some cases, sets of environmental components on floodplains were managed and used, while in other cases, forests on hillsides and Japanese pampas grass fields were managed and used as *yama*. As for the development of new paddy fields on flat land, fields, grasslands, and forest areas were sometimes allocated for each household in geometrical plotting. Despite great variations, the landscapes of Satochi-Satoyama areas are characterized by mosaic land use, in which there are forests, grasslands and irrigation ponds near settlements, and farmland for securing plant and water resources necessary for rice-farming agriculture and daily life. Satochi-Satoyama areas are complex mosaic ecosystems of appropriate scale for supplying necessary resources for humans, and are expected to offer great diversity among habitats. Given the abundant environments where forests are close to grasslands and wetlands, including paddy fields, such dual dwellers as amphibians, dragonflies (whose larvae live in water and then live in forests as adults), and birds of prey that nest in forests and feed in grasslands and near paddy fields could thrive. These cultivated systems are significantly different from monoculture farmlands and forests that expanded since the beginning of the modern era, and highly suggestive for the sustainability of future agriculture and biodiversity. It has become increasingly apparent that monoculture works against the conservation and sustainable use of biodiversity, and in agricultural and environmental policy implemented in Europe, such efforts as erecting live fences and protecting grasslands have been made to ensure heterogeneity in cultivated systems by securing land use other than farming. For the development of plantations in tropical zones, leaving some natural forests intact is encouraged. In addition to Japanese Satochi-Satoyama areas, most other traditional cultivated systems consist of highly natural land use other than farmland, such as forests, wetlands, and grasslands, and have great space heterogeneity. The Satoyama index that takes such space heterogeneity into account shows relatively high ratings for East Asia including Japan, the coastal areas and small islands of Southeast Asia, the northern part of the Iberian Peninsula, Scotland, Eastern Europe, and the eastern part of North America. In contrast, the central plains of North America, India, and Australia have low ratings, and are known to have large monoculture farmlands. This index is shown to have a significant positive correlation with the presence of Gray-faced buzzards, the number of amphibian species, and the number of damselfly species. Washitani and Kadoya (unpublished)

(Izumi Washitani, Committee member)

Indicator 20 Populations and distributions of species living in cultivated systems

Explanation of the Indicator

○ Changes in the populations and distributions of wildlife plant and fauna species living in cultivated systems are an indicator representing the status of biodiversity loss as related to "the first crisis," "the second crisis," and "the third crisis" in cultivated systems.

○ The development of farmland and deterioration of water quality (the first crisis), reduced human activities (the second crisis), and the impact of alien species (the third crisis) reduce the populations and distributions of wildlife species living on farmland, in surrounding secondary forests, secondary grasslands, irrigation channels and ponds, and also degrade the biodiversity of species.

Assessment by the Indicator

○ As farmland and grassland areas have decreased, and agricultural and farming methods been changed, the populations and distributions of species living on agricultural land are believed to be on a downward trend in the long run. The situations for some species living in aquatic environments related to agriculture, such as paddy fields, irrigation channels and ponds, are thought to be particularly aggravated.

*2 (See Table III-2.) : Note that there are different trends depending on taxonomic groups and species, as well as data differing from those in the overall assessment of the degree of biodiversity loss and the trends thereof.

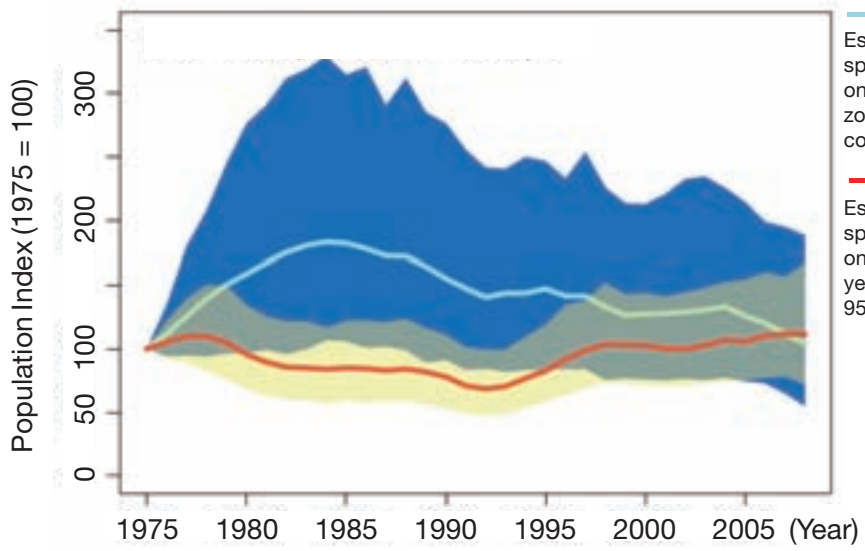
Reason of the Assessment

<Effects of Reduced Scale of Agricultural Land Areas and Changes in Agriculture and Farming Methods>

Following the reduced scale of agricultural land areas, changes in agriculture and farming methods, and development of artificial irrigation channels, the populations and distribution areas of species living on farmland and in surrounding areas have steadily decreased, and many species have become endangered in recent years.[2),16)] For example, there are fewer aquatic animals such as the *ayumodoki* (Kissing loach) moving freely about in paddy fields, channels and rivers, ,as well as fewer predators,[17)] amphibians such as the Daruma pond frog living at the water's edge,[18),19),20)] fauna and flora living in secondary grasslands, such as *okinagusa* (Pulsatilla cernua),[21),22)] aquatic insects living in irrigation ponds, such as the predaceous diving beetle,[23)] and aquatic plants such as *hitsujigusa* (Nymphaea tetragona).[24)] The effects of alien species invading irrigation ponds have also been reported.[7)]

Among the bird species using paddy fields as habitats, the populations of snipes and plovers during the autumn migration season have been decreasing from 1975 (in the second half of the assessment period) up to the present (Data 20- ① : Figure III-8). Changes in farming methods, farmland and channel improvements, and more abandoned arable lands are cited as reasons for these decreases. For example, fewer wet paddy fields where birds can feed during the migration season are considered to have an impact.

It is indicated that if alien species (introduced as one of the farming methods) begin to settle in fields and expand, indigenous species might be adversely affected. For example, competition between the Buff-tailed bumblebee (imported for the pollination of vegetables) and native species is believed to inhibit interaction between native species and plants.[25),26)]



The trends of the population index (each year's relative index to the figure in 1975 as 100) of species both more and less dependent on paddy fields, and species among snipes and plovers that come inland during the autumn migration. The index was calculated from a survey on snipes and plovers conducted by the Ministry of the Environment (1975-2008). The taxonomy of the species is based on literature. The estimated rate of increase in the total index of species more dependent on paddy fields has been significantly negative in the past 30 years.
Source: Amano T., K. Koyama, H. Amano, T. Székely, and W.J. Sutherland (unpublished)

Figure III-8 Trends of population of snipes and plovers that come inland during the autumn migration season (Data 20-①)

BOX 9 Are there fewer sparrows?

A flock of sparrows on a tree (Photo by Osamu Mikami)

In many areas, it has been shown that the number of sparrows (those familiar birds) may be declining. Studying the decline of the sparrow population based on quantitative and quantitative information such as that obtained from the "National Survey on the Natural Environment" (i.e., 2nd survey from 1974 to 1978, 6th survey from 1997 to 2002), the transitions of harmful animal control and bird hunting as studied by the Ministry of the Environment, and the transition of crop damage as studied by the Ministry of Agriculture, Forestry, and Fisheries yielded estimates of the sparrow population having dropped between 20% and 50% of that around 1990. It is also estimated that the sparrow population has dropped to 10% of that around 1960, though sufficient supporting data is lacking. Cited as possible reasons for this decline are changes in sparrow living environments, including fewer tree hollows and wooden buildings where sparrows nest, fewer empty lots and less grassland, the reduction and concentration of farmlands such as paddy fields, the decrease of sun-drying rice plants caused by changes in farming methods, and fewer fallen unhulled rice caused by the widespread use of combine harvesters. More studies are needed to determine the actual reasons for this decline in population.

(Source: Osamu Mikami, 2009: The decline in population of the Tree Sparrow Passer montanus in Japan, Japanese Journal of Ornithology, 58, 161-170)

<Increase and Expansion of Medium-size and Large Mammals>

Since the 1980s, the populations and distribution areas of medium-size and large mammals such as monkeys, deer and wild boars have increased due to decreased human activities in Satochi-Satoyama areas resulting from depopulation and the aging of farming and mountain village residents, the expansion of suitable habitats stemming from more abandoned cultivated areas, and lower hunting pressure because of fewer and aging hunters. The increase and expansion of medium-size and large mammals, along with the settlement and expansion of invading alien species such as raccoons, have not only influenced natural vegetation but also caused conflicts with humans, including agricultural damage.[27),28),29)]

Indicator 21 Diversity of agricultural products and farm animals

Explanation of the Indicator

○ Though it doesn't fall under "the first crisis," "the second crisis," "the third crisis" or "the climate change crisis," the diversity of agricultural products and farm animals is an indicator that represents the status of biodiversity in cultivated systems.

○ The reduction of local species that have long been cultivated in line with regional environmental characteristics impairs the diversity of species and genes as biological resources.

Assessment by the Indicator

○ Despite the lack of data that would directly indicate the disappearance of any native local species, some local cereal and vegetable species that had been customarily cultivated are no longer being cultivated and certain farm animals no longer being raised.

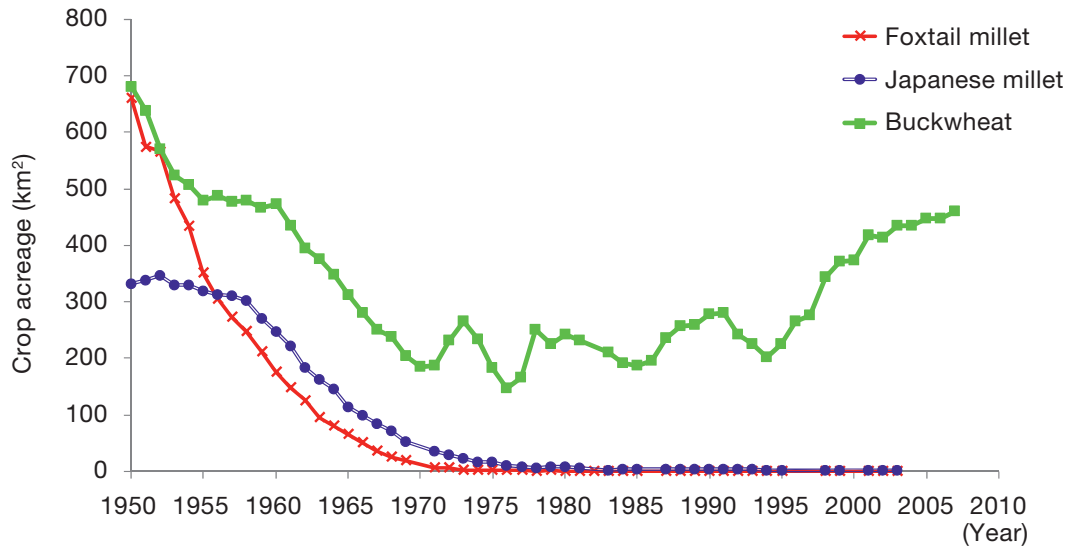
Reason of the Assessment

As productivity is improved and the variation of species declines, the numbers of native species of agricultural products, farm animals and poultry that have long been cultivated or bred have also declined. For example, the cultivation of such cereals as foxtail millets and Japanese millets using the traditional farming method of field burning has sharply declined due to fewer burnt fields from before the assessment period through the first half of the assessment period. In the 1950s when about 100 km^2 of burnt fields remained nationwide,[30] the cultivation area of foxtail millets and Japanese millets once totaled hundreds of square kilometers, but sharply decreased by around 1970, and the cultivation area of buckwheat temporarily declined by the 1970s (Data 21- ① : Figure III-9).

Horses are believed to have been introduced to Japan from the Eurasian continent during the Tumulus period, and until the Edo period had been utilized as draft animals for cultivation, transport, the production of manure, and as cavalry horses without significant selective breeding.[31] During the Meiji period, native breeds of Japanese horses were cross-bred with Western horses, and about 50 native breeds named after their local areas decreased and many disappeared. After World War II, fewer horses were used as draft animals due to the development of automobiles and the mechanization of farming.[31] It is believed that there were fewer than 100,000 domesticated horses in 2004, and about 86,000 in 2006. Among these horses, there are only eight native Japanese breeds—the Yonaguni horse, Miyako horse, Tokara horse, Misaki horse, Taishu horse, Noma horse, Kiso horse, and Hokkaido horse—with a total of only about 2,000 head remaining today.[31]

Cattle are believed to have been introduced from the Korean Peninsula around the sixth century for use as draft animals for cultivation and transport. From the Meiji period to the Taisho period, native breeds of cattle were cross-bred with European cattle, thereby establishing the current "Wagyu" breed (e.g., Japanese Black cattle), which has since been bred throughout Japan.[32] Today, about 4.4 million head of cattle are raised as dairy cows or for beef. Among these cattle, there are only two native Japanese breeds—Mishima cattle and Kuchinoshima cattle—and fewer than 100 head of each breed now remain.[32]

In recent years, efforts have been made to conserve these breeds with the assistance of some zoos.



Source: Ministry of Agriculture, Forestry and Fisheries, Statistics on Crops. Agriculture Promotion Foundation, 2006: Cereal Property Table, Revised Edition

Figure III-9 Transition of crop acreage of foxtail millet, Japanese millet, and buckwheat (cereals) (Data 21-①)

3. Measures for Loss

Though efforts to propagate farming methods that help conserve biodiversity on agricultural land and a steady increase in certified eco-farmers, it is expected to take more time for such efforts to prevail and significantly improve the biodiversity of all agricultural lands in the country. Therefore, measures to address the problems of fewer laborers due to depopulation and measures for previously altered agricultural lands must be improved.

<Securing the Scale of Habitats in Agricultural Land Areas>

While agricultural lands are not suited to conservation through the designation of protected areas, resulting in few agricultural lands thus being designated, regulations such as those prescribed by the Agricultural Land Act prohibit the conversion of agricultural land for other uses.

Moreover, much progress has been made in the conservation, restoration and maintenance of farming village landscapes under the Law for Protection of Cultural Properties and the Landscape Act, and in the conservation and propagation of endangered species living on agricultural land and in surrounding areas under the Law for the Conservation of Endangered Species of Wild Fauna and Flora. In recent years, such efforts as restoring the grasslands in Aso to secure wildlife habitats and related networks in cultivated systems have been initiated.

<Biodiversity-conscious Projects on Agricultural Lands and Sustainable Agriculture>

The efforts to conserve biodiversity have been partially successful. The Land Improvement Act of 2001 mandates coordination between natural environments and field development projects, while the toxicity of agricultural chemicals has been examined and standards established for the amounts of agricultural chemicals.

In farming operations, "eco-farmer" certification has been promoted for conservation-oriented agriculture as environmentally friendly as possible without using chemical or agricultural chemicals, and more than 190,000 eco-farmers have already been certified. In addition, more biodiversity-conscious approaches to agricultural production such as flooding rice paddies in winter have been taken (see BOX 10). While these efforts in farming operations are expected to spread nationwide, it is necessary to monitor the effects of these approaches on the conservation of biodiversity.

BOX 10 Eco-friendly agriculture - Conservation-oriented agriculture

Environmentally friendly agriculture is called "conservation-oriented agriculture." More precisely, it is "sustainable agriculture" that makes use of the material cycle function of agriculture, considers coordination with productivity, and attempts to reduce the environmental impact of fertilizers and agricultural chemicals through soil improvement. As one such effort, the winter flooding of rice paddies has been recently practiced in many areas, where paddy fields are filled with water during the winter season when there is no crop, thereby inhibiting the growth of weeds and hopefully reducing the use of herbicides and chemical fertilizers.

Winter flooding is also called *fuyumizu* tambo. By maintaining their function as wetlands, paddy fields are expected to be wintering sites for geese, ducks, swans and cranes, as well as feeding sites for ibises and storks, whose feral populations are expected to return.

According to research conducted on the use of dry fields and wet fields by birds in the coastal paddy field area of Lake Kasumigaura, many ground birds as well as water birds use the flooded paddy fields as feeding sites, while no water birds were seen in the dry fields. The difference in the use of such fields by birds is attributed to a greater availability of sludgeworms, insects and leeches on the surface and in the soil of paddy fields as a result of flooding. The effect of winter flooding on enhancing the function of paddy fields as wintering environments for birds is thus now being revealed.

(Source: Taku Maeda, Hoshiko Yoshida, 2009: Responses of birds in rice fields to winter flooding, Japanese Journal of Ornithology, 58, 55-64)

<Maintenance of Human Activities in Agricultural Land Areas>

In cultivated systems, the appropriate and ongoing disturbance of the natural environment through human use is necessary, and promotes more biodiversity-conscious, sustainable agricultural production, as well as the conservation and management of wild animals. In order to prevent agricultural damage caused by wild animals, the management of animal habitats, population control, and protection against damage have holistically been promoted in light of the compartmentalization between humans and animals. Moreover, in order to revitalize agriculture and agricultural villages, and brace for the lack of management as pertaining to agricultural lands and irrigation channels, the subsidization of local community activities and efforts to prevent the abandonment of cultivated lands, as well as the subsidization of NPOs that contribute to the conservation and restoration of agricultural village landscapes and natural environments have been initiated. Because it may be impractical to maintain a previous level of management in all cultivated systems, leaving some secondary forests to natural succession has been considered.

<Monitoring Cultivated Systems>

The National Biodiversity Strategy devised by the Ministry of Agriculture, Forestry and Fisheries (in July 2007) mandates the development of indicators based on scientific evidence for grasping both the positive and negative impacts of agriculture, forestry and fisheries on biodiversity, as well as indicators of biodiversity for efficiently promoting relevant measures and policies to be investigated, with related studies already being conducted.

In order to promote research and gathering information on cultivated systems (e.g., Satochi), the Ministry of Agriculture, Forestry and Fisheries and the Ministry of the Environment are conducting such surveys as the Survey on Lives in Paddy Fields and Surrounding Environments, and the National Survey on the Natural Environment. The ongoing gathering of data has also been initiated at Satochi monitoring sites of the "Monitoring Site 1000" project.

References

1) Mizutani, M., 2000: Upstream migration of weatherfish to paddy fields (Advice Center for Rural Environment Support (ed.), Rural environment 16), 70-76.
2) Negishi, J., Y. Kayaba, K. Tsukahara, and Y. Miwa, 2008: Unionoid mussels as imperiled indicator organisms: habitat degradation processes and restoration approaches, Ecology and Civil Engineering, 11, 195-211.
3) Saito, K., O. Katano, and A. Koizumi, 1998: Incursion and spawning by freshwater fish into temporary waters around rice paddies. Ecological Society of Japan 38, 35-47.
4) Jinguji, H., T. Kondo, A. Sawata, and S. Mori, 1999: Habitat conditions and preservation of the Ninespine Stickleback, *Pungitius pungitius* in small springs. Ecology and Civil Engineering 2, 191-198.
5) Suzuki, M., M. Mizutani, and A. Goto, 2001: Trial Manufactures and experiments of small-scale fishways to ensure both upward and downward migration of freshwater fishes in the aquatic area with paddy fields. Ecology and Civil Engineering, 4, 163-177.
6) Matsui, A. and M. Sato, 2004: Distribution of aquatic animals in the drainage systems created by paddy farmland consolidation in Shimodate City, Ibaraki Prefecture, Japan, Japanese Journal of Conservation Ecology, 9, 15-163.
7) Yonekura, R., M. Kita, and M. Yuma, 2004: Species diversity in native fish community in Japan: comparison between non-invaded and invaded ponds by exotic fish, Ichthyological Research 51, 176-179.
8) Fujioka, M., 1998: Herons warn the crisis of rice fields (Y. Ezaki and T. Tanaka (eds.), Conservation of waterfront environments - from a viewpoint of biocenosis - Asakura Publishing), 35-51.
9) Yamamoto, H., K. Ohata, and K. Kuwahara, 2002: Feeding ground of Mallards wintering at Katano-kamoike—A preliminary study for maintaining a stable wintering duck population at Katano-kamoike II, Strix, 20, 13-22.
10) Jinguji, H., T. Ueda, and K. Goka, 2009: Effects of imidacroprid and fipronil insecticide application on the larvae and adults of *Sympetrum frequens* (Libellulidae: Odonata). Transactions of the Japanese Society of Irrigation, Drainage and Rural Engineering, 77, 35-41.
11) Washitani, I., Loss and restoration of floodplain wetlands: efforts to utilize paddy fields as wetlands, Global environmental research, 12, 3-6.
12) Ide, M., H. Moriyama, and N. Harada, 1992: Ecological studies on the rural landscape pattern and its effects on plant species flow, journal of the Japanese Institute of Landscape Architecture, 56, 28-38.
13) Yabu, S., 2009: Satochi-Satoyama culture, vol.1, Foundation and formation of recycling society, Rural Culture Association Japan, 215pp.
14) Mineta, T. and K. Ishida, 2006: A Role of Small Irrigation Pond from Viewpoint of Endangered Submerged Plants Conservation, journal of the Japanese Institute of Landscape Architecture, 69, 577-580.
15) Nakasone, H., I. Yamashita, H. Kuroda, and R. Kato, 2000: The effect of nitrogen fertilizer use at tea yards on water quality of an irrigation pond, Journal of Japan Society on Water Environment, 23, 374-377.

16) Ueta, M., R. Kurosawa, and H. Matsuno, 2006: Habitat Loss and the Decline of Grey-faced Buzzards（Butastur indicus）in Tokyo, Japan, Journal of Raptor Research, 40, 52-56.
17) Ministry of the Environment, 2003: Revised List of Endangered and Threatened Species in Japan - Red Data Book- 4 (brackish and freshwater fish), Japan Wildlife Research Center.
18) Hasegawa, M., 1998: Frog population dependent on paddy cultivation (Y. Ezaki and T. Tanaka (eds.), Conservation of waterfront environments, Asakura Publishing), 53-66.
19) Fujioka, M., and S.J. Lane, 1997: The impact of changing irrigation practices in rice fields on frog populations of the Kanto Plain, central Japan, Ecological Research, 12, 101-108.
20) Lane, S.J., and M. Fujioka, 1998: The impact of changes in irrigation practices on the distribution of foraging egrets and herons (Ardeidae) in the rice fields of central Japan, Biological Conservation, 83, 221-230.
21) Environment Agency, 2000: Revised List of Endangered and Threatened Species in Japan - Red Data Book-8 (plants I: vascular plants), Japan Wildlife Research Center.
22) Yui, M., 2007: The Golden Eagle Aquila chrysaetos and forestry in the Kitakami Plateau, Japanese Journal of Ornithology, 56, 1-8.
23) Nishihara, S., N. Karube, and I. Washitani, 2006: Status and conservation of diving beetles inhabiting rice paddies, Japanese Journal of Conservation Ecology, 11, 143-157.
24) Kadono, Y., 2007: Change in macrophytic flora of Lake Takkobu, Kushiro, Japan, in past 30 years, Japanese Journal of Limnology, 68, 105-108.
25) Washitani, I., 1998: Conservation-ecological issues of the recent invasion of *Bombus terrestris* into Japan. Japanese Journal of Conservation Ecology, 48, 73-78.
26) Muranaka, T., and I. Washitani, 2006: Status of invasive alien species problems in Japan: current status and ecological effects of aggressive invasion of an alien grass, *Eragrostis curvula*, Mammalian Science, 46, 75-80.
27) Ikeda, T., 2006: Problems controlling the invasive raccoon in Japan, Mammalian Science, 46, 95-97.
28) Iwasaki, N., Kurita E., and Mineta T., 2008: The conflict that occurred in boundary zone between rural area and urban or mountain area, and nature restoration, Journal of Rural Planning, 271, 32-37.
29) Kurashima, O., and N. Niwase, 1998: Spacing pattern of feral raccoons (*Procyon lotor*) in Eniwa, Hokkaido, Mammalian Science, 38, 9-22.
30) Sasaki, K., 1972: Shifting Cultivation in Japan, Kokin Shoin, 425pp.
31) Akishinonomiya, F., and T. Komiya, 2009: Horses (Japanese domestic animals, Gakken Marketing), Chapter 1, 8-57.
32) Akishinonomiya, F., and T. Komiya, 2009: Cattle (Japanese domestic animals, Gakken Marketing), Chapter 2, 58-93.

Section 3 Assessment of Urban Systems

This section assesses the degrees and trends of biodiversity loss in urban systems during the assessment period (from the second half of 1950s to the present) by using two indicators, as well as assessing the measures for biodiversity loss.

1. Assessment of Biodiversity Loss in Urban systems

○ Losses in urban systems occurred during the assessment period from the second half of 1950s to the present and are likely to deteriorate on a long-term basis.

○ A reduction of green tracts of land in cities, such as agricultural land and woods, as well as a deteriorated quality of river water during the period of high economic growth in the first half of the assessment period contributed to fewer habitats for living creatures and a lower quality thereof. [First crisis]

○ The preparation of new green lands in urban areas as well as improvements in the quality of river water progressed in the second half of the assessment period, resulting in expanded distributions of some living creatures inhabiting such an environment.

2. Reason of the Assessment

The table below lists the indicators of the status of biodiversity loss in urban systems and the assessment of each indicator:

Table III-3 Indicators and assessments representing the status of biodiversity loss in urban systems

	Indicator	Assessment		
		Long-term trend		Current loss and trend
		First half of the assessment period	Second half of the assessment period	
Indicators of urban systems	Indicator 22: Scale of urban green space	↘	→	→
	Indicator 23: Populations and distributions of species living in urban systems	↘	→	→ *1

Note: The assessment is based on a comparison with the status of ecosystems at the beginning of the assessment period (in the second half of 1950s).

Legend

Subject of assessment	Legend			
Degree of loss	Not Lost	Not significantly lost	Lost	Significantly lost
	▒	■	■	■
Trend	Recovering	Same	Being lost	Being rapidly lost
	↗	→	↘	↓

Note: Some elements are ignored when visual signs are indicated.
Note: The dashed lines for assessing the degree of loss indicate insufficient data.
Note: "*" indicates that there are multiple factors and data related to the indicator in question, as well as existing factors and data showing trends that differ from current assessments of the degrees, effects, and trends of overall loss.
*1: Refer to the assessment of Indicator 23.

Indicator 22 Scale of urban green space

Explanation of the Indicator

○ Urban green spaces that are connected with surrounding forest and mountain systems, cultivated systems and inland water systems support urban biota, and the reduction and fragmentation of urban green spaces via conversion into building sites degrade the quality of urban systems. Therefore, the scale of urban green space is considered to be an indicator that represents the status of biodiversity loss as related to "the first crisis" in urban systems.

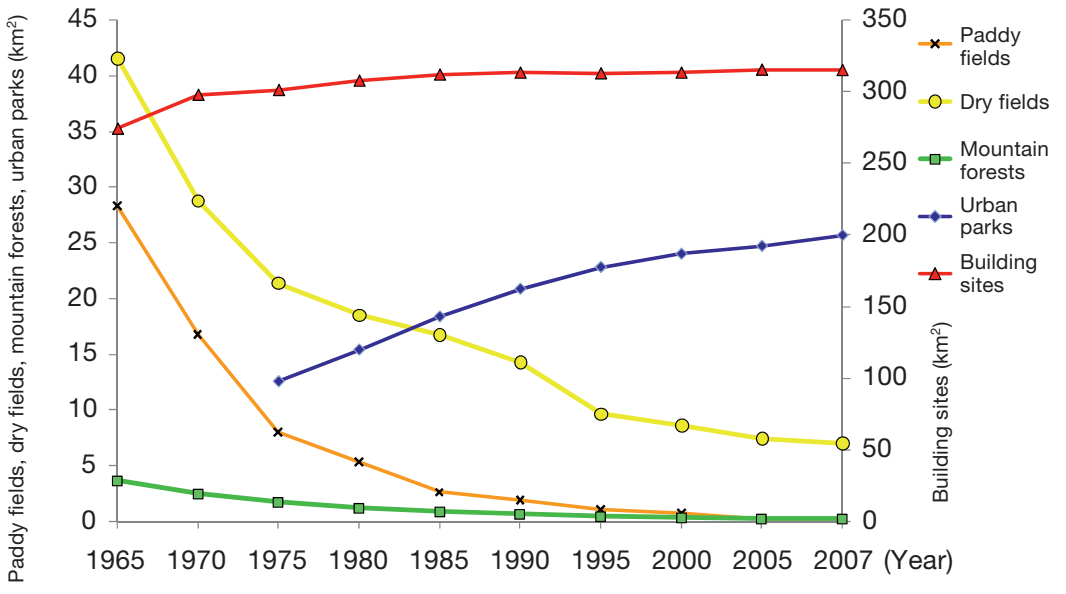
Assessment by the Indicator

○ Urban green spaces, including forests and agricultural lands, have decreased over the long term, but in recent years, the rate of decrease has been alleviated by the development of more urban parks and other green spaces.

Reason of the Assessment

<Reduction and Fragmentation of Urban Green Spaces>

Although the scale of mountain forests and agricultural lands in cities has decreased through the assessment period, the rate of decrease has been relatively moderate after the high economic growth period. For example, the area of mountain forests in the special wards of Tokyo decreased about 3.4 km^2 from 1965 to 2008, with about 1.9 km^2 being lost during the 10 years from 1965 to 1975 and the remaining 1.5 km^2 being lost during the 30 or so years since 1975 (Data 22- ①：Figure III-10). The reason for this trend is that both forest areas and agricultural lands decreased through conversion into residential sites and industrial or transportation lots, whereas additional urban green spaces such as urban parks increased. For example, though the ratio of open green space coverage (i.e., percentage of area covered with greenery, including woods, grasslands, agricultural lands, greenery within building sites and green roofs, greenery in parks, and roadside trees) remained at about 20% from the 1970s to the 1990s, the composition has changed. Relative to 1974, 1998 marked a decrease in grassland and farmland area, and an increase in residential green spaces and parks (Data 22- ② : Appendix). As for the special districts of Tokyo, Osaka and Nagoya, which are the centers of metropolitan areas, many urban parks had already been developed by the first half of the assessment period, and more have been steadily added since then (Data 22- ③ : Figure III-10, Appendix).



The Urban Parks Act was promulgated and enacted in 1956.
Source: Tokyo Metropolitan Government, Tokyo Statistical Yearbook, Ministry of Land, Infrastructure, Transport and Tourism, The annual survey on the statistics of parks and open space in Japan

Figure III-10 Transition of land use in the special districts of Tokyo (Data 22-①, 22-③)

<Alteration of Waterfront Environments>

It is thought that many natural rivers and waterfront environments have disappeared during the assessment period due to worsening air pollution, deteriorated water quality in rivers caused by domestic and industrial wastewater, the spraying of chemicals to control hygiene pests, the conversion of rivers into underdrains for flood control, and the artificial alteration of waterfront environments by constructing bank protection.[1)]

Indicator 23 Populations and distributions of species living in urban systems

Explanation of the Indicator

○ The populations and distributions of species living in urban systems are an indicator that mainly represents the status of biodiversity loss as related to "the first crisis" in urban systems.

○ The reduced scale and fragmentation of urban green area areas decrease the populations and distribution areas of wildlife species living in urban systems.

Assessment by the Indicator

○ Despite the lack of long-term data indicating changes in the populations and distributions of species living in urban areas, the directions of change have varied as species related to agricultural lands have declined since the 1970s, whereas the distribution areas of species as related to more urban parks and the growth of planted vegetation or those adapted to urban environments have grown.

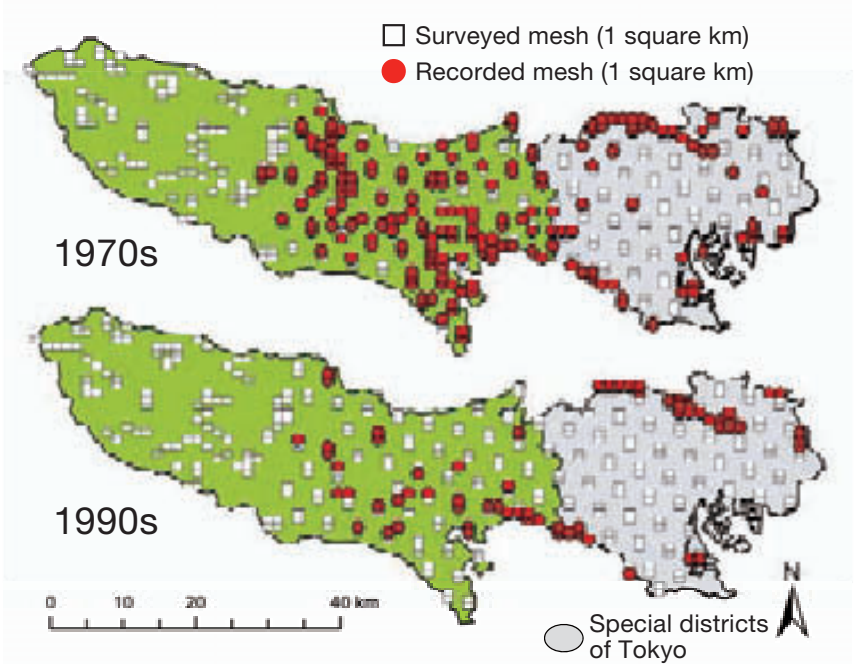
*1 (See Table III-3.): Keep in mind that there are different trends depending on taxonomic groups and species, as well as data differing from those in the overall assessment of the degree of biodiversity loss and the trends thereof.

Reason of the Assessment

<Effects of Changes in the Scale of Urban Green Spaces>

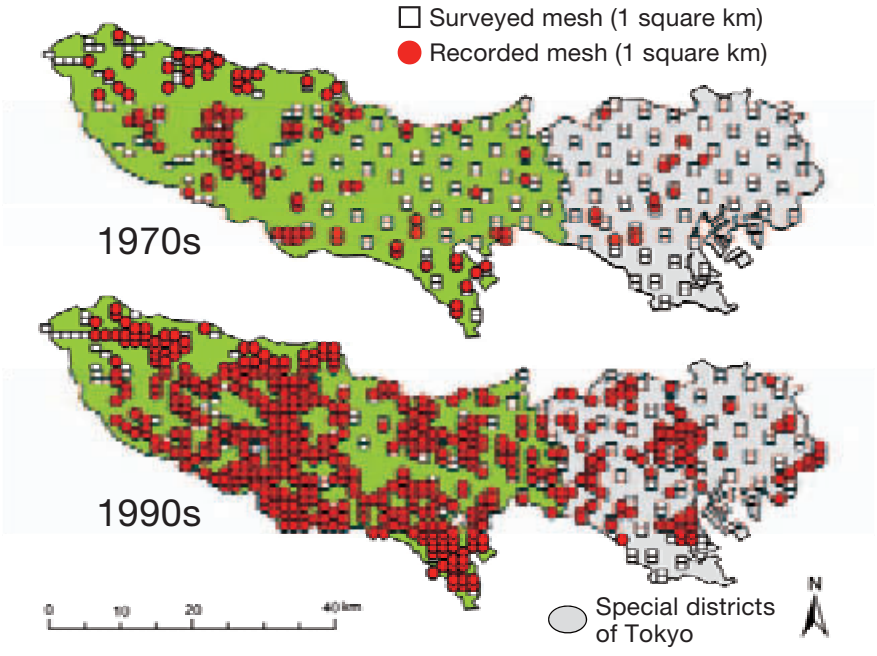
The reduction of green spaces such as forests and agricultural land through conversion into building sites, including the reduction of woodland on private property and near temples and shrines in urban areas during the high economic growth period (in the first half of the assessment period) resulted in decreased species not being able to adapt to those changes.[2] For example, the distribution area of larks living on farmland and grassland in the special districts of Tokyo in the 1990s shows a downward trend compared with that in the 1970s (Data 23- ① : Figure III-11). Meanwhile, the distribution areas of species that adapted to new urban environments increased,[3),4)]; for example, the distribution area of white-eyes (birds) in the special districts of Tokyo was greater in the 1990s than in the 1970s (Data 23- ② : Figure III-12). One reason for this increase is believed to be the creation of more woods resulting from the development of urban parks.

The simplification of biota caused by the remarkable expansion of particular species, however, raises concerns. For instance, the distribution area of omnivorous jungle crows, which nest even in artificial structures and feed on kitchen refuse, was significantly larger in the special districts of Tokyo in the 1990s than in the 1970s (Data 23- ③ : Appendix). The Tokyo metropolitan government has begun to take measures to control crows since 2001, and the number of crows in the special districts is currently decreasing.[5)]



Source: Tokyo Metropolitan Government, 1998: Survey Report on the State of Breeding of Bird Species in Tokyo (1993-1997), Tokyo Metropolitan Government, 1980: Survey Report on the State of Breeding of Bird Species in Tokyo (1973-1978)

Figure III-11 Changes in the distribution of larks in Tokyo (Data 23-①)



Source: Tokyo Metropolitan Government, 1998: Survey Report on the State of Breeding of Bird Species in Tokyo (1993-1997), Tokyo Metropolitan Government, 1980: Survey Report on the State of Breeding of Bird Species in Tokyo (1973-1978)

Figure III-12 Changes in the distribution of white-eyes in Tokyo (Data 23-②)

<Effects of Artificial Light and Photochemical Smog>

There have been concerns about the disturbance affecting the behavior of living things and ecosystems caused by excessive amounts of artificial light and the heat-island effect.[6] With increased urbanization, land use has become increasingly intensive in order to brace for the influx of population and secure building sites, industrial and commercial sites, and transportation lines. For example, large amounts of artificial light emitted from street lights and stores could delay the leaves of roadside trees from turning red and falling, and impede the mating and laying eggs by nocturnal insects. In addition, exhaust emissions from buildings and automobiles, increased exhaust heat such as warm drainage from factories, and less green space have caused the heat island phenomenon, whereby urban centers have higher temperatures than in nearby areas. The heat island phenomenon is believed to contribute to higher temperatures in winter,[7] enable species of southern origins to survive the winter season, and disturb ecosystems by allowing the settlement of invasive species.[8]

When nitrogen oxides (NOx)—the components of smoke from factories and car exhaust emissions—and volatile organic compounds (VOC) are exposed to ultraviolet rays in the atmosphere, chemical reactions called "photochemical reactions" occur, whereby particles and other various forms of oxidizing substances are generated. Those oxidizing substances (called "photochemical oxidants") irritate human mucous membranes and cause illnesses.[9] Like humans, living things in urban areas are exposed to these chemical substances, the effects of which are indicated.[10]

3. Measures for Loss

In urban areas where privately owned green spaces are decreasing with development, such efforts as establishing green spaces in urban parks, conserving green spaces under the Regional Designation System, and securing rooftop and wall greening have been promoted. Approaches such as improving the quality of ecosystems and networking habitats have been taken, with further efforts expected to enhance those measures.

<Conservation and Maintenance of Urban Green Spaces and Waterfronts, and Promotion of Tree Planting>

In order to conserve urban green spaces with scenic beauty or with suitable habitats for fauna and flora, such conservation areas as special landscape conservation areas (formerly landscape conservation areas) were initially designated in the latter half of the high economic growth period (from the second half of 1960s to the first half of 1970s), and have been promoted mainly since the second half of 1970s.

Green spaces have been developed in such public facilities as city parks and national parks, and on privately owned properties, rooftop and wall greening have been promoted under the green space conservation system and the recognition system of greening facilities planning, along with rooftop gardening being initiated in the private sector.

Under the Basic Green Plan or other projects, efforts are being made to conserve major green spaces, along with the large-scale development and improvement of urban parks, and the "water and green network" is being formed through the conservation of road systems and urban parks used as corridor regions, as well as privately owned green spaces used as buffer zones.

Through the conservation of such waterfronts as dry beaches and wetlands as spaces where people in urban areas can closely interact with the natural environment, the creation of eco-friendly forests and waterfronts has been initiated. For example, under the Nature Restoration Green Zone Development Program, the development of infrastructure for natural environments suitable for securing biodiversity has been promoted.

BOX 11 Afforestation of Meiji Shrine

Compared with land use in the major cities of other countries, land use in Tokyo is marked by a high ratio of building sites (about 60%) and a low ratio of open areas (about 15%). Urban green spaces are important for ensuring rich biodiversity as places to interact with nature and alleviate heat island effects; therefore, in creating urban green spaces, it is important to plan based on the time necessary for restoring the ecosystems involved. For example, the forest on the premises of Meiji Shrine was mostly wasteland about 100 years ago, and accounted for no more than one-fifth of the total area. Forestry and landscaping experts who participated in the construction project attempted to create a forest that could thrive and renew naturally, and devised a long-term plan to use evergreen broadleaf trees—a native species of the area—for occupying most of the forest, with competition among tree species and the alternation of generations being taken into account. Today the type of evolved forest confirms the precision of the original intent, and explains why the forest on the premises of Meiji Shrine is considered an artificial forest masterpiece.

The forest at Meiji Shrine as viewed from the Shinjuku Center Building

<Improvement of Air and Water Quality>

In urban areas efforts have been made to improve the quality of air and water by regulating exhaust emissions and effluents, with water quality actually being improved. Moreover, such measures as the greening of rooftops and walls, and developing green spaces have been taken to address the recently prominent heat island phenomena.

References

1) Hanamura, C., H. Kaga, Y. Shimomura, and N. Masuda, 2003: A study of the transition of Osaka canals based on human activities after the Meiji Period, Journal of the Japanese Institute of Landscape Architecture, 6, 669-674.
2) Ueta, M., R. Kurosawa, and H. Matsuno, 2006: Habitat Loss and the Decline of Grey-faced Buzzards（Butastur indicus）in Tokyo, Japan, Journal of Raptor Research, 40, 52-56.
3) Kurosawa, R., 1994: Avifauna in Tokyo and the pavement ratio as an environmental factor, Strix, 13, 155-164.
4) Uchida, Y., H. Shimazu, and K. Sekimoto, 2003: The relationship between the avifauna and environmental changes at Jiyu-Gakuen in Tokyo: a statistical analysis of bird-census data for 35 years, Strix 21, 53-70.
5) Tokyo Metropolitan Government, 2009: Press release (May). http://www.metro.tokyo.jp/INET/OSHIRASE/2009/05/20j51400.htm
6) Ministry of the Environment, 2007: Guide for Reducing the Light Pollution, Ministry of the Environment. http://www.env.go.jp/air/life/hikari_g_h18/
7) Saito, I., R. Kubo, K. Sakai, and O. Ishihara, 2007: Long-term fixed point observations of air temperature and humidity distributions in Kumamoto: Part 1 A study on the heat-island phenomenon of a middle-scale city, Journal of Environmental Engineering, 611, 59-66.
8) Ohashi, K., Y. Kotsubo, and A. Takafuji, 2003: Distribution and overwintering ecology of *Tetranychus takafujii* (*Acari: Tetranychidae*), a species found from the Kinki region, Japan, Journal of the Acarological Society of Japan, 12, 107-113.
9) Itano, Y., 2006: New aspects of photochemical oxidant problem in urban atmosphere, Journal of Urban Living and Health Association, 50, 115-122.
10) Hisano, H., and K. Arai, 2000: Physiological characteristics of trees under ambient air in Tokyo suburbs (I): Effects of photochemical oxidants on gas exchange rates of four species of broad-leaved trees, Journal of the Japanese Society of Revegetation Technology, 25, 208-220.

Section 4 Assessment of Inland Water Systems

This section assesses the degrees and trends of biodiversity loss in inland water systems during the assessment period (from the second half of 1950s to the present) by using three indicators, as well as assessing the measures for biodiversity loss.

1. Assessment of Biodiversity Loss in Inland Water Systems

○ Significant losses in inland water systems occurred during the assessment period from the second half of 1950s to the present and are likely to deteriorate on a long-term basis.

○ A gathering of pebbles and gravel, the creation of artificial rivers, and reclamation of lakes, marshes and wetlands since the first half of the assessment period contributed to a smaller scale of inland water systems, as well as lower quality and continuity throughout Japan. [First crisis]

○ Conversely, the quality of lake water and marshes, likely to have deteriorated in the first half of the evaluation period, improved in the second half. [First crisis]

○ Presently, the impact of development on inland water systems has been reduced due to changes in the socioeconomic situation, but an ongoing influence raises concerns. It is also concerned that living creatures may be captured and gathered for ornamental purposes, as well as a greater influence of alien species. [First crisis and third crisis]

2. Reason of the Assessment

The table below lists the indicators of the status of biodiversity loss in inland water systems and the assessment of each indicator:

Table III-4 Indicators and assessments representing the status of biodiversity loss in inland water systems

	Indicator	Assessment		
		Long-term trend		Current loss and trend
		First half of the assessment period	Second half of the assessment period	
Indicators of the inland water systems	Indicator 24: Scale and quality of inland water systems	↓	↘	→
	Indicator 25: Continuity of rivers and lakes	↓	↘	→
	Indicator 26: Populations and distributions of species living in inland water systems	↘	↘	↘

Note: XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

Legend

Subject of assessment	Legend			
Degree of loss	Not Lost	Not significantly lost	Lost	Significantly lost
Trend	Recovering	Same	Being lost	Being rapidly lost
	↗	→	↘	↓

Note: Some elements are ignored when visual signs are indicated.
Note: The dashed lines for assessing the degree of loss indicate insufficient data.

Indicator 24 Scale and quality of inland water systems

Explanation of the indicator

◯ The scale and quality of inland water systems are an indicator that mainly represents the status of biodiversity loss as related to "the first crisis".

◯ The development of lakes and wetlands such as reclamation reduces the scale of inland water systems, and the deteriorated water quality in rivers and lakes degrades the quality of ecosystems there.

○ The development of manmade riverbanks, dams and weirs reduces the frequency of disruptions caused by floods and deteriorates habitats, leading to a degraded quality of ecosystems. The gathering of gravel from rivers could cause the same kind of biodiversity loss.
○ The reduced use of reed beds along riversides and lakesides (the second crisis), invasion of alien species (the third crisis), and effects of global warming (the climate change crisis) could cause the same kind of biodiversity loss in the future.

Assessment by the Indicator

○ During the high economic growth period in the first half of the assessment period, wetlands and lakes were largely altered by reclamation for the development of agricultural land and building sites.
○ Since the first half of the assessment period, the gathering of gravel and development of dams and weirs have lowered riverbeds and degraded the quality of ecosystems in rivers, due to such complex factors as the disrupting effects of floods being inhibited.
○ The reduced use and management of reed beds along riversides and lakesides have degraded the quality of ecosystems there.
○ Development pressure is currently alleviated, but there are concerns about persisting effects.

Reason of the Assessment

<Reclamation of Wetlands and Lakes>

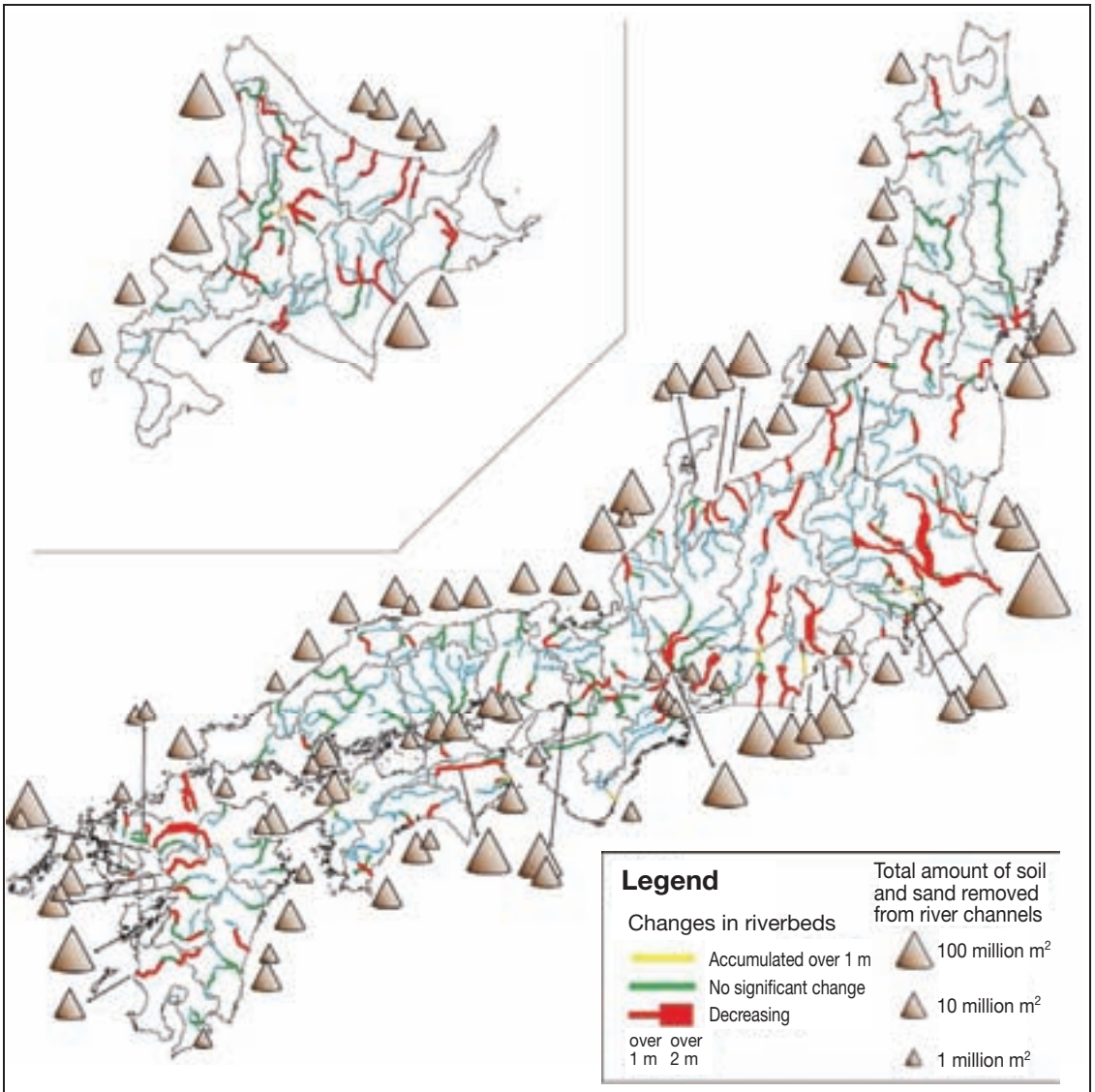
Through the assessment period, the area of wetlands nationwide is thought to have decreased. From around 1900 (before the assessment period) to the 1990s (in the latter half of the assessment period), more than 60% of wetland areas have disappeared due to the development of agricultural land and building sites (Data 24- ① : Appendix). In particular, the area of wetlands in Hokkaido significantly decreased from 1,772 km^2 around 1900 to 709 km^2 in the 1990s.[1),2),3)] The area of the Kushiro Wetland, the largest wetland in Japan, has decreased to 70% of that between 1947 (before the assessment period) and the 2000s (Data 24- ② : Appendix). In addition to reduced area, also indicated are fewer native species due to more tourists stomping around some wetlands[3)] and hydrarch succession caused by changes in underground water due to the alteration of surrounding environments and drainage construction.[4), 5)]

Like those of wetlands, the number and area of lakes significantly decreased between the first half of the assessment period and the beginning of the second half. From 1945 through the 1980s, 15% (or more than 0.01 km^2 in area) of the major natural lakes in Japan were reclaimed (Data 24- ③ : Appendix). Such pollution loads as domestic wastewater and industrial/agricultural effluents have reportedly been discharged into rivers, lakes and wetlands, leading to deteriorated water quality, and more nutrient salts have caused eutrophication.[6),7),8),9),10)] In Lake Biwa, for example, sources of pollution load represented by COD (an indicator of inflow organic pollution) are estimated as 37% from homes and urban districts, 12% from agricultural land, 10% from factories and workplaces.[9)]

<Lowered Riverbeds and Decreased Frequency of Disruptions>

Especially during the high economic growth period in the first half of the assessment period, the large-scale gathering of gravel in rivers nationwide took place (Data 27-②: Figure III-21). According to data recorded since 1945 about the gathering of soil, sand and gravel in Class A rivers, the total amount of soil and sand removed from river channels was about 1,130 million m^3 [11] (Data 24- ④ : Figure III-13). Gathering gravel and dredging river channels have lowered riverbeds and water routes, creating compound cross-sections of the banks by making height differences between the floodplains and flow channels more prominent (Data 24- ④ : Figure III-13). The highly compound cross-sections of riverbanks reduced the frequency of flooding in riverside areas, fixed the watercourse, and inhibited the flow of sand gravel. Meanwhile, since the first half of the assessment period, social demand for preventing frequent flooding and for utilizing water has prompted the dredging of river channels and the development of dams and weirs, thereby stabilizing the flow regime, controlling the quantity of flow,[12),13)] and reducing the frequency and intensity of disruptions by floods.[14),15),16)] Moreover, the blocking of sand and gravel by dams and weirs is believed to have reduced the supply of sand and gravel to downstream areas. For example, the total amount of sand and gravel accumulated by dams in Class A rivers nationwide was about 1,180 million m^3 during the second half of the assessment period (during the past 30 years).[11)] Due to the compound effects of these various factors, fine sand accumulated along riversides and on floodplains, along with vegetation succession and tree growth on dry riverbeds rising high above the water channel. In addition, the original sand and gravel areas of rivers have apparently decreased,[14),15),17),18)] degrading the quality of habitats in rivers and floodplains (see the column titled "Lowering of Riverbeds and Vigorous Tree Growth in Floodplains").

It is also indicated that the artificial modification of rivers (e.g., improving bank protection, straightening rivers) has decreased the diversity of living environments for fish, such as in deep and shallow waters.[19),20),21)]



Note 1: Changes in riverbeds indicate the lowering and accumulation of low-water average riverbeds over the past 30 years.
Note 2: The total amount of soil and sand removed from river channels indicates the total amount of soil, sand and gravel gathered as recorded since 1945.
Source: Ministry of Land, Infrastructure, Transport and Tourism, 2002: Map of the modified sediment transport system

Figure III-13 Lowering of riverbeds and removal of soil and sand from river channels (Data 24-④)

Column: Lowering of Riverbeds and Vigorous Tree Growth in Floodplains

Riverbeds are becoming lower in many rivers nationwide. This trend is evident from data collected by the National Institute for Land and Infrastructure Management.[11] The most common cause of this lowering of riverbeds should have been the gathering of river gravel during the high economic growth period. However, not as much river gravel is being gathered these days as in the past, and in the future, the blocking of soil and sand by dams (e.g., storage dams, sand-control/soil-conservation dams) located in river basins is thought to have an influence. These dams can supply fine sand to downstream areas but tend to capture a particular grain diameter of soil and sand that form the land features of rivers and floodplains. The flood control function of storage dams also equalizes the stream regime in addition to controlling soil and sand. Therefore, the frequency and intensity of flood disturbances in downstream areas of flood control dams are clearly decreased.

The lower riverbeds and flow control fix water routes (low water channels) as well as inhibit the movement of sandbanks; as a result, floodplains are rarely disturbed. For example, riverbeds that originally maintained net-like flow channels have become one water route, thereby making the relative elevation of floodplains to the river greater, lowering the water level of the floodplain (flood channel) during a flood, and facilitating the accumulation of fine sand. Consequently, plants begin to grow and settle there, and plants with rhizomes actually thrive. Trees grow vigorously along riverside sand reefs. The locust tree—an alien species causing problems throughout the country—is a tree species not originating along riversides, but is now expanding its distribution range to riverside areas, with a characteristic bud flush from roots. On the other hand, native Japanese species that include kawara (meaning "riverside" in Japanese) in their names, such as kawara-nogiku (*Aster kantoensis*), kawara-hahako (*Anaphalis margaritacea*) and kawara-batta (*Eusphingonotus japonicus*), are disappearing from Japanese rivers.

Such vigorous tree growth is also seen along rivers in Hokkaido. *Chosenia arbutifolia* is a tree species distributed disjunctly in Kamikochi, Nagano and in the eastern part of Hokkaido. This species grows along net-like flow channels with frequent disturbances, and is widely distributed along mountain streams with a sand gravel valley floor and in alluvial fans. Frequent flow channel changes in lateral directions play an important function in those areas. Sand gravel ground frequently disturbed by flowing water is suitable for the germination of *Chosenia arbutifolia*. On rare occasions, stable geomorphic surfaces are created by major changes in flow channels and enable *Chosenia arbutifolia* to become a mother tree. That is, the dynamism of rivers provides growth environments necessary for each stage of *Chosenia arbutifolia*'s life cycle. Salicaceae species including *Chosenia arbutifolia* disseminate seeds from May to July when snow runoffs subside. In this way, the seeds can quickly penetrate bare grounds formed by runoff and grow there.

If these changes in low channels and snow runoffs are suppressed by the flow control of reservoirs or other river developments, it can be easily imagined that *Chosenia arbutifolia* would disappear from the waterfront and other tree species would grow vigorously on sand reefs and floodplains. In fact, disturbances by floods sharply decreased in Hokkaido's Satsunai River because of dams. As a result, fine sand accumulates on sand reefs, and not only Salicaceae species but also young Japanese ash and Japanese elm trees (that appear in the later stage of succession) have begun to settle there. Young trees of *Chosenia arbutifolia* (adapted to sand gravel ground) can no longer settle, but other tree species are showing rapid and vigorous growth on floodplains.

(Futoshi Nakamura, Committee member)

<Reduced Management of Riverside/Lakeside Vegetation>

Reeds thriving along riversides and lakesides were used for thatched roofs, and disturbances from human activities such as controlled burning and reaping on reed beds are thought to have contributed to the survival of species living on wet grasslands (including reed beds), and many species depend on those disturbances. Reduced human activities on reed beds due to the modernization of people's lives and socioeconomic changes have been shown to degrade the quality of reed beds and decrease the frequency of disturbances, leading to a loss of living environments for many wetland plants.[22)]

Indicator 25 Continuity of rivers and lakes

Explanation of the Indicator

○ The continuity of rivers and lakes is an indicator that mainly represents the status of biodiversity loss as related to "the first crisis" in inland water systems.

○ The artificial modification of riverbanks, construction of dams and weirs, and reclamation of lakes reduce the longitudinal continuity of rivers, the continuity of ecotones (waterfront transitional zones) along riversides and lakesides, or the continuity of rivers with lakes, wetlands and agricultural waterways in a river basin.

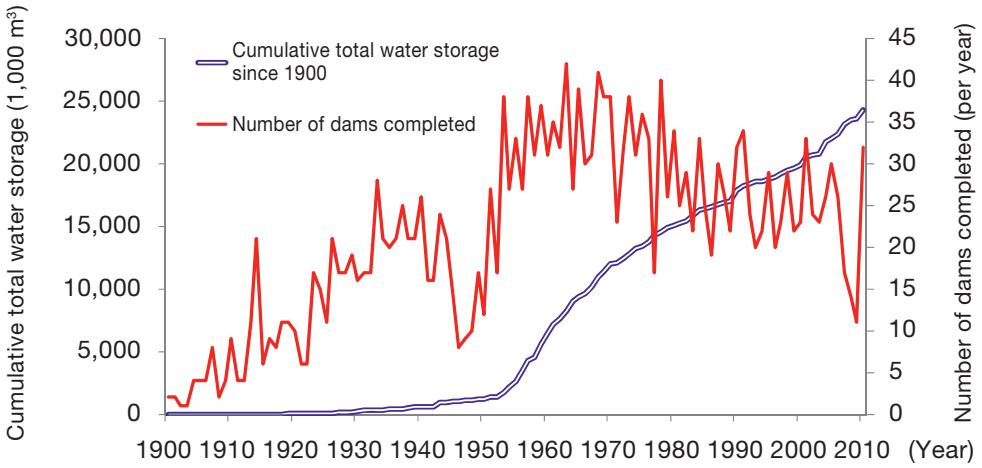
Assessment by the Indicator

○ Since the first half of the assessment period, dams and weirs have been developed for flood control and water utilization, thereby reducing the vertical continuity of rivers. The artificial modification of riverbanks and lakesides has degraded the continuity of ecotones along riversides and the lateral continuity in river basins.

Reason of the Assessment

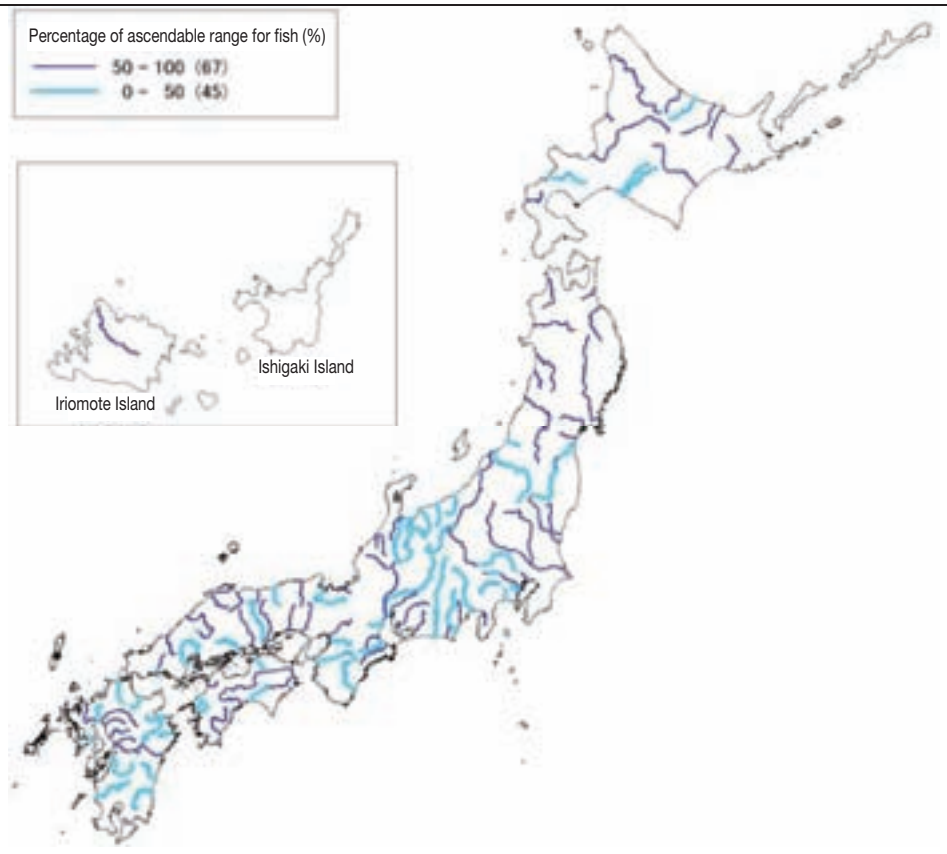
<Development of Dams and Weirs>

Through the assessment period, dams and weirs have been developed for flood control and water utilization, leading to the fragmentation of rivers and reduced continuity between upstream and downstream areas, or between rivers and the sea.[3),21),23),24),25),26)] For example, since the first half of the assessment period, dams and weirs have been developed for flood control and water utilization. Since the 1950s when the high economic growth period began, more dams have been completed, along with growing storage capacity, and such development is still continuing (Data 25- ① : Figure III-14). It is indicated that the reduced continuity of rivers could impede the upstream migration of animals,[23),24),26),27)] and also impede the transport of soil and sand from upstream to downstream areas.[18),28)] For example, in the 1980s during the second half of the assessment period, there were 14 rivers (12%) among the country's 113 major rivers (such as Class A rivers) in which migratory fish such as cherry salmon and Japanese trout with high upstream swimming capability could swim upstream less than 25% of the river length, and 46 rivers (41%) recorded less than 50%. By the 1990s, among those same 113 rivers, 17 rivers (15%) showed less than 25% upstream capacity and 46 rivers (41%) less than 50% (Data 25- ② : Figure III-15). The effect of the reduced ascendable range is believed to be more serious for fish such as goby with low upstream swimming capability.[28)]



Dams represented in this table are used for flood control, disaster prevention for agricultural land, irrigation, and the generation of electricity.
Note 1: There are overlaps due to redevelopment.
The development of Lake Kasumigaura and Lake Biwa is excluded from the number of completions and total water storage.
Dams whose year of completion is unknown are excluded from the number of completions and total water storage.
Source: Ministry of Land, Infrastructure, Transport and Tourism, Digital National Land Information, Dam Data

Figure III-14 Transition in the number of dams completed and cumulative total water storage since 1900 (Note 1) (Data 25-①)

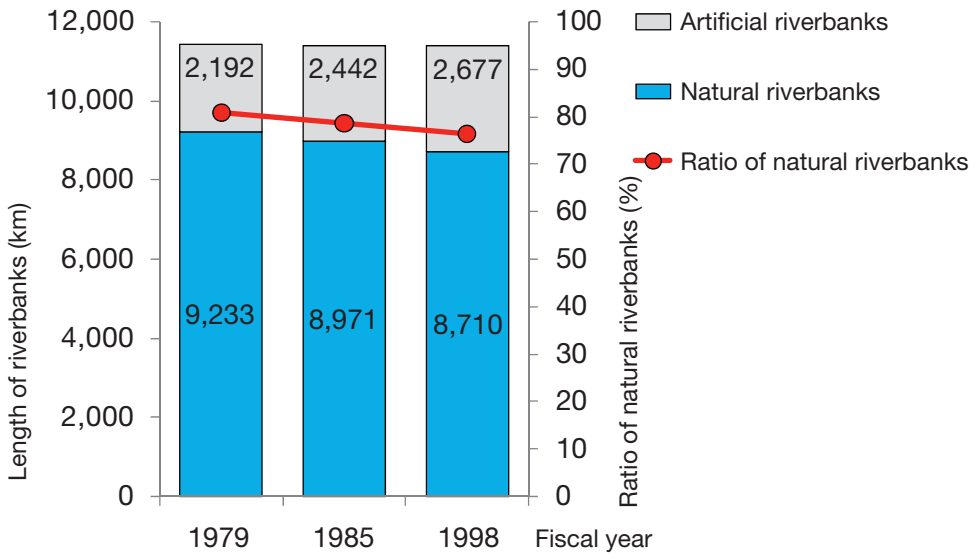


Note 1: The research targets are 112 Class A rivers throughout the country and the Urauchi River (on Iriomote Island, Okinawa).
The researched segments are, in principle, the segments of major rivers under direct government control.
Note 2: The ascendable range for fish refers to the range from the river mouth to the researched segment where river-crossing structures first prevent fish from swimming upstream.
Note 3: The data are from a survey conducted in FY 1998, but may not precisely represent the conditions in that year.
Source: Ministry of the Environment, River Survey, National Survey on the Natural Environment (5th)

Figure III-15 Ascendable range for fish in Class A rivers in the 1990s (Data 25-②)

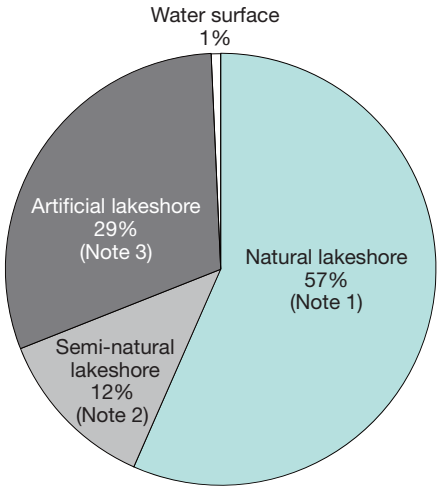
<Effects of Artificial Modification of Rivers and Lakes>

Based on such perspectives of flood control as preventing damage, the artificial modification of waterfront lines of rivers and lakes began in the first half of the assessment period.[24] For example, by the 1990s during the second half of the assessment period, more than 20% of the waterfront lines along the country's major rivers (such as Class A rivers) had been developed as artificial waterfront lines (Data 25- ③ : Figure III-16), and in the country's major natural lakes, about 30% of waterfront lines had been artificially modified by the 1980s (Data 25- ④ : Figure III-17). In Lake Biwa, the largest lake in Japan, the area of coastal reed beds significantly decreased from the 1960s through the 1970s,[29] and the area of reed beds in the second half of 1990s was about 50% of that in the first half of 1950s (Data 25- ⑤ : Appendix). The artificial modification of waterfront lines along rivers and lakes causes the loss of ecotones (waterfront transitional zones) such as floral zones along riversides and lakesides,[24),29] and degrades the quality of habitats for amphibians and fish. The reduced continuity of rivers with backwater areas, paddy fields and channels is also indicated.[3]



Note 1: The research targets are 112 Class A rivers throughout the country and the Urauchi River (on Iriomote Island, Okinawa). The researched segments are, in principle, the segments of major rivers under direct government control.
Note 2: Artificial riverbanks refer to artificial structures that reach waterfront lines.
Note 3: The fiscal years in the figure indicate the surveyed years, and may not precisely represent the conditions in those years.
Source: Ministry of the Environment, River Survey, National Survey on the Natural Environment (2nd, 3rd, and 5th)

Figure III-16 Transitions in status of the river waterfront line (Data 25-③)



The calculation and analysis targets are the 478 major lakes among natural lakes that have, in principle, an area of over 0.01 km^2 (1 ha).
Note 1: A lakeshore that has no artificial structure on the waterfront line or in the bordering land area (within 20 m from the waterline).
Note 2: A lakeshore that has a natural state on the waterfront line, but the land area bordering the waterfront line (within 20 m from the waterline) has artificial structures.
Note 3: A lakeshore that has artificial structures on the waterfront line.
Note 4: The data are from a survey conducted in FY 1991, but may not precisely represent the conditions in that year.
Source: Ministry of the Environment, Lake Survey, National Survey on the Natural Environment (4th)

Figure III-17 Alteration of the lakeshores of major lakes around 1990 (Data 25-④)

Indicator 26 Populations and distributions of species living in inland water systems

Explanation of the Indicator

○ The populations and distributions of species living in inland water systems are an indicator representing the status of biodiversity loss as related to "the first crisis", and "the third crisis".

○ The development of rivers, lakes and wetlands, deteriorated water quality caused by domestic and industrial effluents, and invasion of alien species reduce the area of and degrade the quality of habitats.

Assessment by the Indicator

○ In addition to development since the first half of the assessment period, alien species such as largemouth bass and bluegills have caused a significant loss of biodiversity. The reduced number of native freshwater fish due to capturing for ornamental use is of concern.

Reason of the Assessment

< Current State of Species Living in Inland Water Systems>

Over the long term, the populations and distributions of species living in inland water areas have decreased, and the number of endangered species has increased. Of the 1,002 animals listed as endangered species in the latest version of the Red List of Threatened Species released by the Ministry of the Environment, more than 50% depend on freshwater areas for some or all of their life cycle. Some 34% of amphibians and 36% of freshwater fish are endangered; these rates are relatively higher than other taxonomical groups (Data 4- ① : Appendix). Of the aquatic plants that live in water for at least some parts of their life cycle, 43% are endangered.[30)] Development is considered the cause of the decrease for all endangered amphibians and about 90% of endangered freshwater fish, and degraded water quality for about 40% of amphibians and about 60% of freshwater fish. In addition to these conventional factors, the capture of freshwater fish for ornamental use and the invasion of aggressive alien species such as largemouth bass, bluegills and American bull frogs have reportedly caused great biodiversity loss in conventional ecosystems in recent years (see BOX 12). According to the Red Data Book published in 2000 and 2003, capturing and gathering were cited as causes of the 20 to 30% decrease of endangered amphibians and freshwater fish, as well as the introduction of alien species (Data 4- ⑤ : Figure II-7). In recent years, the demand for breeding and cultivation for ornamental use has led to the capturing and gathering of aquatic/wetland plants and freshwater fish, raising concerns about the adverse effects on some rare species.

BOX 12 Invasion of largemouth bass in Lake Izunuma and long-term changes in fish catches by species

In Lake Izunuma, largemouth bass was first sighted in the 1990s and is now the dominant fish species there. In the past, a large number of Japanese bitterling such as *Acheilognathus typus* and gobies such as *Rhinogobius* and *Gymnogobius* lived in Lake Izunuma. However, the growing largemouth bass population since 1996 has caused a sharp decline in catches of small Cyprinidae species such as Japanese bitterling and stone moroko. Lake Izunuma was once the largest habitat for *Acheilognathus typus*, which have disappeared in recent years, and the numbers of killifish and *Gymnogobius* have been on downward trends. Since 1996 when largemouth bass increased in population, the total fish catch has dropped from 30 to 40 tons to about 10 tons, seriously affecting the fishing industry at Lake Izunuma.

(Source: Kiyotaka Takahashi, Takeshi Onodera, and Akira Kumagai, 2001: Appearance of largemouth bass [Micropterus salmoides] and changes in species composition of fish caught by set net at Izunuma and Uchinuma, Miyagi Prefectural Report of Fisheries Science, 1, 11-18)

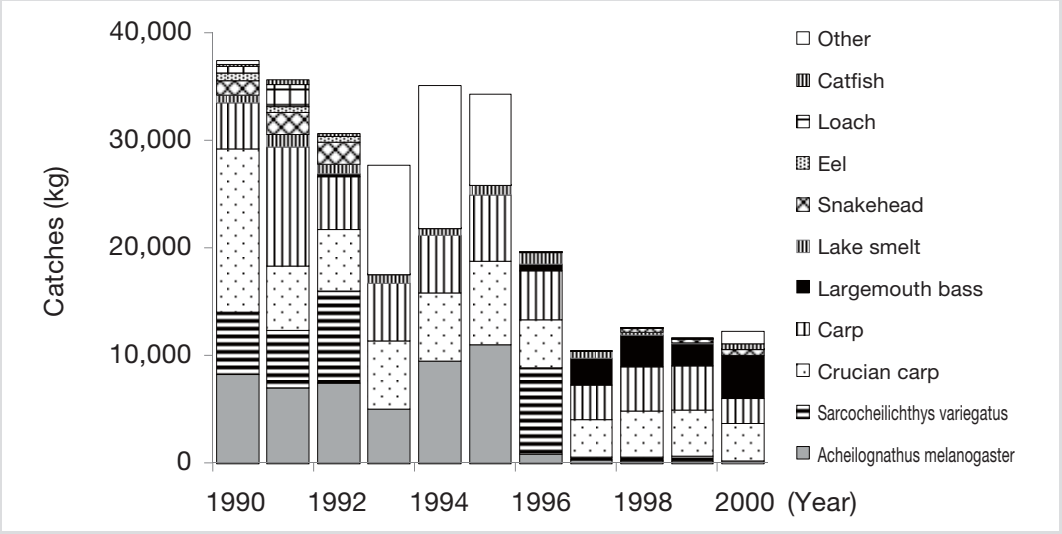


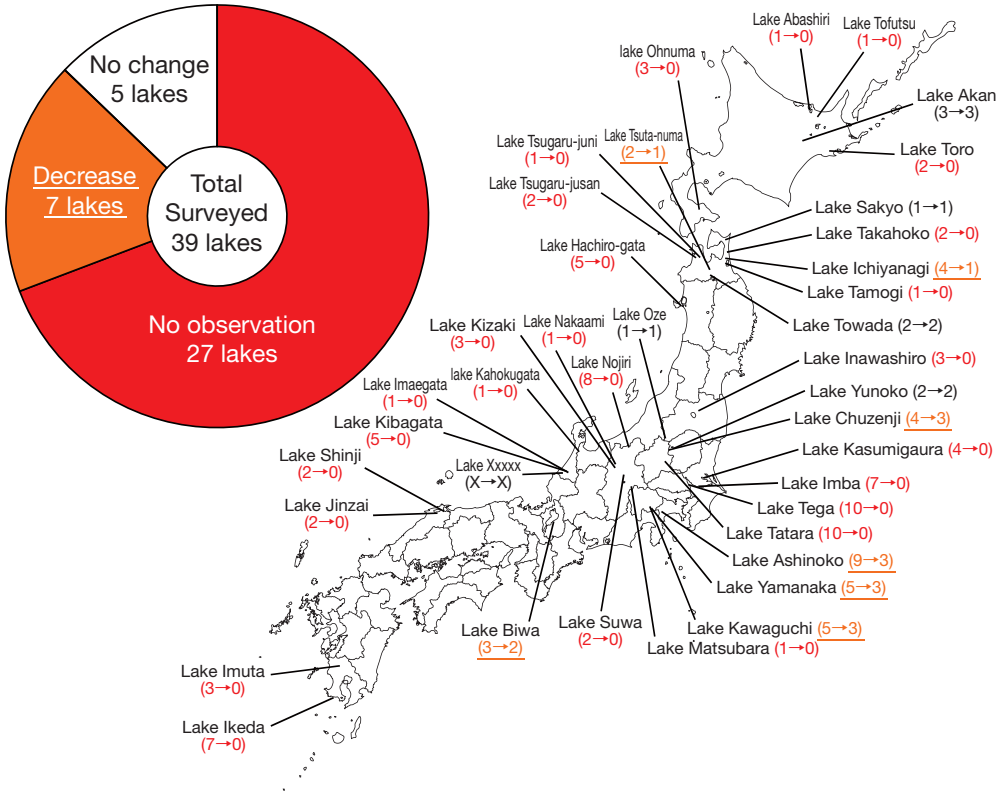
Figure: Long-term changes in fish catches by species

<Degraded Quality and Continuity of Rivers as Habitats>

The fragmentation and changes of environments in inland water systems have been shown responsible for significant changes in the populations and distributions of animal and plant species living in ecosystems there.[18),21),31),32),33)] For example, the upstream and downstream migration of such fish as salmon may be obstructed. Also indicated are growing populations of stone moroko and crucian carp that are adapted to stagnant water zones, and changes in aquatic species composition caused by the decrease of Japanese dace that originally inhabited the area.[34)] The disappearance of coves and ecotones (waterfront transitional zones) in rivers is said to have decreased various species such as Japanese water shrews living in those areas[35)] and deepbody bitterling, which relied on those areas for spawning sites. It is indicated that the flow control by dams and the gathering of gravel have reduced gravel sites as habitats for species characteristic to rivers,[15)] thus affecting the original biota of rivers, such as terns, snipes and plovers.[14), 36)]

<Effects of Wetland and Lake Development and Water Pollution such as Eutrophication>

The effects of developing wetlands and lakes, and water pollution such as eutrophication are said to be serious.[37] The populations and distributions of numerous species, including freshwater fish such as Japanese bitterling in lakes, aquatic plants such as bladderworts, and hydrarch plants such as dew plants and primroses in wetlands have decreased and become endangered.[38] The degraded water quality in rivers and lakes caused by eutrophication leads to, for example, large outbreaks of blue-green algae, harming the habitats of aquatic organisms and fish. Degraded water quality has also been shown to decrease fauna and flora adapted to oligotrophic environments such as high moors and mountain streams.[6),7),39] For example, among charophytes, which grow in highly transparent lakes, a total of 31 species were observed in 46 lakes nationwide in the 1960s during the first half of the assessment period. In the 1990s, however, a survey of the 39 lakes where charophytes were once observed revealed that only six species were observed in 12 lakes (Data 26- ① : Figure III-18).



Chara is a common name for underwater plants belonging to the order Charales in the class Charophyceae of the kingdom Viridiplantae that grow in highly transparent lakes. In the Red List of the Ministry of the Environment, chara is cited as an endangered species as follows: four species as extinct (EX), one species as extinct in the wild (EW), 52 species as critically endangered (CR+EN), and one species as vulnerable (VU).
Note 1: Fumie Kasai, 2006 modified. Parenthesized figures indicate the number of species in 1964 and from 1992 to 1998.
Source: Fumie Kasai, 2006: National Institute for Environmental Studies News 25-5, National Institute for Environmental Studies, Booklet "Shajikumo" (http://mcc.nies.go.jp/Chara2006/chara-pdf.pdf), Ministry of the Environment, 2007: List of Endangered Wildlife Species in Japan (Algae)

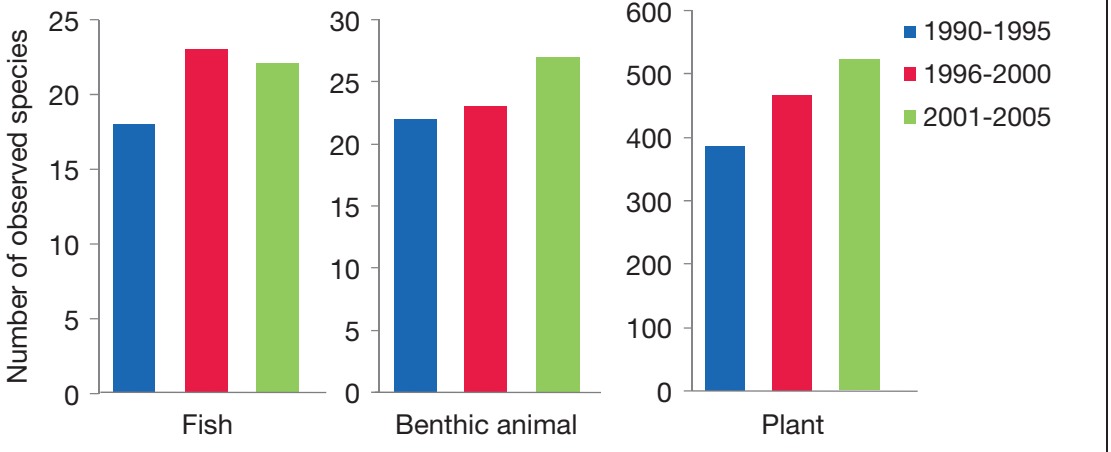
Figure III-18 Observed number of charophyte species in lakes nationwide (Data 26-①)

<Effects of Alien Species>

While the numbers of many species in inland water systems show downward trends, there have been upward trends in the numbers of alien species of fish and benthic animals and plants observed in Class A rivers nationwide since 1990 (Data 26- ② : Figure III-19), and some species have settled and expanded.[14),40)] In particular, largemouth bass and bluegills, known as aggressive alien species, have been observed settled in rivers and lakes nationwide (Data 9- ④ : Figure II-17), and the effects of their predation of native species on ecosystems and damage to fisheries have been of concern.[41)] Moreover, fish released for fishing and fish mixed with those fish are said to disturb the associated structures of native species in many areas. As for native species, the population of great cormorants has sharply increased, with more conflicts with humans such as fishery damage being reported.

As for plants, the distribution areas of burr cucumbers and Eragrostis curvula have been expanded[7),41),42),44)] (Data 9- ④). The invasion and expansion of alien plant species are believed to change the environments of round-stone riversides and degrade the quality of habitats of *Eusphingonotus japonicus* and Aster kantoensis.[6)]

In some inland water areas, the effects of residual chemicals on fish have raised concerns.[14)]



Note 1: In the National Census on River Environment, much of the data in the early period (1990-1995) were not computerized and lists of species not sufficiently prepared; therefore, there were fewer data and fewer targeted rivers in the early period than after 1996.
Note 2: Domestic alien species are not included.
Source: Ministry of Land, Infrastructure, Transport and Tourism, 2008: National Census on River Environment, Summary Report of the Results of 1st, 2nd, and 3rd Surveys (on Rivers)

Figure III-19 Number of alien species observed in Class A rivers (Note 1, Note 2) (Data 26-②)

3. Measures for Loss

In inland water areas, various approaches to deal with many problems have been taken, such as designating protected areas, conserving and propagating rare species, conserving water quality, restoring nature, and controlling alien species. However, the status of endangered species nationwide attributed to past alteration or alien species has not improved, and further efforts are considered necessary.

<Protected Areas in Inland Water Areas>

Particularly during the second half of the assessment period, efforts were made to promote the designations of protected areas for wetlands and lakes considered important for conserving biodiversity, with regulations being tightened on the capture of certain endangered species living in rivers. For example, such wetland waterfowl habitats as lakes and moors that are important for the conservation of biodiversity have been designated as game reserves or natural parks, and inscribed as registered wetlands under the Ramsar Convention. However, few entire basins or water systems have been designated, even though upstream areas near headwaters with a higher degree of nature have been designated as conservation areas.

<Conservation of Species Living in Inland Water Areas>

Regulations on capturing, conserving and propagating some endangered species such as *Acheilognathus longipinnis* that live in inland water systems including rivers have been promoted under the Law for the Conservation of Endangered Species of Wild Fauna and Flora.

<Measures for Water Quality>

Mainly since the second half of the assessment period, the development of sewage treatment facilities and regulations on industrial effluents have been promoted, along with efforts to achieve environmental standards for nitrogen and phosphorus.

<Nature Restoration in Inland Water Areas and Environmentally Friendly Projects for Rivers>

Since the 1990s, goals have been set for environmental conservation in river management under the revised River Law. Technological developments such as eco-friendly construction methods and improved construction, planning and design and river management technology have been promoted, and in order to conserve and create living environments originally possessed by rivers, "Nature-oriented River Works" that cover such wide-ranging river management projects as research, planning, design, construction and maintenance have been initiated. For example, the promotion of "Model Projects for the Promotion of River Works to Facilitate Fish Migration" from 1991 has resulted in almost all 19 model-project rivers nationwide increasing the ascendable range for fish, with a total increase from 1,249 km to 2,048 km.

In 2002, the Act for the Promotion of Nature Restoration was enacted, and efforts to form ecosystem networks and restore nature in rivers have been initiated. In the Kushiro Wetland (of the Kushiro River) and other areas, nature restoration projects at rivers, lakes and wetlands have been promoted in cooperation with local residents and other wide-ranging activity groups. Such projects aim at restoring wetland environments, reconstructing meandering rivers, and restoring lakefront environments and gravel riverfronts (see BOXES 13 and 14). As for aggressive alien species such as largemouth bass and bluegills, control efforts by the public and private sectors have been promoted in areas where those alien species have impacted ecosystems and industries.

BOX 13 Nature restoration in rivers of Shiretoko

Valued for its unique ecosystems formed by the interaction between coastal and land areas, Shiretoko was designated a World Natural Heritage site. However, upon said designation, the International Union for Conservation of Nature (IUCN) requested the development of fishways where salmon fish species can migrate freely through all river structures within the nominated areas. Working groups involved in river structures under the Shiretoko World Natural Heritage Site Scientific Council have been focused on restoring nature in rivers. Of the 44 rivers within the World Natural Heritage site, 14 rivers had a total of 123 river structures (mostly erosion control dams) installed, and based on an assessment of effects on fish, it was determined that 31 structures in five rivers needed to be improved. Structural designs most suitable for the conditions of rivers in each area were chosen after carefully examining the migration of salmon fish species, negative effects of structures and fishing sites on upstream and downstream environments, structural capabilities, and ease of management after improvements were made. As a result, some erosion control dams have been observed as having restored the migration of salmon fish species and expanding upstream spawning beds, while maintaining their damage prevention functions.

Natural river flowing through forests in Shiretoko (Photo by Futoshi Nakamura)

BOX 14 Efforts for Nature-oriented river works

In 1990, the River Bureau of the Ministry of Construction issued "Operating Procedures of Nature-oriented River Works" and instructions to all national government agencies and local governments. There were about 28,000 cases of nature-oriented river works between FY 1991 and FY 2002, mainly involving improvements to individual sites for the conservation and restoration of waterfront areas. In some of these cases, river environments were possibly aggravated by planning with uniform standardized cross-sections in mind, or by monotonizing riverbeds and waterfronts. To inspect the current state of nature-oriented river works and consider the future direction based on new information, the Ministry of Land, Infrastructure, Transport and Tourism established the "Nature-oriented River Works Review Committee" in 2005, and announced the "Basic Policy for Nature oriented River Works" in 2006 based on recommendations of the committee. Thus, efforts are now being made with broader perspectives as pertaining to securing reproduction environments, considering such river space components as shallow and deep waters and riverside forests, planning with the entire river in mind, restoring nature, and river works taking into account the watershed areas and life history.

<Ecosystem Networks in Rivers>

Securing the longitudinal continuity of rivers remains a problem, and therefore, such river-crossing facilities as weirs, dams and sediment control dams are being reconstructed. Accordingly, efforts are being made to manage sediments holistically from mountain areas to the ocean and develop technology on sediment migration in rivers. How to secure ecosystem networks that connect rivers and their basins (via tributaries, channels, lakes and ponds, and paddy fields) is also being considered.

<Surveys and Enhanced Information on Inland Water Systems>

Through long-term monitoring research, surveys and enhanced information on inland water systems have been promoted. Research on geese and ducks began in 1970, and ongoing data gathering has been conducted for snipes and plovers. The census on riverfront areas since 1995 has done research on the living status of a broad range of other taxonomic groups including fish and shellfish, and in the River Ecology Research Group (established in 1996), ecology and engineering researchers have been cooperating in comprehensive studies on historical changes of rivers, the structures and functions of river ecosystems, the effects of flood disturbances, and the restoration of ecosystems. Moreover, the National Survey on the Natural Environment has been conducted regularly and at inland-water-area monitoring sites of the "Monitoring Site 1000" project, with continuous data gathering having been initiated in 2003.

References

1) Fujimoto, M., S. Maeda, Y. Nagamori, and H. Arakawa, 2005: Conservation of winter habitats of birds, particularly geese, along the lower reaches of the Kitakami River, Report of Riverfront Research Institute, 16, 51-57.
2) Takeuchi, K., N. Maruoka, and S. Daimon, 2007: Nature restoration plan for the lower reaches of the Ishikari River, Report of Riverfront Research Institute, 18, 33-40.
3) Takahira, K., S. Maeda, Y. Yamamoto, S. Watanabe, and F. Tezuka, 2005: Restoring a fish-centered ecological network in the lower reaches of the Shinano River, Report of Riverfront Research Institute, 16, 43-50.
4) Nakamura, T., H. Yamada, Y. Nakagawa, Y. Kasai, F. Nakamura, and T. Watanabe, 2004: Ecological aspects of Hirosato restoration area in the Kushiro Mire: Impacts of artificial disturbances on the relationship between distribution of vegetation and hydrochemical environments, Ecology and Civil Engineering, 7, 53-64.
5) Yamada, H., T. Nakamura, Y. Nakagawa, Y. Kamiya, F. Nakamura, and T. Watanabe, 2004: Ecological aspects of Hirosato restoration area in the Kushiro Mire: Effect of pasture developments and river improvements on hydrochemical environments of groundwater, Ecology and Civil Engineering, 7, 37-51.
6) Nakamura, F., T. Sudo, S. Kameyama, and M. Jitsu, 1997: Influences of channelization on discharge of suspended sediment and wetland vegetation in Kushiro Marsh, northern Japan, Geomorphology,18, 279-289.
7) Kameyama, S., Y. Yamagata, F. Nakamura, and M. Kaneko, 2001: Development of WTI and turbidity estimation model using SMA Application to Kushiro Mire, eastern Hokkaido, Japan, Remote Sensing of Environment, 77, 1-9.
8) Kanematsu, S., 1997: Occurrences of red tide and water qualities in Seto Inland Sea and Lake Kojima, Journal of Japan Society on Water Environment, 20, 486-490.
9) Agricultural Land Division/Rural Development Promotion Division, Department of Agriculture and Fisheries, Shiga Prefecture, 2008: Aiming for Sound Water Cycle in Rural Agricultural Land. http://www.pref.shiga.jp/g/kochi/mizujyunkan/nohai_taisaku/siryo-syu/siryo-syu.html
10) Shimamura, T., N. Tokuchi, K. Osaka, M. Itoh, N. Ohte, and Y. Takemon, 2009: Assessments of spatial distribution of water quality in Lake Mizoro-ga-ike for water quality management, Japanese Journal of Conservation Ecology, 2009, 14, 153-163.
11) Fujita, K., Y. Tomita, K. Ohnuma, T. Oro, K. Ito, and Y. Yamahara, 2008: Facts and introductory knowledge about downstream effects of dams on the physical environment—For building a common and scientific basis for discussion on dams and the river environment—, Technical Note of National Institute for Land and Infrastructure Management, No.445.
12) Takahashi, H., N. Maruoka, K. Takeuchi, and K. Watanabe, 2007: Experimental research on restoration of the gravel bed of the Makomanai River, Sapporo Hokkaido: interim report, Report of Riverfront Research Institute, 18, 1-6.
13) Tamai, N., 1999: Principles for restoration of rivers, Ecology and Civil Engineering, 2, 29-36.
14) Masuko, T., Y. Maemura, T. Mishina, and S. Uchida, 2007: Restoration of gravel beds in the middle reaches of the Kinu River, Report of Riverfront Research Institute, 18, 25-32.

15) Masuko, T., Y. Maemura, and T. Sudo, 2009: Appropriate management of river basin forests in the Kanna River, Report of Riverfront Research Institute, 20, 51-59.
16) Tsujimoto, T., 1999: Effects of dams on physical environment of rivers: from the aspects of river engineering and hydraulics, Ecology and Civil Engineering, 2, 103-112.
17) Fujimoto, M., H. Godo, and S. Uchida, 2006: Restoration of gravel beds in the Tama River, Report of Riverfront Research Institute, 17, 25-31.
18) Nakamura, F., 1999: Influences of dam structure on dynamics of riparian forests, Ecology and Civil Engineering, 2, 125-139.
19) Inoue, M., and S. Nakamura, 1994: Physical environment structure of a small stream with special reference to fish microhabitat, Japanese Journal of Ecology, 44, 151-160.
20) Kayaba, Y., 2003: Activities in Aqua Research Restoration Center for the restoration of habitats in streams and rivers in Japan, Ecology and Civil Engineering, 5, 257 -263.
21) Watanabe, K., F. Nakamura, K. Kamura, H. Yamada, Y. Watanabe, and S. Tsuchiya, 2001: Influence of stream alteration on the abundance and distribution of benthic fish, Ecology and Civil Engineering, 4, 133-146.
22) Washitani, I., Loss and restoration of floodplain wetlands: efforts to utilize paddy fields as wetlands, Global Environmental Research, 12, 3-6.
23) Hayashi, Y., and K. Tanida, 2008: Impact of a reservoir on the genetic population structure of *Stenopsyche marmorata* (*Trichoptera*: *Stenopsychidae*): an example in the Sakawa River (Kanagawa Prefecture), Ecology and Civil Engineering, 11, 153-159.
24) Tsuzuki, T., Y. Mori, Y. Kodama, J. Sago, and N. Nakamura, 2009: Nature restoration of the Ina River of the Yodo River system, Report of Riverfront Research Institute, 20, 16-26.
25) Kagawa, N., 1999: Changes in river water quality by impoundment as the cause of discontinuity in the river continuum, Ecology and Civil Engineering, 2, 141-151.
26) Mori, S., 1999: Dam and fish life-history-ecological perspectives in environmental conservation, Ecology and Civil Engineering, 2, 165-177.
27) Tsuzuki, T., M. Mizuno, S. Sakamoto, M. Tsuji, and A. Ikemura, 2005: Creating a symbiotic river for white storks and humans, Report of Riverfront Research Institute, 16, 25-34.
28) Han, M., M. Fukushima, S. Kameyama, T. Fukushima, and B. Matsushita, 2008: How do dams affect freshwater fish distributions in Japan? Statistical analysis of native and nonnative species with various life histories, Ecological Research, 23, 735-734.
29) Saito, S., M. Mizuno, M. Tsuji, and Y. Kawashima, 2005: Measures to improve the land-water transition zone of Lake Biwa, Report of Riverfront Research Institute, 16, 74-81.
30) Kadono, Y., 2009: Conservation of biodiversity of land-water aquatic plants (Hydrosphere Photosynthetic Organism Study Group (ed.), Water environments, now and future: What algae and plants can, Seibutsu Kenkyusha, 141pp).
31) Takeuchi, K., N. Maruoka, S. Okado, and Y. Watanabe, 2006: A study on the Ishikari riverbanks as *Lethenteron japonicum* habitat, Report of Riverfront Research Institute, 17, 1-8.

32) Taki, K., H. Watanabe, K. Sakanoi, F. Tooi, H. Seki, and N. Sugino, 2007: River improvement to restore *Thorea okadae* habitats: Yasumuro River experience (The 4th report), Report of Riverfront Research Institute, 18, 7-14.

33) Yamauchi, K., 2002: Effects of the Nagara River Mouth Barrage on the river-bed sediment and bivalves in the lower reaches of the Nagara River, Ecology and Civil Engineering, 5, 53-71.

34) Kawaguchi, Y., F. Nakamura, and Y. Kayaba, 2005: Effects of a re-meandering project on the physical habitats and fish in the Shibetsu River, Ecology and Civil Engineering, 7, 187-199.

35) Abe, H., 2003: Trapping, habitat, and activity of the Japanese water shrew, *Chimarrogale platycephala*, Mammalian Science, 43, 51-65.

36) Toba, E., 1994: Decrease of the nests of the Little Tern *Stema albifrons* along the Sai and Chikuma Rivers in the Nagano Basin, and the protection of colonies, Strix, 13, 93-101.

37) Oka, N., 1988: Effects of development of the lake and its surrounding area on waterfowls in Lake Teganuma, The 1990's theme of Lake Teganuma: Symbiosis of birds and humans, 71-98.

38) Nanjo, Y., Y. Hosoi, Y. Kido, O. Yagi, and K. Inaba, 2000: Limiting substances of algal growth in Lake Koyamaike, Journal of Japan Society on Water Environment, 23, 690-696.

40) Muranaka, T., and I. Washitani, 2001: Alien plant invasions and gravelly floodplain vegetation of the Kinu River, Ecology and Civil Engineering, 4, 121-132.

41) Minobe, H., and K. Kuwamura, 2001: Analysis of the change in fish fauna and ecological environment in "naiko" around Lake Biwa, Ecology and Civil Engineering, 4, 27-38.

42) Chikumagawa River Office, Hokuriku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism, 2003: *Sicyos angulatus* in the Chikuma and Sai River, Research Division, Chikumagawa River Office, Hokuriku Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism.

43) Miyawaki, S., and I. Washitani, 1996: A population dynamics model for soil seedbank plant and its application to the prediction of the effects of weeding on a population of *Ambrosia trifida L.* invading into a nature reserve, Japanese Journal of Conservation Ecology, 1, 25-47.

44) Miyawaki, S., and I. Washitani, 2004: Management of invasive alien plants in riparian habitats of Japan for biodiversity conservation, Ecology and Civil Engineering, 6, 195-209.

Section 5 Assessment of Marine and Coastal systems

This section assesses the degrees and trends of biodiversity loss in marine and coastal systems during the assessment period (from the second half of 1950s to the present) by using three indicators, as well as assessing the measures for biodiversity loss.

1. Assessment of Biodiversity Loss in Marine and Coastal systems

○ Significant losses in marine and coastal systems occurred during the assessment period from the second half of 1950s to the present and are likely to deteriorate on a long-term basis.

○ In particular, development in the first half of the assessment period contributed to a significant reduction in the nationwide scale of some parts of marine and coastal systems, such as tidal flats and natural coastlines. [First crisis]

○ Presently, the impact of development on marine and coastal systems, such as the reclamation of coastal areas, has been lowered due to changes in the socioeconomic situation, but an ongoing influence raises concerns. Also new concerns about erosion deteriorating the coastline, an invasion of alien species, and the effects of global warming are emerging. [Third crisis and climate change crisis]

2. Reason of the Assessment

The table below lists the indicators of the status of biodiversity loss in marine and coastal systems and the assessment of each indicator:

Table III-5 Indicators and assessments representing the status of biodiversity loss in marine and coastal systems

	Indicator	Assessment		
		Long-term trend		Current loss and trend
		First half of the assessment period	Second half of the assessment period	
Indicators of marine and coastal systems	Indicator 27: Scale and quality of coastal ecosystems	↓	↘	↘
	Indicator 28: Populations and distributions of species utilizing neritic areas	↓	↘	↘
	Indicator 29: Status of valuable fish resources	?	→	↘

Note: The assessment is based on a comparison with the status of ecosystems at the beginning of the assessment period (in the second half of 1950s).

Legend

Subject of assessment	Legend			
Degree of loss	Not Lost	Not significantly lost	Lost	Significantly lost
Trend	Recovering	Same	Being lost	Being rapidly lost
	↗	→	↘	↓

Note: Some elements are ignored when visual signs are indicated.
Note: The dashed lines for assessing the degree of loss indicate insufficient data.

Indicator 27 Scale and quality of coastal ecosystems

Explanation of the Indicator

○ The scale and quality of coastal ecosystems are an indicator that mainly represents the status of biodiversity loss as related to "the first crisis" in marine and coastal systems.

○ The development of coastal ecosystem components, such as tidelands and underwater plant beds, reduce the scale of coastal ecosystems.

○ The degraded water quality in coastal sea areas caused by domestic wastewater and industrial effluents degrades the quality of ecosystems.
○ The invasion of alien species (the third crisis) and global warming (the climate change crisis) could cause the same degree of biodiversity loss as mentioned above in the future.

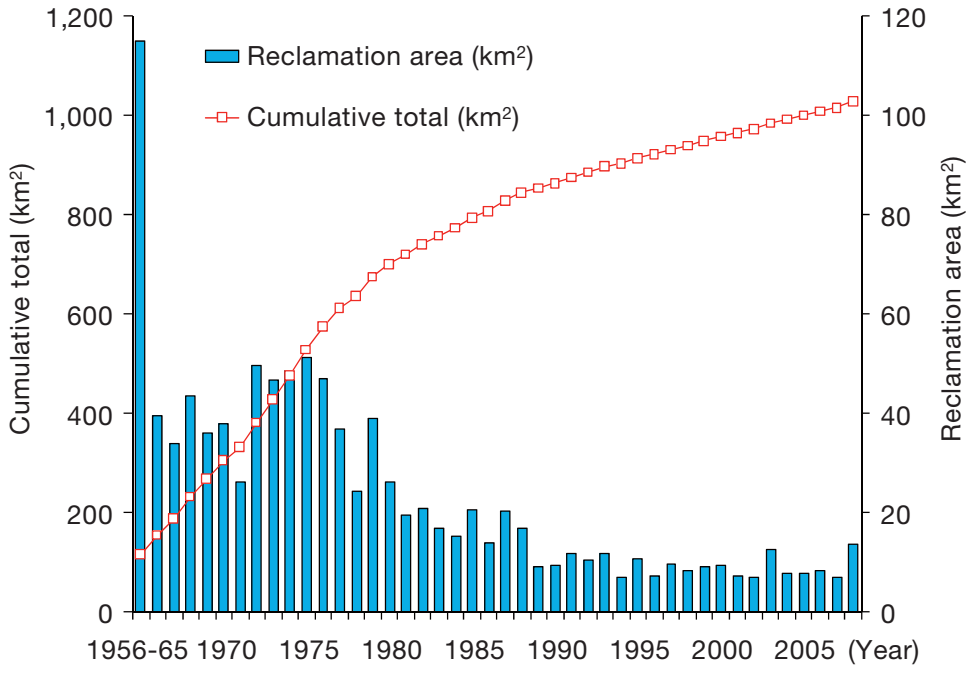
Assessment by the Indicator

○ During the high economic growth period in the first half of the assessment period, neritic areas nationwide were largely developed and altered by reclamation, significantly reducing neritic ecosystems, such as tidelands, underwater plant beds, coral reefs, sandy beaches, rock reefs, and sandbanks.
○ Due to changes in socioeconomic circumstances, development pressure on coastal ecosystems has currently been alleviated, but there are concerns about persisting effects. Moreover, accelerated coastal erosion and the effects of global warming are also concerns.

Reason of the Assessment

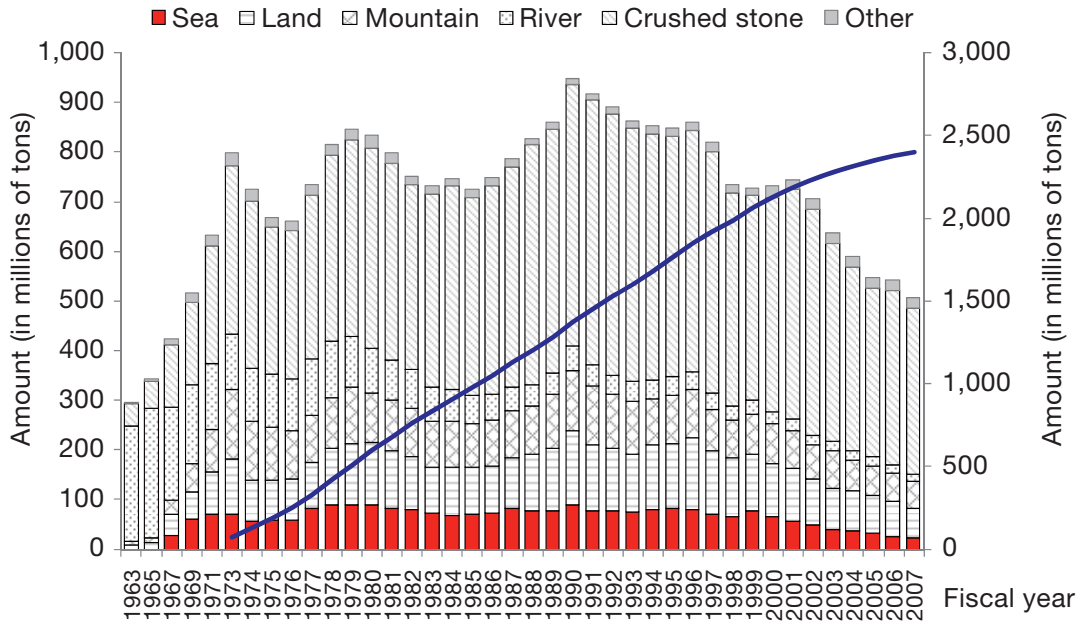
<Development such as Reclamation>

During the high economic growth period in the first half of the assessment period, development such as reclamation and dredging, the gathering of sea gravel (sea sand), and installation of manmade structures greatly reduced the scale of components of such neritic ecosystems as tidelands, underwater plant beds, coral reefs, and natural sandy beaches (Data 27- ④ : Table III-6, Appendix, 27- ⑤ : Appendix, 27- ⑥ : Table III-6, Appendix, 27- ⑦ : Table III-6, Appendix, 27- ⑧ : Table III-6, Appendix). In Japan, both population and industry are concentrated on level ground in coastal areas, and therefore environmental load tends to be higher on coastal ecosystems;[1)] about 40 km^2 of neritic lands were reclaimed each year from the second half of 1950s during the high economic growth period, to around 1980 (Data 27- ① : Figure III-20). The reclamation area has gradually decreased and since 1990, annual reclamation area has totaled about 10 km^2. Though there are still ongoing effects, such effects may be relatively alleviated as a cause of additional loss. Meanwhile, the gathering of sea gravel (sea sand) increased in 1960, and from the 1970s to the second half of 1990s, about 70 to 90 million tons were gathered every year. Since then, with tightened regulations in the Seto Inland Sea, the nationwide total amount has stabilized below 40 million tons, but in other marine areas, gathering is still continuing (Data 27- ② : Figure III-21).



Note 1: Reclamation area was calculated based on prefectural publications (on newly formed land) under the Local Autonomy Act.
Source: Geographical Survey Institute, Land Area Survey

Figure III-20 Transitions of reclamation area in neritic areas (Data 27-①)



Note 1: "Gravel" includes sand and round stone.
Note 2: The amount of gathering refers to that gathered under license based on the Sand and Gravel Gathering Act and the Quarrying Right Act.
Source: Ministry of Economy, Trade and Industry, Aggregate Supply and Demand Table

Figure III-21 Transitions in the amount of gravel gathered (Data 27-②)

<Artificial Coasts>

Mainly during the first half of the assessment period, the artificial modification of coasts (e.g., installation of manmade structures on the shoreline and around nearby land and sea) to prevent damage from tidal waves and tsunami progressed, leading to a smaller scale of natural coast and reduced continuity between land and sea, such as coast-shore-inshore areas.[2)] Given the development of artificial coasts, the length of shorelines with banks and revetments rapidly increased, especially from the 1960s to the 1970s, and currently those shorelines are as long as about 10,000 km, accounting for about 30% of Japan's total shoreline length (Data 27- ③ : Appendix). The length of natural coasts having no manmade structures around the shoreline had already decreased to about 60% of the total shoreline length by 1978—the middle of the assessment period—and dropped to about 50% by 1998. The length of natural coasts has decreased particularly along sandy beaches rather than rocky shores (Data 27- ④ : Table III-6, Appendix). The Seto Inland Sea (on the Chugoku side), Osaka Bay, Toyama Bay, Ise Bay, and Tokyo Bay are areas with few natural coasts, while the Sea of Japan (along San-in) and Sanriku are areas with many natural coasts. It is said that today there are even fewer coasts with natural shoreline areas and natural hinterland areas.

<Reduced Tidelands>

Given their typical location in inner bays and the ease of development, tidelands greatly decreased mainly during the high economic growth period in the first half of the assessment period through reclamation.[3)] Like coasts, many tidelands tend to be isolated from the land through the alteration of surrounding backland areas.[4),5),6)] The area of tidelands in Japan decreased by 35% in about 30 years from 1945 (before the assessment period) to the second half of 1970s, and over the next 20 years decreased by 6% compared with the area in 1945 (Data 27- ⑤ : Table III-6, Appendix). For example, in about 50 years from 1945 to around 1990, the area of tidelands in the Seto Inland Sea was halved from about 210 km^2 to about 120 km^2, and that in Tokyo Bay decreased about 80% from about 100 km^2 to about 20 km^2 during the same period (Data 27- ⑥ : Appendix).

<Reduced Underwater Plant Beds>

Formed by sea grass and seaweeds under subtidal zones, underwater plant beds are spawning sites and habitats for fry and young fish as used by inner-bay organisms, as well as by organisms living in the open sea, and even those from the outer sea. As for the nationwide distribution of underwater plant beds, the five prefectures of Hokkaido, Aomori, Ishikawa, Shizuoka and Nagasaki account for over 50%, with about 30% of sea grass beds being distributed in Hokkaido. Throughout the country, sea grass beds have greatly decreased due to water pollution and such alterations as reclamation; moreover, seaweed beds have significantly decreased due to rocky shore denudation.[7),8)] In the first half of 1970s during the middle of the assessment period, the area of underwater plant beds in the country totaled about 2,100 km^2, then decreased by about 4% to about 2,010 km^2 around 1990 during the second half of the assessment period (Data 27- ⑦ : Table III-6, Appendix). From the 1990s to the 2000s, the area is estimated to have further decreased.[9)] Cited as one reason for the decrease is that subtropical plant-eating fish began staying in winter because of rising seawater temperatures.[10)] In some marine regions, the species composition of Sargassum beds changed from temperate Sargassum to subtropical Sargassum, thereby reflecting the effects of global warming.

<Reduced Coral Reefs>

The area of coral communities in coral reefs located in the Nansei Islands and other areas deceased 4% in about 15 years from the second half of 1970s to around 1990, and in Okinawa, the area decreased by 15% (Data 27- ⑧ : Table III-6, Appendix). It is said that though the rate of coral cover in the Nansei Islands and other areas was almost 100% in the 1970s, about 60% of coral communities around 1990 had coral cover rates of less than 5%, and about 90% had coral cover rates of less than 50%. Therefore, coral cover is generally shown to be at low levels (Data 27- ⑧ : Appendix).

Cited as reasons for the reduced scale and quality of coral are such developments as reclamation,[3),11)] the inflow of red soil,[12),13)] feeding by crown-of-thorns starfish, coral bleaching, and acidification of the ocean. In the Nansei Islands, large outbreaks of coral-eating crown-of-thorns starfish were recorded from the beginning of the assessment period, and large outbreaks from the 1970s to 1980s caused significant damage.[14)] In the 2000s, large outbreaks occurred and caused damage (Data 27- ⑨ : Appendix). Though the causal association is still controversial, global warming has reportedly led to such phenomena as coral bleaching since the 1980s due to abnormal rises in water temperature[15)] (Data 12- ② : Figure II-19) and the recent distributional shift of coral toward the north.[16)] The acidification of the ocean (Data 27- ⑩ : Appendix) is said to affect the survival of biological communities of shellfish, coral and coccolithophore, which have shells and bones composed of calcium carbonate.[17)]

<Reduced Sandy Beaches and Sandbanks>

In many parts of the country, the reduction of sandy beaches due to coastal erosion has progressed and even accelerated. Coastal erosion has been caused by the gathering of sea gravel (sea sand) and river gravel, a reduction of soil and sand supply due to such river developments as dams,[18),19)] and the effects of changes in the drift sand system resulting from coastal structures that protrude from land into the sea.[19),20),21),22),23)] For example, the rate of erosion along sand gravel coasts in the country was about 0.7 km^2 annually from the beginning of the 20th century (in the middle of the Meiji Era) to the second half of 1970s, whereas the rate was about 1.6 km^2 annually from the second half of 1970s to the first half of 1990; therefore, the effects on sandy beaches may have increased significantly (Data 27- ⑪ : Appendix). In the Seto Inland Sea, the Ariake Sea and the Yatsushiro Sea, the repeated gathering of sea gravel (sea sand) is believed to have reduced sandbanks that were formed by tidal currents in shallow waters. The gathering of sea gravel (sea sand) is also thought to have reduced sea grass beds, followed by a simultaneous improvement of water quality and the recovery of sea-grass bed areas. Moreover, the deep pits formed by gathering sea gravel (sea sand) have been shown to cause dysoxic water mass and deteriorate living environments for benthic organisms.[24)] In recent years, the effects of rapid rises in sea level due to global warming on tidelands and sandy beaches are raising concerns. [20)]

Table III-6 Changes in the scale of coastal ecosystems (Data 27-④, 27-⑤, 27-⑥, 27-⑦, 27-⑧)

Ecosystems \ Year (Note 1)	1945 (Note 2)	1973 (Note 2)	Around 1978 (Note 2)	1984 (Note 3)	Around 1990 (Note 4)	Around 1995 (Note 5)
Area of tidelands (km²) (Note 6)	841 **(100)**		553		514 **(61)**	496
Area of underwater plant beds (km²)		2,097 **(100)**	2,076		2,012 **(96)**	1,455
Area of sea grass beds (km²)		478	469		316	264
Area of seaweed beds (km²)		1,587	1,578		1,561	655
Area of coral communities within reefs (km²)			357 **(100)**		342 **(96)**	
Length of natural coasts (km) (Note 7)			18,717 **(100)**	18,155	17,859 **(96)**	17,414
Length of beaches (km)			9,817	9,326	9,089	8,722
Length of rocky shores (km)			8,901	8,829	8,770	8,692

Note 1: "Year" indicates the year when the survey was conducted, and may not precisely represent the conditions of that year.

Note 2: The areas of tidelands, underwater plant beds and coral communities around 1978 were calculated by adding the areas lost between 1978 and around 1990 to the areas that existed around 1990. The area of tidelands in 1945 was calculated by further adding the area around 1978 to the area lost between 1945 and around 1978. This also applies to the area of underwater plant beds in 1973. As for the length of natural coasts around 1978, the data from FY 1978 to FY1979 are used.

Note 3: Data from FY 1984.

Note 4: Data from FY 1989 to FY 1992 were used for the areas of tidelands, underwater plant beds and coral communities, and data from FY 1993 for the length of natural coasts.

Note 5: Data from FY 1995 to FY 1996. As for the areas of tidelands and underwater plant beds, the prefectures of Tokushima and Hyogo were not surveyed, but supplemented with data from FY 1989 to FY 1992. As for the area of underwater plant beds, whereas the previous two surveys included areas up to 20-m deep, this survey included areas up to 10-m deep and therefore cannot be directly compared.

Note 6: Tidelands refer to existing ones that meet the following requirements: ① The maximum width of drained area between the high-water line and low-water line is at least 100 m. ② The area of continuously drained area during the spring tide is at least 0.1 km². ③ The bottom has mobile qualities (of gravel, sand, sandy mud, or mud).

Note 7: Natural coasts refer to "coasts without artificial alteration (along shorelines) and which maintain natural conditions (with no manmade structures along shorelines)." Whether there are artificial structures in hinterland areas does not matter.

Note 8: Parenthesized values are index numbers that indicate the rate of change from the standard year as 100.

Source: Ministry of the Environment, Coast Survey, National Survey on the Natural Environment (2nd, 3rd, and 4th), Marine Environment Survey, National Survey on the Natural Environment (5th), Tideland, Underwater Plant Beds, and Coral Reef Survey, National Survey on the Natural Environment (2nd), Marine Habitat Environment Survey, National Survey on the Natural Environment (4th), Neritic Environment Survey, National Survey on the Natural Environment (5th)

<Changes of Water Quality in Closed Marine Areas>

The water quality of closed marine areas such as inner bays slightly improved during the second half of the assessment period. In Tokyo Bay, Ise Bay and the Seto Inland Sea, fewer red tides and blue tides were caused by the eutrophication of seawater during the second half of the assessment period (Data 27- ⑫ : Appendix). However, the degree of achieving environmental standards (BOD, COD) in closed marine areas has been shifting toward a downward trend in recent years, though it improved from the middle of the 1970s to the 1990s (Data 27- ⑬ : Appendix). It is indicated that while domestic wastewater is causing eutrophication,[25] ecosystems with a self-cleaning function such as tideland in urban river mouth areas are decreasing.[26] An extraordinary proliferation of Ulva pertusa Kjellman has also been observed in some regions. It is believed that the reduced transparency caused by water pollution, increases in bottom hypoxic water mass, and deoxidization at the seabed kill fish, and reduce the primary production of benthic micro algae and biomass.[27] Warm wastewater and contaminated effluents from coastal facilities have also been shown to affect organisms living in the area.[28),29] The bleaching of lavers observed in some marine areas such as the Seto Inland Sea and the Ariake Sea also pose problems.

Indicator 28 Populations and distributions of species utilizing neritic areas

Explanation of the Indicator

○ The populations and distributions of species utilizing neritic areas are an indicator that mainly represents the status of biodiversity loss as related to "the first crisis" in marine and coastal systems.

○ The development of neritic ecosystems and the degraded water quality caused by domestic and industrial wastewater reduce the population and distribution areas of wildlife species that utilize neritic areas.

○ The invasion of alien species and the effects of chemicals (the third crisis) and global warming (the climate change crisis) could cause the same degree of biodiversity loss as those mentioned above in the future.

Assessment by the Indicator

○ In addition to the biodiversity loss caused by development, alteration and degraded water quality since the first half of the assessment period, the effects of coastal erosion and global warming have become greater concerns in recent years.

Reason of the Assessment

<Effects of the Development of Neritic Areas>

The development of coastal areas has reduced the scale of ecosystems and affected the populations and distributions of snipes and plovers,[30] clams (Japanese littleneck and common orient clams), horseshoe crabs, seaside plants, spawning sea turtles,[31),32] and fish that have relied on these marine areas in parts of their life cycles[33),34] (see BOX 15). For example, from the second half of 1970s to the present (the second half of the assessment period), the populations of snipes and plovers that utilize tidelands and sandy beaches during autumn migration have been decreasing. This has been attributed to the reduction of tidelands and sandy beaches in our country, as well as the deterioration of East Asian environments as breeding sites and stopover points (Data 28- ① : Figure III-22). The deterioration of environments in tidelands and on sandy beaches may have affected clams living in these areas as important resources of fisheries. The catches of clams peaked in the 1960s and have declined ever since, dropping to about 3% of its peak in recent years. Among all clam species, those living in tidelands are especially endangered in many areas (Data 28- ② : Figure III-23). It is also indicated that the declining catches of Japanese littleneck clams since the 1980s have been influenced by deteriorated environments through the reclamation of sandy beaches and

tidelands.[35] Moreover, decreased sandbanks caused by the gathering of sea gravel (sea sand) have also reduced sand lance resources (see column titled "The Sandbank Ecosystem"), leading to a reduction of loons. Sandy beaches in Japan are important as the only egg-laying sites for the North Pacific population of loggerhead sea turtles. The main egg-laying sites are in the southern part of Kyushu, and the most concentrated area is the northeastern part of Yaku Island (Data 28- ③ : Appendix).

BOX 15 Changes in the number of shoreline fauna species (in the case of Kure on the Seto Inland Sea)

At six coastal sites near the city of Kure in Hiroshima Prefecture, surveys were conducted on the number of shoreline fauna species over about 40 years from 1960 to 1999; the survey results at many sites showed sharp decreases in the number of species during the high economic growth period, from the first half of 1960s to the first half of 1970s. Later, the number of species showed a recovery trend after the Act on Special Measures concerning Conservation of the Environment of the Seto Inland Sea took effect in 1973, yet soon again reverted to a downward trend as the number of species continued to decrease until the mid-1990s. From the mid-1990s to 1999, the number of species gradually increased, but remained far below the 1960s standard. It is believed that the decrease in species is mainly caused by eutrophication, an inflow of soil and sand caused by upstream area development, water pollution, and an inflow of harmful chemicals.

(Source: Yoshitaka Fujioka, 2000: Transitions of ecosystems in the Hiroshima coastal area, The Seto Inland Sea as observed by residents, Give Us Back the Sea, Technology and Human Beings, 81-92, pp209)

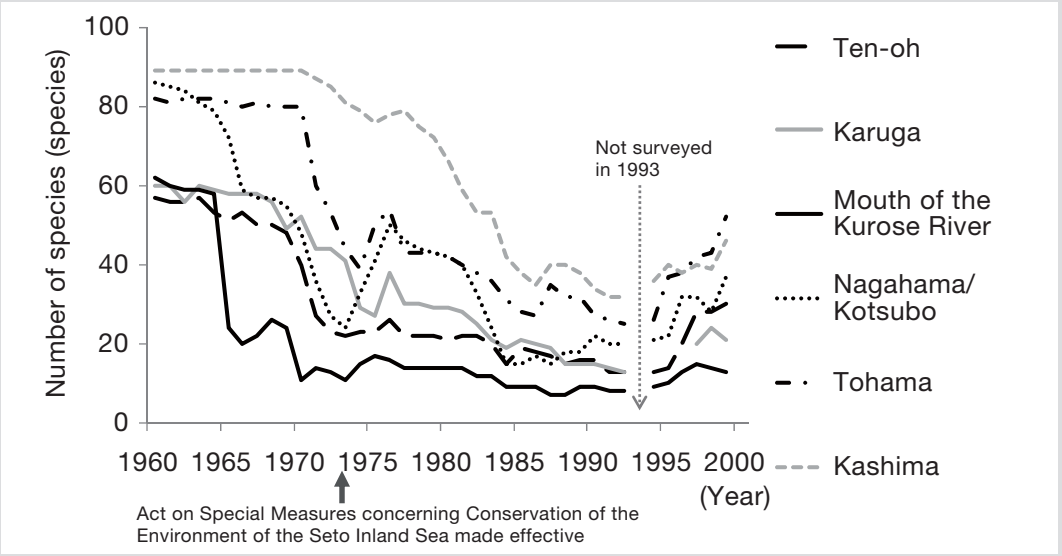
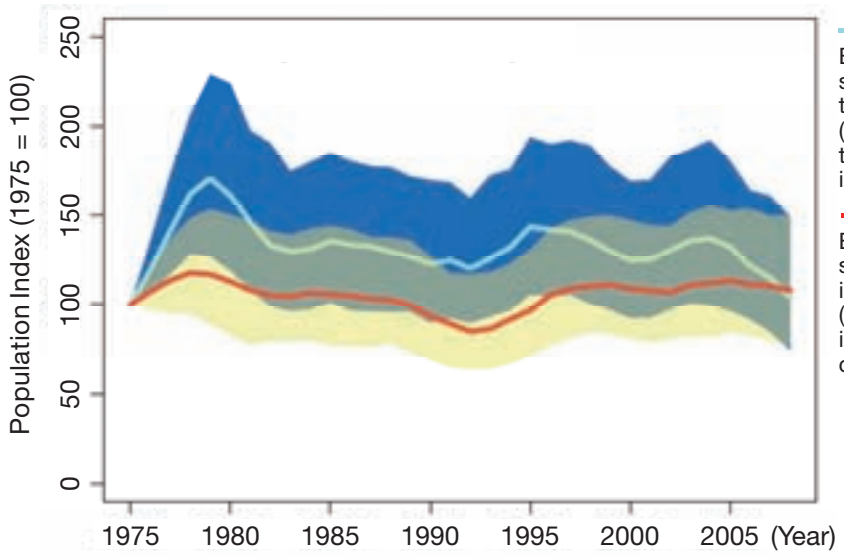
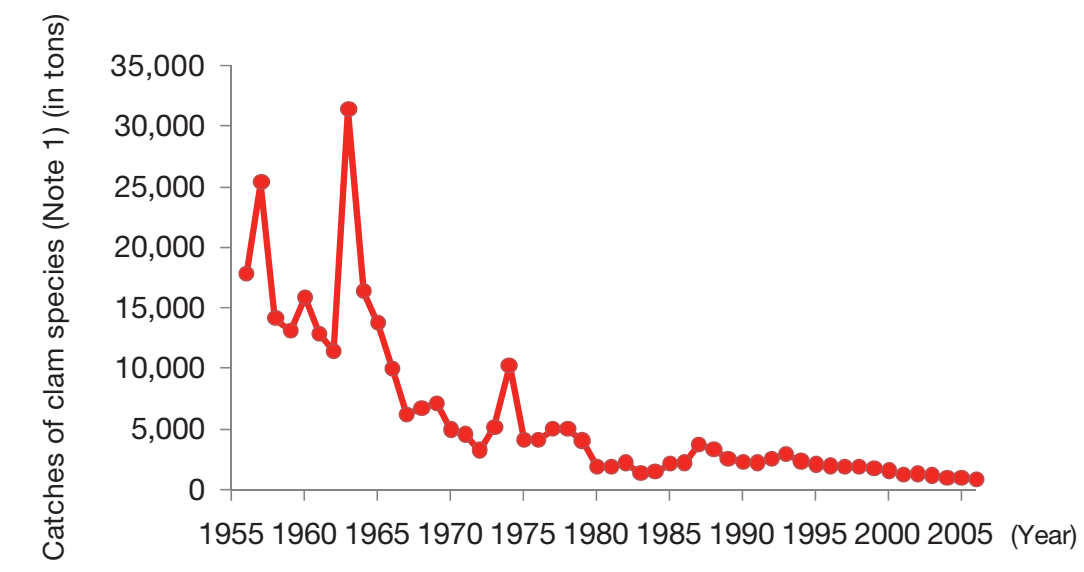


Figure: Changes in the number of shoreline species near the city of Kure



The trends of the Population Index (for each year compared with 1975 as 100) for species that mainly use coastal areas and those that mainly use inland areas, among snipes and plovers that pass through Japan during migration. The index was calculated using the Snipes and Plovers Survey (1975-2008) conducted by the Ministry of the Environment.
Source: Amano T, K Koyama, H Amano, T Szekely and WJ. Sutherland (unpublished)

Figure III-22 Population trends of snipes and plovers passing through Japan during autumn migration (Data 28-①)



Note 1: Clam species include common orient clams (*Meretrix lusoria*), Korean clams (*Meretrix lamarckii*), and Chinese clams (*Meretrix petechialis*).
Source: Ministry of Agriculture, Forestry and Fisheries, Annual Report of Catch Statistics on Fishery and Aquaculture

Figure III-23 Transitions of clam species catches (Data 28-②)

Column: The Sandbank Ecosystem

Although most of the seabed consists of a muddy bottom, specific neritic areas have places where sand is accumulated, and those sand sediments are called sandbanks. In the Seto Inland Sea where open sea and shallow waters are not separated, big tidal flows filter sand that is deposited around the tide-flowing shallows, thus forming sandbanks. Sandbanks are habitats for sand lance and lancelets, which tend to hide in sand. Sand lance, a cold-water fish, plays a particularly key role in the food chain in the Seto Inland Sea. The abundance of sand lance is believed to have supported the abundant fishery resources of the Seto Inland Sea, such as sea bream.

In the Seto Inland Sea, the habitats of three species closely related to sandbanks were designated as natural treasures—the habitats of lancelets around Uryu Island and the town of Saizaki in the city of Mihara, the sea surface where groups of loons come and stay near the town of Toyohama in the city of Kure, and the sea surface where finless porpoises migrate near the town of Takasaki in the city of Takehara. Uryu Island itself is a sandbank, and traditional fishing methods of catching sand lance and sea bream along with loons and finless porpoises (fishing with birds and with finless porpoises) are employed in marine regions where loons and finless porpoises follow sand lance for feeding, These facts demonstrate how sandbanks and the related food chain characterize the nature of the Seto Inland Sea.

Large amounts of sea sand were gathered for the aggregate of concrete or for landfills, however, during the high economic growth period. Thus, many sandbanks disappeared from the 1970s to the 1990s. At Bisanseto in Okayama Prefecture, there had been numerous sandbanks, but many disappeared during the same period, and simultaneously the catches of sand lance sharply decreased. Conversely, there was a sandbank called Shikanose in the offshore area of Akashi in Hyogo Prefecture. Because the Fisheries Cooperative Association of Akashi did not allow sand to be gathered in Shikanose, this sandbank and sand lance fishing in this marine area fortunately continue to thrive, and in early spring, boiled sand lance called *kugini* are distributed throughout the Kansai region.

Because sand is slowly replenished from rivers to the Seto Inland Sea, the sea sand resources depleted by excessive gathering are not likely to be recovered in the short term. Prefectures bordering the Seto Inland Sea belatedly decided to prohibit sea sand gathering by around 2000, and the practice was discontinued. However, the demand for sand aggregate did not decline, and today the sites for gathering sea sand have been shifted to Kyushu and the Nansei Islands. Sandbanks in these marine areas are located on sandy beaches and in offshore coral reefs rather than the inland sea. The effects of gathering sea sand vary. Gathering sea sand not only directly destroys nature and biodiversity in sandbanks but also decreases the rich biota such as sand lance in sandbanks and influences entire ecosystems of the inland sea through the food chain. Moreover, the contamination that occurs during sand gathering greatly reduces the transparency of marine regions, covers the seabed with sludge, and may seriously affect underwater plant beds and coral reefs. The backfilling from surrounding areas also occurs in dredged areas after sea sand is gathered, resulting in a chain reaction that leads to a receding coastline.

Though sufficient surveys have not been conducted on neritic sandbanks in the Nansei Islands, it is certain that these sandbanks have a high degree of biodiversity. It cannot be overemphasized that sea sand is never a limitless resource, and that those sandbanks and sand itself support high degrees of biodiversity and abundant food chains.

(Makoto Kato, Committee member)

<Effects of Alien Species>

The growing populations and expanded distributions of alien species in coastal regions are indicated.[36),37)] Some alien species have been intentionally introduced for food, such as Corbicula fluminea, while others such as Mediterranean mussels and Euspira fortunei[37)] have been unintentionally introduced via ballast water or by clinging to the hulls of ships entering Japanese waters. And for some aggressive alien species, their expanded distribution and effects on existing ecosystems are of great concern.[36),37)]

<Effects of Chemicals>

The effects of non-biodegradable chemicals on marine and coastal organisms are indicated. For example, such harmful chemicals as PCB are known to remain in the body of higher-order consumers through the food chain,[38),39),40)] and affect wild animals and humans. Moreover, such chemicals as TBT (tributyltin compound) painted on the hulls of ships have reportedly affected the reproductive ability of shellfish.[41),42)]

<Effects of Global Warming>

The effects of global warming on marine and coastal species are of great concern. Though the association is controversial, changes in the composition of species have been reported, such as increases of southern fish caused by rising seawater temperatures in some regions, and changes in the northern and southern limits of seaweed distribution in others. In addition, the acidification of seawater caused by increases in carbon dioxide in the atmosphere is thought to affect such marine species as shellfish and coral reefs that have calcareous bone frames.

Indicator 29 Status of valuable fish resources

Explanation of the Indicator

○ The status of valuable fish resources is an indicator that mainly represents the status of biodiversity loss as related to "the first crisis" in marine and coastal systems.

○ If the direct alteration of neritic areas reduces underwater plant beds and tidelands—the habitats of fish that are valuable as biological resources—or if overfishing exceeds the resilience of nature, the populations of such resources may decline.

Assessment by the Indicator

○ About 40% of fishery resources currently being assessed are at low levels. In recent years, while some species are increasing due to successful resource management, more species are generally decreasing.

Reason of the Assessment

<Assessment of Resources>

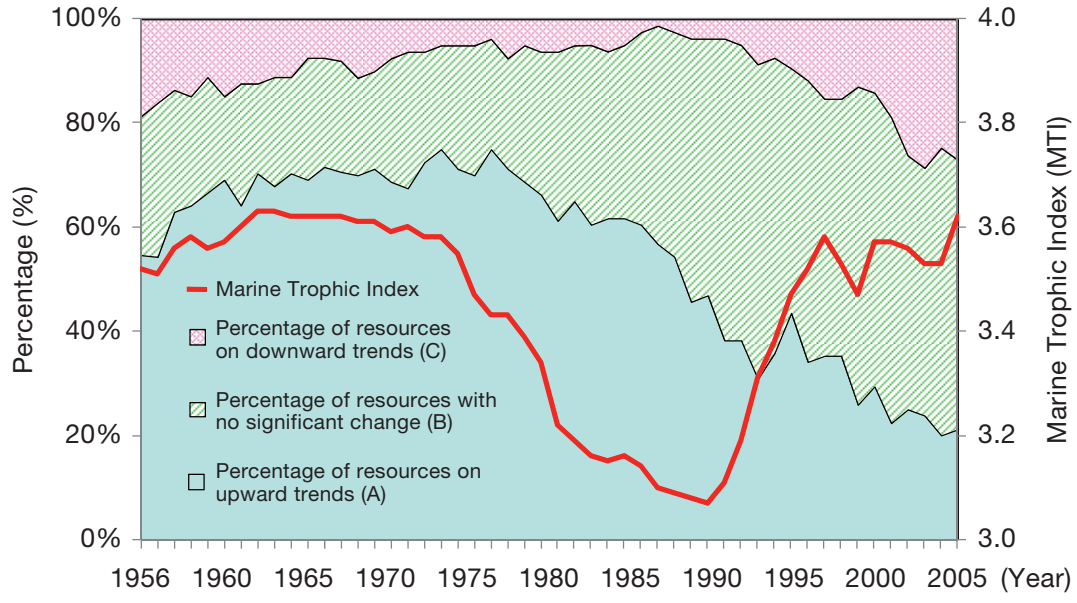
While the marine ecosystems around Japan are utilized by the fishing industry, about 40% of fishery resources currently being assessed in marine regions around Japan are at low levels.[43] Specifically, 13 groups including saury have high levels, 34 groups including saurel have medium levels, and 37 groups including common mackerel have low levels (Data 29- ① : Appendix). The effects of various factors are indicated, including changes in ocean environments such as rising seawater temperatures, reduced underwater plant beds and tidelands as habitats caused by coastal development, and overfishing beyond the resilience of some resources.[9]

<Marine Trophic Index>

The Marine Trophic Index (MTI) [44] indicates average trophic levels based on fish catch data, and represents both the completeness of ecosystems and the sustainability of biological resources. Japan's MTI is at a high level compared with the world average of 3.3. The index temporarily dropped in the 1980s when there was a bountiful catch of pilchard, but is now at the same trophic level as 50 years ago (Data 29- ② : Figure III-24, Appendix). However, the MTI as an indicator must be carefully used: for example, fish at low trophic levels have been customarily utilized in Japan.

<Long-term Trends of Fish Catches>

For about 80 species of fish, the geometric average of fish catches after 1977 (when 200-mile fishing zones were established) was calculated and those higher than the average were classified as A, below half as C, and the rest as B, and along with the number of species caught each year, long-term trends of fish catches were examined (Data 29- ③ : Figure III-24). As for fish species on a downward trend (C), there were many unused resources until the 1970s, and in 1987 there were almost no unused resources, later resulting in an upward trend (Data 29- ③). Salmon, anchovies, yellowtails, Atka mackerel, cero, sandfish, sea bass, spiny lobsters, scallops, and Sakhalin surf clams fall under Class A, and are recently increasing in number, partly due to successful resource management and the production of seeds and seedlings. In contrast, recently declining species include pilchards, walleye pollack, ocean perch, broadbanded thornyhead, pike conger, Japanese tiger prawns, red king crabs, common orient clams, Japanese littleneck, kelp, and Ceylon moss.



For the northern Atlantic where high-level consumable fish are mainly caught, the MTI is regarded as an indicator of overfishing; however, in Japan where low-trophic-level fish are customarily used, this indicator may not necessarily represent sustainability. Species other than fish, such as squid, are not included in FishBase or calculated in this assessment. Past fisheries include ocean fishing differ from current fisheries in terms of operation areas; ideally, fish catches only within exclusive economic zones should be compared.
Source: Fisheries Agency, Annual Statistics on Fish Catches by Species in Marine Fishery (National)

Figure III-24 Marine Trophic Index (Data 29-②) and long-term trends of fish catches (Data 29-③)

3. Measures for Loss

Such measures as designating protected areas, constructing frameworks for resource recovery, restoring nature, and conserving water quality are being taken mainly in coastal areas. However, the designation of marine and coastal protected areas such as tidelands (an important neritic area) remains inadequate, and efforts to recover declining fishing resources are still necessary.

< Protected Areas in Marine and Coastal Areas>

In marine and coastal areas, the most important marine areas have been designated as protected areas (e.g., natural parks, game reserves) and registered wetlands under the Ramsar Convention, yet the coverage ratios in marine areas such as tidelands, underwater plant beds and coral reefs are relatively lower than those in land areas. To improve the coverage ratio of protected areas, efforts have been made to enhance conservation systems for marine biodiversity in natural parks and natural environment conservation areas, and examine how to manage marine protected areas as measures for conserving biodiversity and its sustainable use based on the Basic Plan on Ocean Policy (see BOX 16).

BOX 16 Multiple Use Integrated Marine Management Plan for the Shiretoko World Natural Heritage site

Marine areas within the Shiretoko World Natural Heritage site are secured as ordinary areas in Shiretoko National Park, while for fisheries, in addition to laws and regulations, the conservation and management of fishery resources are promoted through the autonomous efforts of fishery operators. After registration of the Heritage site in July 2005, the Multiple Use Integrated Marine Management Plan for the Shiretoko World Natural Heritage site was established with the aim of maintaining a balance between conserving marine ecosystems and the sustainable use of fishery resources in December 2007. The basic policies of this plan include the principle of autonomous regulation by fishery operators. In coastal areas located in marine areas within the Heritage site on the Rausu side of the Shiretoko Peninsula, local fishery operators have autonomously set up no-fishing areas since 1995 based on their own knowledge gained from experience, in order to protect walleye pollack resources. Moreover, by voluntarily reducing the number of ships, suspending fishing, and increasing the mesh size of gill nets, fishery operators have aimed at the sustainable use of walleye pollack resources. As autonomous approaches to resource management by fishery operators, these efforts have been officially placed in the Marine Management Plan under the Convention concerning the Protection of World Cultural and Natural Heritage.

<Protection of Species Living in Marine and Coastal Areas>

As for some endangered species living in marine and coastal areas (such as marine mammals, sea birds, and sea turtles), capturing is regulated under the Cultural Assets Preservation Act, the Act for the Conservation of Endangered Species of Wild Fauna and Flora, and the Act on the Protection of Fisheries Resources.

<Sustainable Use of Marine and Coastal Biological Resources>

As for species utilized as biological resources, capturing and fishing have been specifically regulated either nationally or locally, along with autonomous regulation imposed by fishery operators, under fishing laws and regulations aimed at controlling fishing and conserving fishery resources since before the assessment period. Since the 1990s, additional measures focused on resource management such as sustainable use have been taken. For example, the total allowable catch (TAC) has been set for each species of major fish since 1997, and via establishment of the Resources Recovery Plan since 2002, fishing efforts have been curtailed regarding fish species for which resource recovery is urgent, along with the promotion of other resource management efforts. As for fishery resources from offshore areas through the open sea, the appropriate conservation and sustainable use of fishery resources based on scientific evidence are being promoted through the framework of local fishery management institutions. In the private sector, efforts have been made to establish fishery certification systems that identify to consumers those fishery products that were caught in considering the ecosystem and sustainability of resources (see BOX 17).

BOX 17 Promotion of fishery certification systems

The fishery certification system is an approach to promote a sustainable fishing industry and fishery products by certifying sustainable and environmentally friendly fisheries, whereby "marine eco-labels" are attached to fishery products caught by certified fisheries, thus affording consumers the option of selecting those labeled products. The logo mark of the MSC (Marine Stewardship Council) is one of the representative eco-labels. Fishery certification was not only originally aimed at securing environmental benefits but also commercial and economic benefits, such as higher brand value, the improved traceability of food from where to where, and enhanced perception among corporations regarding social responsibilities. Therefore, such certification is an approach in which fishery operators, companies that process and market fishery products, retailing companies, and consumers can cooperate.

As of May 2008, there were 1,554 products with MSC "marine eco-labels" being sold in 35 countries in the world. In Japan, products with the MSC logo mark were first sold in July 2006, and by April 2008, 100 products carried the logo mark. The Kyoto Danish Seine Fishery, carrying snow crab and flathead flounder, was certified in September 2008 for the first time in Asia, and products with "marine eco-labels" are steadily taking hold in Japan.

(Source: Kozo Ishii, 2008: MSC Certification System - Overview of the System and Its Expansion, Japanese Society of Fisheries Science, 74, 1133-1138)

<Nature Restoration in Coastal Areas>

In coastal areas, nature restoration has been in progress, and such maintenance and management activities as conserving and creating underwater plant beds and tidelands, which are important environments for fishing, and the control of predator species by fishery operators have been promoted. Numerous projects are underway, including the restoration of tidelands such as the Gamo Tideland and Mikawa Bay in Sendai, coral communities in Sekiseishoko in Okinawa Prefecture, Tatsukushi in Kochi Prefecture, and Takegashima in Tokushima Prefecture, as well as the Bay Renaissance Project in Tokyo Bay, Osaka Bay, Ise Bay, Hiroshima Bay and other areas.

<Biodiversity-conscious Projects in Coastal Areas>

The amended Coast Act in 1999 included the improvement and conservation of coastal environments, as well as the protection of coasts. Based on these concept for coastal management, eco-coast projects suited to ecosystems and natural landscapes have been promoted.

<Measures for Water Quality in Coastal Areas>

In closed marine areas, measures for the accumulation of nitrogen, dredging of bottom mud, measures for deteriorated bottom environments covered by sand, and measures for the accumulation of chemicals have been promoted.

<Monitoring in Marine and Coastal Areas>

Research and the gathering of information on coastal ecosystems have been promoted, including the National Survey on the Natural Environment aimed at grasping the conditions of living things and ecosystems in the country. In the "Monitoring Site 1000" project, the ongoing gathering of data has been initiated at underwater plant beds, tidelands, seashores, coral reefs, egg-laying beach sites for sea turtles, and group nesting sites for sea birds. As measures for alien species, debates have been promoted over effectuation of the International Convention for the Control and Management of Ships' Ballast Water and Sediments.

References

1) Yamashita, H., 2000: Amateurism and conservation activities for the seashore ecosystem: a case of endangered mollusks, Ecology and Civil Engineering, 3, 45-63.
2) Shikida, A., 1999: Macro level monitoring of artificial modification of the coastline in the Seto Inland Sea area, Journal of Japanese Association for Coastal Zone Studies, 11, 65-72.
3) Environment Agency, 1981: The 2nd National Survey on the Natural Environment, Report of marine area survey, coastal survey, marine environment survey, tideland/underwater plant beds/coral reef distribution survey (1981/ national).
4) Hanawa, S., 2007: Tideland in Japan, now and future, Global Environmental Research, 11, 235-244.
5) Kokubu, H., H. Okumura, and O. Matsuda, 2008: Historical changes in the tidal flat and its effects on benthos and sediment quality in Ago Bay, Journal of Japan Society on Water Environment, 31, 305-311.
6) Takegaki, T., T. Wada, Y. Kanemori, and Y. Natsukari, 2005: Distribution and population density of Boleophthalmus pectinirostris in estuaries in Ariake and Yatsushiro Bays, western Kyushu, Japan, Japanese Journal of Ichthyology, 52, 9-16.
7) Environment Agency, 1994: The 4th National Survey on the Natural Environment, Report of neritic area ecosystem survey (underwater plant beds survey), (1994).
8) Environment Agency, 2008: The 6th and 7th National Survey on the Natural Environment, Report of neritic area ecosystem survey (underwater plant beds survey), (2008).
9) Fisheries Agency, 2008: White Paper on Fisheries for FY 2008.
http://www.jfa.maff.go.jp/j/kikaku/wpaper/index.html
10) Fujita, D., 2006: How Herbivorous Fishes Have Interacted with Seaweeds and Their Beds, Fisheries Engineering, 43, 53-58.
11) Environment Agency, 1994: The 4th National Survey on the Natural Environment, Report of neritic area ecosystem survey, Vol.3, coral reefs (1994).
12) Tsuchiya, M., and Y. Fujita, 2009: Anguish of coral reefs, Tokai University Press, 203pp.
13) Omija, T., 2004: Inflow of polluted effluent loads from land areas (Ministry of the Environment and the Japanese Coral Reef Society (eds.), Coral Reefs in Japan, Ministry of the Environment), 67-70.
14) Yokochi, H., 2004: Coral-eating species (Ministry of the Environment and the Japanese Coral Reef Society (eds.), Coral Reefs in Japan, Ministry of the Environment), 51-57.
15) Nakano, Y., 2004: Global environmental change and coral bleaching (Ministry of the Environment and the Japanese Coral Reef Society (eds.), Coral Reefs in Japan, Ministry of the Environment), 44-50.
16) Precht, W.F., and R.B. Aronson, 2004: Climate flickers and range shifts of reef corals, Frontiers in Ecology and the Environment, 2, 307-314.
17) Tadokoro, K., T. Sugimoto, and M. Kishi, 2008: The effects of anthropogenic global warming on the marine ecosystem, Oceanography in Japan, 17, 404-420.

18) Unoki, S., 2007: Effects of dam construction on coastal environments and fisheries, Bulletin of the Japanese Society of Scientific Fisheries, 73, 85-88.
19) Martin, D., F. Bertasi, M.A. Colangelo, Mindert de Vries, M. Frost, S.J. Hawkins, E. Macpherson, P.S. Moschella, M.P. Satta, R.C. Thompson, and V.U. Ceccherelli, 2005: Ecological impact of coastal defense structures on sediment and mobile fauna: Evaluating and forecasting consequences of unavoidable modifications of native habitats, Coastal Engineering, 52, 1027-1051.
20) Kato, M., 2006: The inland sea ecosystem supported by tidelands and banks, Global environmental research, 11, 149-160.
21) Jiang, Q., M. Fukuhama, and F. Kato, 2006: Basic Study on Evaluation of the Environmental Impact of Shore Protection Facilities on the Ecosystem, Annual Journal of Coastal Engineering, 53, 1111-1115.
22) Suda, Y., 2002: Biology and conservation of sandy beaches (Y. Hayakawa and S. Yasuda, (eds.), Science of fishing environments, Seizando Publishing), 108-129.
23) Torii, K., F. Kato, and T. Uda, 2000: Some issues of coastal works from the aspects of ecosystem conservation and their future perspective, Ecology and Civil Engineering, 3, 29-36.
24) National Institute of Advanced Industrial Science and Technology, 2003: Annual Report of Institute of Marine Resources and Environment for FY 2003, Report No.7 of Institute of Marine Resources and Environment http://unit.aist.go.jp/shikoku/kaiyou/mre/l_jp/u/group/rg08out.html
25) Seiki, T., Y. Komai, T. Koyama, O. Nagafuchi, Y. Hino, and K. Murakami, 1998: Shift of the circumstances in effluent pollutant loads and water pollution in the Seto Inland Sea, Journal of Japan Society on Water Environment, 21, 780-788.
26) Suzuki, T., 2006: Material recycling and water clarification functions of tideland areas, Global environmental research, 11, 161-171
27) Azuma, M., 2003: The Isahaya land reclamation project and the "Ariake Sea Disaster" -a proposal for sustainable ecosystem management of the Ariake Sea-, Japanese Journal of Limnology, 64, 209-217.
28) Teixeiraa, T.P., L.M. Nevesa, and F.G. Araújo, 2009: Effects of a nuclear power plant thermal discharge on habitat complexity and fish community structure in Ilha Grande Bay, Brazil, Marine Environmental Research, 68, 188-195.
29) Lardicci, C., F. Rossi, and F. Maltaglitati,1999: Detection of Thermal Pollution: Variability of Benthic Communities at Two Different Spatial Scales in an Area Influenced by a Coastal Power Station, Marine Pollution Bulletin, 38, 296-303.
30) Amano H., 2006: Current state of migratory birds using tideland, Global environmental research, 11, 215-226.
31) Kishida, H., 2000: Start of a new coastal management system, Ecology and Civil Engineering, 3, 65-75.
32) Pizzolon, M., E. Cenci, and C. Mazzoldi, 2008: The onset of fish colonization in a coastal defense structure（Chioggia, Northern Adriatic Sea）Estuarine, Coastal and Shelf Science, 78, 166-178.
33) Sasaki, Y., S. Shibata, and Y. Morimoto, 2006: The prediction and healthiness of plant species structure of coastal vegetation on semi-natural and artificial coasts of the Seto Inland Sea, Journal of the Japanese Society of Revegetation Technology, 31, 364-372.

34) Stoh, Aya, 2008: The current status and conservation of coastal tiger beetles (*Coleoptera: Cicindelidae*), Japanese Journal of Conservation Ecology, 13, 103-110.
35) Sekiguchi, H., and R. Ishii, 2003: Drastic decreasing of annual catch yields of Manila clam ruditapes hilippinarum in Ariake Sound, southern Japan, Oceanography in Japan, 12, 21-36.
36) Iwasaki, K., 2007: Non-indigenous organisms introduced into Japanese waters and their impacts on native ecosystems and industries, Bulletin of the Japanese Society of Scientific Fisheries, 73, 1121-1124.
37) Otani, M., 2004: Introduced marine organisms in Japanese coastal waters, and the processes involved in their entry, Japanese Journal of Benthology, 59, 45-57.
38) Tsuno, H., T. Shinkai, T. Nakano, H. Eirei, S. Matsumura, T. Koreeda, 2007: PCBs distribution and bioconcentration to mussel in the Seto Inland Sea, Journals of the Japan Society of Civil Engineers (G), 63, 149-158.
39) Tsuno, H., T. Nakano, H. Nagare, C. Matsumura, M. Tsurukawa, T. Koreeda, and Y. Takabe, 2007: Accumulation characteristics of POPs from water to bivalves, Journal of the Japan Society of Civil Engineers (G), 63, 179-185.
40) Watanabe, I., 2008: Trial studies applying experimental analysis to evaluate the ecology of pollutants and their toxic effects on wild mammals, Mammalian Science, 48, 169-174.
41) Horiguchi, T., 2000: Organotin pollution and reproductive abnormalities in marine snails, Biomedical research on trace elements, 11, 225-234.
42) Nakata, H., S. Kobayashi, Y. Hitayama, and Y. Sakai, 2004: Contamination of organochlorines, polycyclic aromatic hydrocarbons and organotin in coastal shellfish from the Ariake Sea and the effects of tributyltin on imposex induction in rock shell, Bulletin of the Japanese Society of Scientific Fisheries, 70, 555-566.
43) Fisheries Agency, 2009: FY 2009 Assessment of resources by fish species and by species group (52 fish species and 84 species groups)
http://abchan.job.affrc.go.jp/
44) Pauly, D., and R. Watson, 2005: Background and interpretation of the 'Marine Trophic Index' as a measure of biodiversity, Philos Trans R Soc Lond B Biol Sci., 360, 415-423.

Section 6 Assessment of Island Systems

This section assesses the degrees and trends of biodiversity loss in island systems during the assessment period (from the second half of 1950s to the present) by using one indicator, as well as assessing the measures for biodiversity loss.

1. Assessment of Biodiversity Loss in Island systems

○ Significant losses are currently observed in island systems. While there is not sufficient data to assess conditions in the first half of the assessment period, the situation deteriorated in the second half of the assessment period (since the second half of 1970s) and is likely to deteriorate on a long-term basis.

○ Due to the development and invasion/settlement of alien species, the habitats of some domestic species, including indigenous ones, are deteriorating. [First crisis and third crisis]

○ It is concerned about the effects of global warming on the coral reefs ecosystem. [Climate change crisis]

2. Reason of the Assessment

The table below lists the indicators of the status of biodiversity loss in island systems and the assessment of each indicator:

Table III-7 Indicators and assessments representing the status of biodiversity loss in island systems

	Indicator	Assessment		
		Long-term trend		Current loss and trend
		First half of the assessment period	Second half of the assessment period	
Indicators of island systems	Indicator 30: Populations and distributions of species endemic to islands	?	↘	↘

Note: The assessment is based on a comparison with the status of ecosystems at the beginning of the assessment period (in the second half of 1950s).

Legend

Subject of assessment	Legend			
Degree of loss	Not Lost	Not significantly lost	Lost	Significantly lost
				
Trend	Recovering	Same	Being lost	Being rapidly lost
				

Note: Some elements are ignored when visual signs are indicated.
Note: The dashed lines for assessing the degree of loss indicate insufficient data.

Indicator 30 Populations and distributions of species endemic to islands

Explanation of the Indicator

○ The populations and distributions of species endemic to islands are an indicator that mainly represents the status of biodiversity loss as related to "the first crisis" and "the third crisis" in island systems.

○ On some islands in Japan, many species can only be found there (endemic species). Development reduces the habitats of endemic species, and predation and competition by aggressive alien species reduces the populations of endemic species.

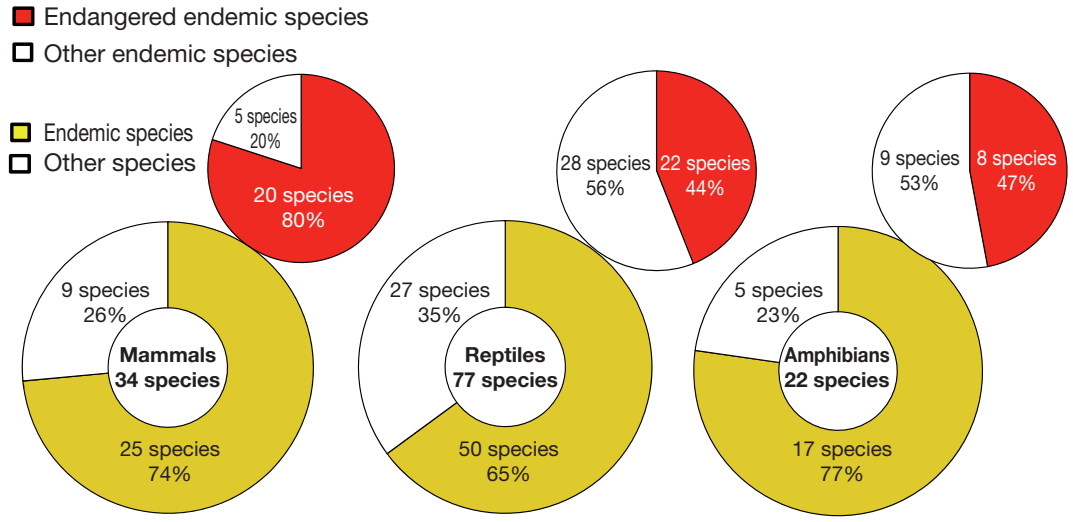
Assessment by the Indicator

○ Though there is no long-term chronological data about changes in the populations and distributions of endemic species on islands, many endemic species living on islands have become endangered due to development and the invasion/expansion of aggressive alien species during the second half of the assessment period.

Reason of the Assessment

<Ratio of Endemic Species on Major Islands>

In island systems, the differentiation of species evolves in isolation from other areas and therefore, there are many endemic species.[1),2)] In the Nansei Islands that have been repeatedly connected to and separated from the Eurasian continent in geological history, and in the Ogasawara Islands that have been long isolated as oceanic islands in geological history, there are particularly high ratios of endemic species in the biota of each area. In fact, 74% of the mammals, 65% of reptiles, and 77% of amphibians (including subspecies) living on the Nansei Islands are endemic species (Data 30- ① : Figure III-25), and 94% of land snails, 28% of insects, and 37% of plants (including subspecies) are endemic species (Data 30- ② : Figure III-26).



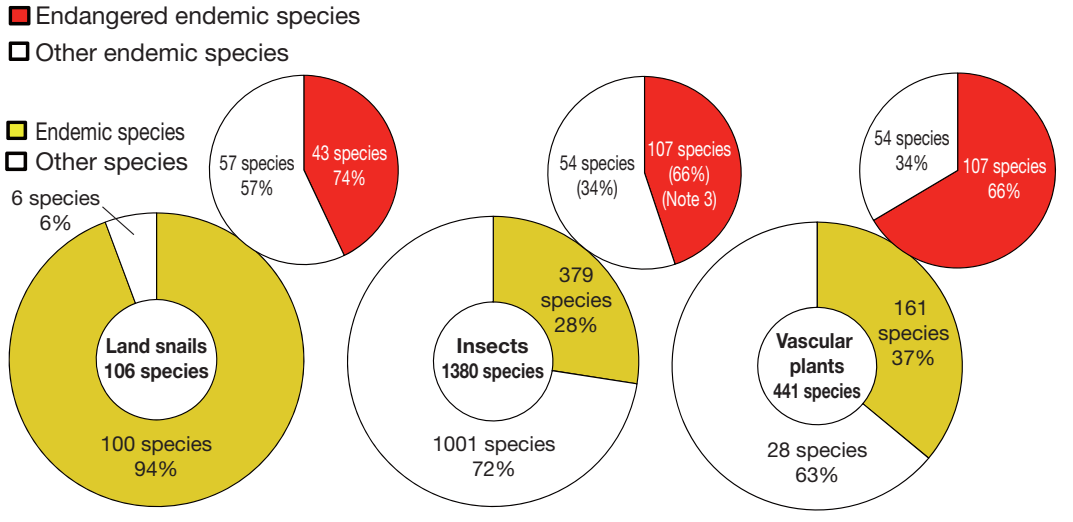
The ratios of mammals, reptiles and amphibians that are endemic to the Nansei Islands (Note 1) and the ratios of endangered species (Note 2) among endemic species were calculated. The ratios of endangered species in Japan are 23% of mammals, 32% of reptiles, and 34% of amphibians.

Note 1: The Nansei Islands include the Tokara Archipelago, the Amami Islands, Okinawa Islands, Kerama Archipelago, Yaeyama Archipelago, Daito Islands, and Senkaku Islands.

Note 2: The ratios of endangered species are ratios of extinct (EX), extinct in the wild (EW), and endangered (CR+EN+VU) species among all species (subspecies) living on the Nansei Islands.

Source: Ministry of the Environment, 2006: FY 2005 Outsourced report on important areas of the Ryukyu Islands nominated as a World Natural Heritage site, Ministry of the Environment, List of Endangered and Threatened Species in Japan, Ministry of the Environment, 1989: Survey for Selection of animal and plant species that need urgent protection

Figure III-25 Ratios of endemic species and endangered endemic species on the Nansei Islands (Data 30-①)



The ratios of land snails, insects and vascular plants that are endemic to the Ogasawara Islands (Note 1) and the ratios of endangered species (Note 2) among endemic species were calculated.

Note 1: The Ogasawara Islands include the Mukojima Archipelago, Chichijima Archipelago, Hahajima Archipelago, island of Nishinoshima, and Iwo Archipelago.

Note 2: The ratios of endangered species are ratios of extinct (EX), extinct in the wild (EW), and endangered (CR+EN+VU) species among all species (subspecies) living on the Ogasawara Islands.

Note 3: The ratio of endangered insects is the total of Buprestidae, Lucanidae, Mordellidae, Cerambycidae, Libellulidae, and bees.

Source: Government of Japan, 2010: Recommendation for the World Heritage List, The Ogasawara Islands, Ministry of the Environment, List of Threatened and Endangered Wildlife Species in Japan

Figure III-26 Ratios of endemic species and endangered endemic species on the Ogasawara Islands (Data 30-②)

BOX 18 Continental relict endemic species — Eublepharidae on the Nansei Islands

The Nansei Islands were formed by repeated separation from and connection to the Eurasian continent that resulted from crustal movements after the Miocene Epoch of the Tertiary period and changes in sea level after the Quaternary period. During the process, living things were isolated on the islands and uniquely evolved. This resulted in the formation of biota with many relict endemic species. Species differentiation among islands is still continuing, and there are abundant new endemic species and many varieties among islands. The Ryukyu ground gecko, a primitive gecko, is a relict endemic species whose most closely related species are endemic to Vietnam and the southeastern part of China, and has differentiated into five species on the island of Tokunoshima and specific islands of Okinawa, reflecting the speciation process on continental islands. On the other hand, deteriorated living environments and poaching are threatening the survival of populations.

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<Effects of Direct Use and Development on the Islands>

During the assessment period, direct uses such as capture and development are thought to have continuously reduced the ecosystems in forests, rivers and neritic areas, and degraded the quality of ecosystems on certain islands, thereby still raising concerns about the effects.

On some islands, several endemic species such as the Daito Varied Tit and Japanese wood pigeon native to the Ogasawara Islands had already been extinct before the assessment period,[3] but the causes of their extinction are not known. Mainly during the first half of the 20th century before the assessment period, marine mammals and birds including the Japanese Sea Lion and short-tailed albatross were excessively captured on some islands in harmful animal control and for such commercial use as the gathering of feathers.[3),4)] These rapidly diminished populations have yet to recover.[4)]

Whereas the nature of the islands had been utilized before the assessment period by local societies, a rapid conversion of forests into agricultural land, land for transportation, and for building sites, and the development of artificial rivers and coasts have been promoted since the second half of the assessment period. On some islands, the numbers of tourists and other visitors have significantly increased. And on the Nansei Islands, the runoff of red soil from such land areas as farmland into neritic areas is seriously affecting such ecosystems as coral reefs and underwater plant beds.[5),6),7)]

The invasion and expansion of aggressive alien species are also having a significant adverse impact on endemic species living on the islands.[8)]

<Causes of Decreasing Endemic Species on the Islands>

The Red List issued by the Ministry of the Environment indicates that among endemic species (including subspecies) living on the Nansei Islands, 80% of mammal endemic species, 44% of reptile endemic species, and 47% of amphibian endemic species are endangered (Data 30- ① : Figure III-25). On the Ogasawara Islands, 74% of endemic land snails, 66% of endemic insects (Buprestidae, Lucanidae, Mordellidae, Cerambycidae, Libellulidae, and bees), and 66% of endemic plant species are endangered (Data 30- ② : Figure III-26). These ratios are higher than those for other endangered species in the country (Data 4- ① : Appendix). Among the causes of this decrease, "development" is the most common (41 species) for endangered mammals, reptiles and amphibians living on the Nansei Islands (45 species), followed by "introduced alien species" (19 species) and "capturing and gathering" (11

species) (Data 30- ③ ; number of species including subspecies: Appendix). In the originally fragile island systems, aggressive alien species have great adverse impact, with particularly significant effects on endemic species.[9),10),11)] On islands such as the Nansei Islands and the Ogasawara Islands that have unique ecosystems due to their geological history with many endemic species including the Amami rabbit, Okinawa rail, Amami woodcock, Ishikawa's frog, Bonin Island honeyeater, and Rhododendron boninense, the effects of aggressive alien species have been extremely serious.[10),11),12),13),14),15)] Escaped or abandoned pets and domesticated animals are also reportedly to have serious impacts such as the predation of endemic species and destruction of vegetation on some islands, particularly the predation of rare species by feral cats on the Nansei Islands,[14),16),17)] the destruction of vegetation by wild goats on the Ogasawara Islands,[18)] and the predation of sea birds by black rats.[19)]

<Effects of Global Warming>

In the coral reef ecosystem of the Nansei Islands, the effects of coral bleaching have been significant in recent years, and its association with global warming is arguably indicated.[20)]

3. Measures for Loss

Though the populations of some rare species have thus far been recovering and certain alien species eradicated as means of protection vigorously promoted through designation of the Country's Rare Wild Species by conservation and propagation projects, and the control of specific alien species, effective measures for conserving all island systems and continuing to enhance existing measures are considered necessary, taking into account the vulnerability of island systems.

<Conservation and Propagation of Rare Species>

On some islands, protected areas have been designated, and for some species, designation of the Country's Rare Wild Species and conservation/propagation projects have been promoted. For example, the short-tailed albatross was once considered to be endangered, but since it was observed on Tori Island in the Izu Archipelago, vigorous protection efforts such as conserving existing nesting sites and luring the birds to new nesting sites have been promoted, and the population is currently recovering (see BOX 19).

BOX 19 Conservation and propagation of the short-tailed albatross

The short-tailed albatross once thrived in abundance on Tori Island in the Izu Archipelago, and its population was estimated to have been at least 5 million. However, its population sharply decreased due to development for gathering feathers since the Meiji period, and around 1950, the species reportedly became extinct. Through the protection efforts and conservation/propagation projects undertaken by scientists since the 1980s, its population has now been recovered to over 2,000 birds. In addition to existing breeding sites, new breeding sites for the short-tailed albatross are now being created on Muko Island in the Ogasawara Islands, and activities to lure the birds are in progress.

A young short-tailed albatross brought to Ogasawara (Muko Island) from Tori Island for breeding

<Measures for Alien Species>

The island systems are small in scale and sometimes have no higher-level predators to inhibit the invasion and settlement of alien species, thereby making such systems especially vulnerable to environmental loads.[11] On islands where many endemic species are distributed, efforts have been promoted to control such alien species as the Javan mongoose, green anole and American bullfrog that seriously affect both endemic species and their ecosystems (see BOX 20).

BOX 20 Eradication of the American bullfrog on the Ogasawara Islands

The American bullfrog, an aggressive alien species, had settled nowhere in the Ogasawara Islands except on Ototo Island in the Chichi-jima Archipelago. On Ototo Island, there are five dragonfly species endemic to the Ogasawara Islands, thereby making it very necessary to eliminate the American bullfrog, and as part of a project of the Ministry of the Environment, control has been carried out since 2004. So far, 64 mature and young adults, and numerous eggs and tadpoles have been eliminated. On Shikanohama, a major habitat, there has been no record of breeding for four years and seven months since June 2005. In nighttime monitoring, no frog calls have been recorded since July 2006. For this species, the period from metamorphosis to maturity is said to be two to three years, and immature individuals are unlikely to live far from the pond; therefore, the American bullfrog has been considered eradicated on Ototo Island. This represents an almost unprecedented case of eradicating a species in the country, and is also believed to be the first case of the complete elimination of the American bullfrog in an archipelago.

An American bullfrog caught by a basket trap

References

1) Fujita, T., K. Takayama, T. Shumiya, and H. Kato, 2008: Vascular flora of Minami-iwo-to Island, Ogasawara research, 33, 49-62.
2) Takagi, M., 2009: Avifauna of Nansei Shoto (southwest islands), Japan, in relation to distances among islands, Japanese Journal of Ornithology, 58: 1-17.
3) Environment Agency, 2002: Revised List of Endangered and Threatened Species in Japan - Red Data Book-2 (birds), Japan Wildlife Research Center.
4) Environment Agency, 2002: Revised List of Endangered and Threatened Species in Japan - Red Data Book-1 (mammals), Japan Wildlife Research Center.
5) Ohgaki, S., and M. Noike, 1992: Land development activity and the coral reef in Shiraho, Ishigaki Island, Okinawa, Japanese Journal of Ecology, 42, 9-20.
6) Tsuchiya, M., and Y. Fujita, 2009: Anguish of coral reefs, Tokai University Press, 203pp.
7) Yasumura, S., S. Maekawa, and T. Sato, 2004: Spatio-temporal distribution of red soil sedimentation in a coral reef at Shiraho, Ishigaki Island, Okinawa, Japanese Journal of Conservation Ecology, 9, 117-126.
8) Ogura, G., T. Sasaki, M. Toyama, K. Takehara, M. Nakachi, O. Ishibashi, Y. Kawashima, and S. Oda, 2002: Food habits of the feral small Asian mongoose (*Herpestes javanicus*) and impacts on native species in the northern part of Okinawa Island, Mammalian science, 42: 53-62.
9) Abe, T., K. Wada, and N. Nakagoshi, 2008: Extinction threats of a narrowly endemic shrub, Stachyurus macrocarpus（Stachyuraceae）in the Ogasawara Islands, Plant Ecology, 198, 169-183.
10) Yamada, F., 1998: The 41st Symposium "Verification from wild mammals in the 20th century: Thinking of environmental impact," Status of alien mammals and problems caused by them in Japan, Mammalian Science, 38, 97-105.
11) Yamada, F., 2006: Challenges in eradicating the invasive mongoose in Japan, Mammalian Science, 46, 99-102.
12) Kotaka N., M. Kudaka, K. Takehara, and D. Sato, 2009: Ground use pattern by forest animals and vulnerability toward invasion by *Herpestes javanicus* into Yambaru, northern Okinawa Island, southern Japan, Japanese Journal of Ornithology, 58, 28-45.
13) Makihara, H., H. Kitajima, H. Goto, T. Kato, and S. Makino, 2004: An evaluation of predation impact of the introduced lizard *Anolis carolinensis* on the endemic insect fauna of the Ogasawara Islands based on insect collection records and feeding experiments, with special reference to longicorn beetles (*Insecta: Coleoptera: Cerambycidae*), Bulletin of the Forestry and Forest Products Research Institute, 3, 165–183.
14) Jogahara, T., G. Ogura, T. Sasaki, K. Takehara, and Y. Kawashima, 2003: Food habits of cats (*Felis catus*) in forests and villages and their impacts on native animals in the Yamabaru area, northern part of Okinawa Island, Japan, Mammalian Science, 43, 29-37.
15) Watari, Y., S. Takatsuki, and T. Miyashita, 2008: Effects of exotic mongoose (Herpestes javanicus) on the native fauna of Amami-Oshima Island, southern Japan, estimated by distribution patterns along the historical gradient of mongoose invasion, Biological Invasions, 10, 7-17.

16) Kawakami, K., and H. Higuchi, 2002: Bird Predation by domestic cats on Hahajima Island, Bonin Islands, Japan., Ornithological Science 1, 143-144.
17) Kawakami, K., and M. Fujita, 2004: Feral cat predation on sea birds on Hahajima, the Bonin Islands, Southern Japan. Ornithological Science 3, 155-158.
18) Tokida, K., 2006: A Report on the Public Symposium at IMC9: Part 4: the feral goat eradication program on the Ogasawara Islands, Mammalian Science, 46, 93-94.
19) Horikoshi, K., H. Suzuki, and T. Sasaki, 2009: The impact assessment of invasive alien mammals on sea bird colonies, Global environmental research, 14, 103-105.
20) Okamoto, M., S. Nojima, and Y. Furushima, 2007: Temperature environments during coral bleaching events in Sekisei Lagoon, Bulletin of the Japanese Society of Fisheries Oceanography, 71, 112-12.

Chapter IV
General Overview of the Assessment

This chapter generalizes the assessment conducted up to now, and presents an overall picture of biodiversity loss in Japan as observed by 2010. Based on these facts, this chapter also discusses the expected biodiversity loss after 2010 and describes the direction of long-term measures.

Section 1 Biodiversity Loss Observed by 2010

This section generalizes the assessment presented in each section in Chapters II and III, comprehensively assesses the loss of biodiversity observed from the second half of 1950s to 2010, and discusses the relationship between these losses and biodiversity services.

1. Assessment of Biodiversity Loss Observed by 2010 (Generalization)

(1) Overview

The following describes the assessment of the status of biodiversity loss in 2010 and the factors of losses from the second half of 1950s to 2010 (Table IV-1).

○ Loss of biodiversity as a result of human activities in Japan has affected all ecosystems, and the loss is continuing on the whole.

○ The degree of biodiversity loss has been especially large in inland water systems, marine and coastal systems, and island systems. The trend towards biodiversity loss is continuing at present.

○ As for the drivers of the loss, the "First Crisis ((brought about by development, direct use, and water pollution)," particularly development, has had the greatest impact, but the speed at which loss attributable to this crisis has slightly abated. The "Second Crisis (reduced use and management of *Satochi-Satoyama* areas)" continues to intensify. Furthermore, among all factors falling under the "Third Crisis (invasive alien species and chemicals)," the effects of invasive alien species are particularly prominent. The "Climate Change Crisis (the impact of climate change on living organisms)" poses serious concerns for certain ecosystems that are particularly vulnerable. Various responses have been taken to address these crises, 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.

○ The Japanese people currently enjoy lifestyles characterized by material wealth and convenience, but for the past 50 years those lifestyles have meant the domestic loss of biodiversity and dependence on the supply of ecosystem services overseas. From 2010 onwards, the lingering effects of past development (First Crisis), the increasing seriousness of the problem of reduced use and management of *Satochi-Satoyama* areas (Second Crisis), settlement and further encroachment by invasive alien species (Third Crisis), rising temperatures (Climate Change Crisis), and other related factors are expected to result in further loss. Thorough responses, including those that address indirect drivers, are necessary. For that purpose, it is important to build consensus at the local level.

Table IV-1 Biodiversity Loss up to 2010

	Current state of loss and trends		Drivers of loss (degree of impact) and current trends				
	Degree of loss from original state	Degree of loss from state as of the second half of 1950s and current trends	First crisis: Development, direct use and water pollution	Second crisis: Reduction in use and management	Third crisis: Invasive alien species and chemical compounds	Climate change crisis	Other
Forest and mountain systems						 *1	
Cultivated systems	–						• Decrease in local varieties of crops and livestock
Urban systems	–			–			
Inland water systems					 *2		
Marine and coastal systems				–	 *3		• Outbreaks of coral predators • Coralline flat
Island and islets ecosystem				–			

Legend

Subject of assessment	State				Drivers			
	Degree of current loss		Trend of current loss		Degree of impact during assessment period		Current trend of impact	
Legend	Not Lost		Recovering		Weak		Decreasing	
	Not significantly lost		Same		Medium		Same	
	Lost		Being lost		Strong		Increasing	
	Significantly lost		Being rapidly lost		Very strong		Increasing rapidly	

Note: The dashed lines for assessing the degree of impact indicate insufficient data.
Note: "*" indicates multiple factors and data related to the indicator in question, as well as existing factors and data that show trends that differ from current assessments of the degrees, effects, and trends of overall loss.
* 1: The degree of impact on alpine systems has been and continues to be serious.
* 2, * 3: While the problem of chemical compounds has been mitigated to some extent, the problem of invasive alien species is serious.

(2) Factors of the loss

"The first crisis" (development, direct use, and water pollution), "the second crisis" (a reduction in the use/management of ecosystems), "the third crisis" (alien species and chemical substances), and "the climate change crisis" (rising temperatures) are all wielding strong impacts as direct factors of loss.

<The First Crisis and Its Indirect Factors>

Since the second half of 1950s, "the first crisis," especially the influence of development, has caused the largest loss of biodiversity in Japan.

As the background of "the first crisis," socioeconomic changes during the period of high economic growth from the second half of 1950s to the first half of 1970s, and social demand accompanied by other changes are considered indirect factors (see Table VI-3 on later page). During this period, the national population rapidly grew by 1 to 2% annually. Japan began to rely on fossil fuels from overseas as its main energy source, industry was dramatically developed, and population became concentrated in cities. In response to such phenomena, forest and mountain systems must provide a large quantity of timber; cultivated systems and marine and coastal ecosystem need to provide food efficiently; inland water systems must contain frequently occurring floods and secure enough water for power generation, industry and daily life; marine and coastal systems and urban systems need to secure land for housing and industry, and prevent such disasters as tidal waves.

The development of various ecosystems was promoted nationwide due to these indirect factors. The factors caused a huge impact, especially on inland water systems, marine and coastal systems, and island systems.

These social demands are now being satisfied somewhat by economic growth and rising income levels, huge volumes of energy, food and timber supplied from abroad, improved housing and facilities for industry, and the development of social capital. This is why the pace of "the first crisis" causing damage to biodiversity tends to slow down (see Table VI-3 on later page). However, relatively small-scale development and regional development are still underway. It is also difficult to restore the interaction among living organisms or between living organisms and the environment in ecosystems damaged by past development. There are concerns that such impact will continue or be observed in the future.

As for measures against "the first crisis," the "protected area system" has been improved during the assessment period, and designated areas also expanded. Regulation of water discharge has been promoted to conserve water quality. Considerations have recently been given for improving social capital and efforts initiated for sustainable agriculture, forestry and fishery industries. These measures are considered to have had certain effects. However, all these measures are not necessarily effective enough to counter major socioeconomic changes that have functioned as indirect factors in Japan. Therefore, improving important areas in terms of conserving biodiversity and restoring the huge damage caused in the past are still considered to be our tasks.

<The Second Crisis and Its Indirect Factors>

"The second crisis" is causing damage to forest and mountain systems and some cultivated systems. The socioeconomic changes that began during the period of high economic growth from the second half of 1950s to the first half of 1970s functioned not only as "the first crisis" but also as "the second crisis" (see Table VI-3 on later page). The dependence on fossil fuels from overseas during the period of high economic growth resulted in much less use of fuelwood taken from secondary forests. It also consequently caused changes in agricultural methods that reduced the use of secondary forests and secondary grasslands in terms of grazing land and mowing. After that, as food and timber began to be imported from abroad, the trend toward depopulation and aging residents in farming villages continued. During the decade from 1980 to 1990, more fields were abandoned due to a shortage of workers engaged in agriculture, forestry and fishery operations. Insufficient management in terms of thinning or weeding became problematic in artificial forests. At the same time, fewer hunters and less hunting pressure due to aging also became apparent.

"The second crisis" is caused by reduced or discontinued human approaches to "Satochi-Satoyama" areas or secondary forests, artificial forests, farmland, channels, ponds, and grasslands that surround settlements due to such socioeconomic changes as indirect factors. In Japanese Satochi-Satoyama areas, the biota that once thrived in some natural forests and floodplains depended on disturbances caused by the use and management of traditional farmland, secondary forests and secondary grasslands, and thus helped interactions among living organisms and between organisms and the environment. Upon losing their economic value, secondary forests and secondary grasslands will be proactively used for other purposes. Such reduction of use may be shifted to "the first crisis." However, in "the second crisis," such reduction of use and management also reduces the disturbances that had long been maintained, and the transition of vegetation will gradually degrade the quality of ecosystems in a relatively longer time frame. The impact of the reduced use and management on biodiversity is complicated, and further study is needed for specific solutions. Not all impacts of "the second crisis" progress gradually, but some may cause loss in a very short period. For example, the growing population and distribution of deer due to less hunting pressure is affecting natural vegetation.

These indirect factors of decreased human interaction with nature are still functioning on an ongoing basis. Therefore, said impact is gradually increasing today (see Table IV-3 on later page).

As for measures regarding "the second crisis," the population control of birds and medium-size to large mammals is in progress. However, such measures regarding indirect factors as promoting the use of natural resources and creating a framework in which local entities can cooperate are still being discussed.

<"The Third Crisis" and Its Indirect Factors>

The huge impact of "the third crisis," especially the impact of alien species, has been alarming in recent years. The issue of alien species was partly caused by the drastic increase of international trade and exchange over the past 50 years (see Table VI-3 on later page). During the assessment period, alien species were intentionally imported as pets or materials for industry, or unintentionally introduced as they clung to cargo or were mixed in ballast water, and then intruded and settled in domestic ecosystems. Some species demonstrated rapid expansion. Among alien species, the impact of invasive ones that cause serious damage to ecosystems is particularly huge in isolated ecosystems such as inland water systems and island systems, and this impact on virtually all ecosystems is growing.

Measures taken against invasive alien species achieved great progress in the 2000s from the standpoint of preventing further damage to biodiversity, through the introduction of import regulations and other regulations on feeding, planting, storage, carrying and release in terms of preventing invasion. Problems are pointed out regarding the control of settled species (e.g., capture, collection, eradication, measures to prevent damage). As for chemical substances, regulations on production, importation and use have been enacted since the 1970s in considering the impact on humans, and the situation has generally improved.

<The Climate Change Crisis and Its Indirect Factors>

The indirect factor of "the climate change crisis" is the emission of greenhouse gases such as carbon dioxide. The volume of such emissions increased dramatically over the past 50 years and continues to rise. "The climate change crisis" is of course caused by greenhouse gas emissions worldwide, and not only from Japan. In the 1990s and later, the total volume of carbon dioxide emissions continued to increase despite international efforts. The domestic volume of emissions is much greater now than that in 1990. The increased emissions from households are of particular concern.

The causes and effects of biodiversity loss due to global warming remain controversial, but global warming has had a profound impact on forest and mountain systems (alpine zones), marine and coastal systems (e.g., coral reefs), and island systems.

Such mitigation measures as curtailing greenhouse gas emissions shall be promoted based on an international framework. Japan must also discuss measures for adapting to the impact of global warming on biodiversity.

<For Mainstreaming of Biodiversity>

Greater social awareness of biodiversity is important as the basis of measures against damage. Social awareness and "nature conservation" activities were observed in the early stages of the assessment period. In the later stages of the assessment period, a trend toward familiarizing oneself with nature began to be widely recognized in society. The notion of biodiversity has been institutionalized since the 1990s, but is still not considered widely accepted in society.

(3) Loss of biodiversity in individual ecosystems

The loss of biodiversity has affected all ecosystems in Japan, and continues even now as a whole. The factors behind the losses caused by the "first crisis," "second crisis," "third crisis," and "the climate change crisis" do not demonstrate their individual impact, but intricately function with one another to cause losses in ecosystems (see Table IV-2).

Table IV-2 Assessment of Loss in Each Ecosystem (Chapter III)

Ecosystem	Assessment of loss in each ecosystem
Forest and mountain systems	Loss in forest and mountain systems occurred during the assessment period from the second half of 1950s to the present, and is likely to worsen on a long-term basis. ○ The overall size of a forest apparently does not make a large difference, but pristine natural forests have diminished through conversion into artificial forests. The connectivity of forests has also been decreasing. [First crisis] ○ During the latter half of the assessment period, the rate of deterioration of pristine natural forests slowed down, while the quality of ecosystems in secondary forests and artificial forests has been declining. [Second crisis] ○ Recently, as deer populations have increased along with an expanded distribution, the damage to trees and underlying vegetation has become evident. There are also reports about a negative influence on alpine plants probably due to global warming. [Second crisis and climate change crisis] ○ Presently, there is less impact on forests by development due to changes in the socioeconomic situation, but ongoing influence raises concern.
Cultivated systems	Loss in cultivated systems occurred during the assessment period from the second half of 1950s to the present, and is likely to worsen on a long-term basis. ○ The development of residential land mostly in the first half of the assessment period, as well as changes in agriculture and agricultural methods, contributed to smaller-scale cultivated systems and lower quality. [First crisis] ○ The reduced use of fields, mostly in the first half of the assessment period, as well as less use of agricultural land, mostly in the second half of the assessment period, contributed to smaller-scale cultivated systems and lower quality. [Second crisis] ○ Presently, there is less impact on cultivated systems resulting from development and direct use, as well as changes in agriculture and agricultural methods, due to changes in the socioeconomic situation, but ongoing influence raises concern. It is also concerned about the growing influence of the reduced use and control of agricultural land.
Urban systems	Loss in urban systems occurred during the assessment period from the second half of 1950s to the present to some extent, and is likely to worsen on a long-term basis. ○ A reduction of green tracts of land in cities, such as agricultural land and woods, as well as the deteriorating quality of river water, during a period of high economic growth in the first half of the assessment period contributed to a reduction and lower quality of habitats for living creatures. [First crisis] ○ The preparation of new green lands in urban areas as well as the improved quality of river water progressed in the second half of the assessment period; as a result, the distribution of some living creatures inhabiting such environments is expanding.
Inland water systems	Significant loss in inland water systems occurred during the assessment period from the second half of 1950s to the present, and is likely to worsen on a long-term basis. ○ A gathering of pebbles and gravel, the creation of artificial rivers, and the reclamation of lakes, marshes and wetlands since the first half of the assessment period contributed to smaller-scale inland water systems, as well as lower quality and more fragmentation, throughout Japan. [First crisis] ○ Conversely, the quality of lake water and marshes, likely to have deteriorated in the first half of the evaluation period, improved in the second half. [First crisis] ○ Presently, there is less impact on inland water systems from development due to changes in the socioeconomic situation, but ongoing influence raises concern. It is also concerned that living creatures may be captured and gathered for ornamental purposes, as well as a greater influence of alien species. [First crisis and third crisis]
Marine and coastal systems	Significant loss in marine and coastal systems occurred during the assessment period from the second half of 1950s to the present, and is likely to worsen on a long-term basis. ○ In particular, development in the first half of the assessment period contributed to a significant reduction in the nationwide scale of some marine and coastal systems, such as tidal flats and natural coastlines. [First crisis] ○ Presently, there is less impact on marine and coastal systems by development, such as reclamation in coastal areas, due to changes in the socioeconomic situation, but ongoing influence raises concern. We also face new concerns over deteriorating erosion of the coastline, an invasion of alien species, and the effects of global warming. [Third crisis and climate change crisis]
Island systems	Significant loss is currently observed in island systems. While there is lack sufficient data to assess conditions in the first half of the assessment period, the situation deteriorated in the second half of the assessment period (since the second half of the 1970s) and is likely to worsen on a long-term basis. ○ Due to the development and invasion/settlement of alien species, the habitats of some domestic species, including endemic ones, are deteriorating. [First crisis and third crisis] ○ It is concerned about the effects of global warming on the coral reef ecosystem. [Climate change crisis]

<Ecosystems Suffering Particularly Huge Loss as Observed during Assessment Period>

The loss of biodiversity is serious in inland water systems, marine and coastal systems, and island systems. The loss now tends to be exacerbating. In these ecosystems, the current impact manifested by the "third crisis (alien species)" is intricately functioning in connection with the strong impact of the conventional "first crisis."

In inland water systems, such development over the past 50 years as reclamation in wetlands and lakes, the gathering of gravel in rivers, increasing numbers of artificial river banks and lake shores, and the construction of dams and floodgates has damaged the intrinsic scale, quality and continuity of ecosystems to a great extent. For example, the reduction of gravel riversides due to lowered riverbeds and decreased vertical continuity within the rivers between inland water areas and floodplains are pointed out. In particular, inland water systems consist of a water system network along with paddy fields, channels and reservoirs that comprise some cultivated systems, and have contributed to the maintenance of biota observed in floodplains. There are concerns that this deteriorated continuity might impact the entire water system network that includes cultivated systems. The major cause of loss was considered to be water pollution (eutrophication) due to water discharge from industries, agriculture as well as households. The situation is now improving thanks to countermeasures. Conversely, invasive alien species such as largemouth bass have had a huge impact on water areas and the waterside environment in recent years. The influence of chemical substances has not been fully clarified, but there are still some concerns.

In marine and coastal ecosystems, such development in coastal areas as reclamation of coastal lines over the past 50 years, the gathering of sea gravels (beach sand, etc.), and artificial seashores had a huge impact. In some enclosed coastal seas, water pollution (eutrophication) is still underway and exacerbated by accelerated coastal erosion, the expansion of invasive alien species, and impact associated with global warming, thus causing a serious decrease in the size and degraded quality of ecosystems that include tidal flats, kelp coasts and coral reefs. The status of useful fish resources in the ocean is also not very reassuring.

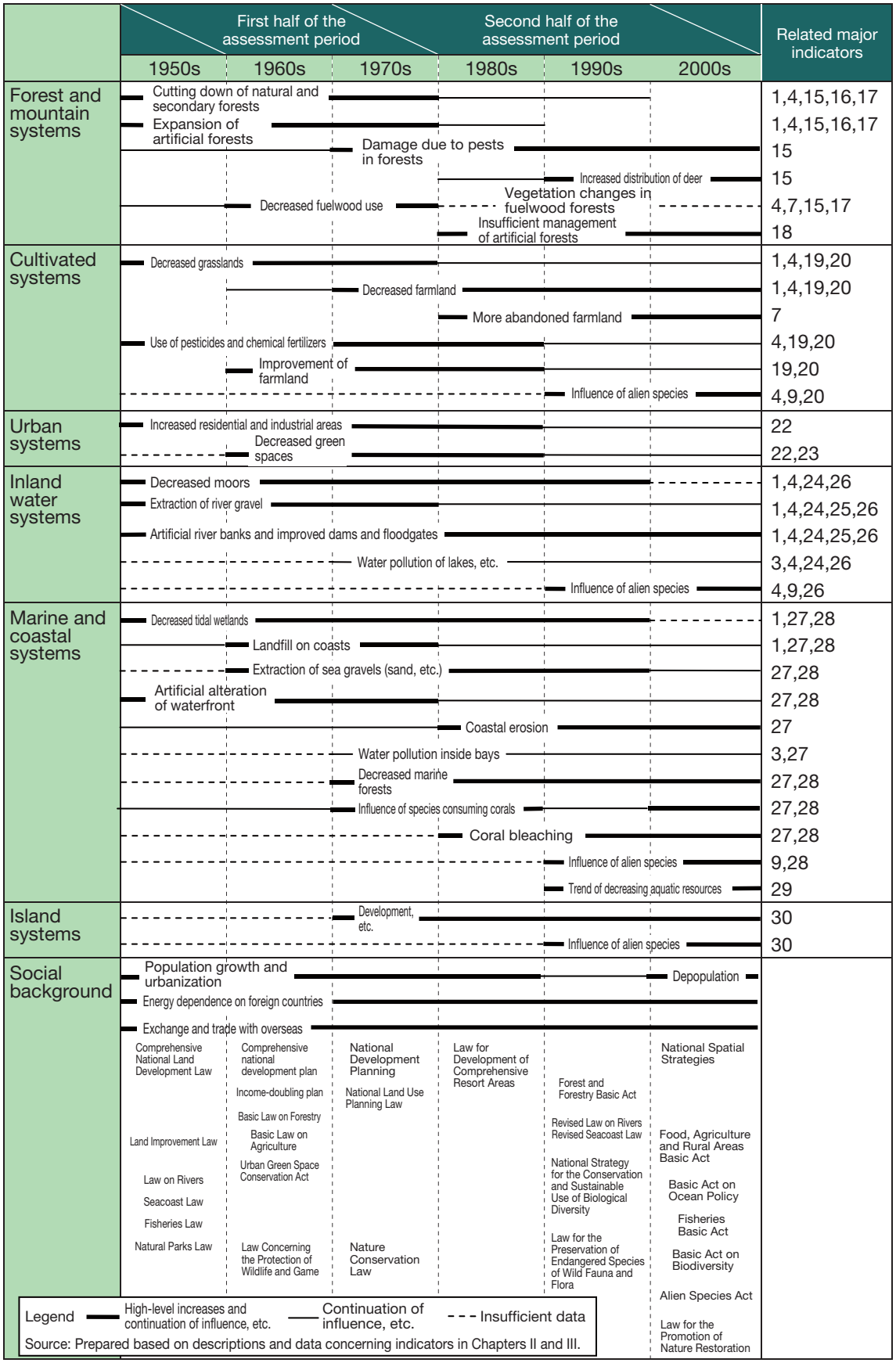
The island systems are small in size, highly fragile, and susceptible to the factors of loss. In addition to the impact of development, such invasive alien species as the small Indian mongoose in the Nansei Islands and Carolina anoles (*Anolis carolinenses*) in the Ogasawara Islands have had a serious impact on endemic species in recent years. Measures to eliminate some of these species have already been initiated on these islands. Moreover, the successful eradication of invasive alien species has been reported from very small islands.

<Ecosystems Suffering Huge Loss as Observed during Assessment Period>

The forest and mountain systems and cultivated systems are also damaged. These ecosystems are characterized by the impact of "the second crisis" along with the "first crisis."

In the past 50 years, the conversion to artificial forests has been promoted in forest and mountain systems, and forests with high naturalness have decreased. Judging from the intrinsic forest and mountain systems, the entire loss of those before the assessment period is serious. The conversion of cultivated systems for housing development reduced the area of farmland, and the development of farmland and channels degraded the quality of cultivated systems. At the same time, the ecosystems in "Satochi-Satoyama" areas where intricate mosaic patterns are formed with surrounding farmland, channels, reservoirs, secondary forests, artificial forests and grasslands have been reduced in scale or degraded in quality due to less traditional use that maintained those ecosystems for generations. The degraded continuity in the water system network formed when linking paddy fields, channels and reservoirs (that comprise some cultivated systems) to inland water systems is also a concern.

Table IV-3 Major topics concerning factors and assessment of biodiversity loss



Source: Prepared based on descriptions and data concerning indicators in Chapters II and III.

2. Biodiversity Loss and Ecosystem Services in Japan

(1) Summary

Generally speaking, the loss of biodiversity degrades ecosystem services. However, some degradation was caused during the assessment period only when focusing on certain ecosystem services. It is also noted that the dependence on ecosystem services from abroad was promoted to a large extent during the period.

(2) What are ecosystem services?

The ecosystem services refer to the benefits and convenience that human beings receive from ecosystems. Our daily lives are supported by various ecosystem services. The Millennium Ecosystem Assessment (MA) classifies ecosystem services into four categories: the service that provides food, water and timber (provision service), the service that regulates climate, flood and water quality (regulation service), the cultural service that offers recreation and mental satisfaction (cultural service), and the service that functions as the basis of other ecosystem services such as soil formation and pollination (basis service).

Biodiversity is the foundation on which to provide ecosystem services. Various ecosystems have provided services, which support our lives.

Regarding the provision service, for example, forest and mountain systems provide us with such timber as cedar and Japanese cypress to be used as construction materials; cultivated systems provide us with food that includes such agricultural products as rice, vegetables and fruits, and livestock products; inland water systems and marine and coastal ecosystems provide us with such food as fish and shellfish. The forest and mountain systems and inland water systems also provide water for household and industry. As for the regulation service, forest and mountain systems regulate the atmosphere, climate and water, inhibit soil erosion, and prevent mountain disasters. Cultivated systems control diseases and harmful insects by employing natural enemy organisms and offer pollination through bees and other insects. All ecosystems involve the cultural service. Diversified climate in Japan has resulted in the creation of festivals and food culture unique to individual regions. Educational value appreciated through children's play such as hunting for insects and such recreation as mountain climbing, sea bathing and diving are also offered by ecosystems. Excellent natural landscapes designated as national parks have offered aesthetic values that have been used as artistic themes since the olden days. Ecosystems also provide the basis service regarding soil formation and photosynthesis.

The ecosystem services shall be provided in response to socioeconomic demand. Changes in the form and content of these services are observed in order to meet the needs of the times. For example, forest and mountain systems used to provide animal furs to be used for protection against the cold through hunting in the olden days. The provision of such services is now decreasing.

Comprehensive assessment has yet to be achieved, however, regarding the volume of ecosystem services provided by the ecosystems in Japan or the transition of the contents and kinds of services as illustrated here.

Table IV-4 Classification of ecosystem services in millennium ecosystem assessment and examples in Japan[1)]

Services listed in the Millennium Ecosystem Assessment			Examples of services in Japan	Major ecosystems that provide services
A Provision service	Food	Agricultural products	Cultivation of rice, vegetables and fruits	Cultivated systems
		Livestock	Raising of beef cattle, dairy cattle, pigs, chickens, etc.	Cultivated systems
		Fishery	Fishing for fish and shellfish in rivers, lakes and sea	Inland water systems, marine and coastal ecosystems
		Aquaculture	Cultivation of fish and shellfish in lakes and sea	Inland water systems, marine and coastal ecosystems
		Products from wildlife	Gathering of mountain vegetables and mushrooms (hunting of wild animals and birds)	Forest and mountain systems, etc.
	Fibers	Timber	Construction materials such as cedar and Japanese cypress	Forest and mountain systems
		Cotton, linen, and silk	(Cultivation of cotton plants, silk cultivation)	Cultivated systems
		Firewood	(Fuelwood)	Forest and mountain systems
	Genetic resources		(endemic species of grains, vegetables and livestock)	Cultivated systems, etc.
	Biochemical substances, natural medicine			
	Materials for ornamentation		Japanese lacquer and other paints, plant dye, gardening	Forest and mountain systems, cultivated systems, etc.
	Fresh water		Water intake from rivers for industrial and household use, hydraulic power generation	Inland water systems, forest and mountain systems, cultivated systems
B Regulation service	Regulation of atmosphere			Forest and mountain systems, etc.
	Regulation of climate		Absorption of greenhouse gases by forests	Forest and mountain systems
	Regulation of water		Flooded irrigation by forests, wetlands, and paddy fields	Forest and mountain systems, inland water systems, cultivated systems, Inland water systems, marine and coastal ecosystems, etc.
	Inhibition of soil erosion		Inhibition of soil erosion by forests	Forest and mountain systems, etc.
	Water purification and waste disposal		Water purification function of tidal flats	Forest and mountain systems, inland water systems, cultivated systems, Inland water systems, marine and coastal ecosystems, etc.
	Disease prevention			
	Control over diseases and harmful insects		Control of harmful insects by natural enemy insects and farm animals	Cultivated systems, etc.
	Pollination		Pollination of farm produced by bees	Cultivated systems, etc.
	Protection against natural disasters		Prevention of mountain disasters by forests, breakwaters by sandy beaches and coral reefs	Forest and mountain systems, marine and coastal ecosystems
C Cultural service	Cultural diversity		Festivals and food culture characterized by individual regions	All ecosystems
	Mental/religious values		Local religions represented by sacred shrine forest	
	Knowledge system (traditions/customs)		Agricultural calendar	
	Educational value		Insect hunting by children	
	Inspiration		Seasonal words for *haiku* poems	
	Aesthetic value		Visiting national parks	
	Social relationship		National character/Prefectural character	
	Feelings toward the place		Prefectural bird/flower	
	Value as cultural assets		Natural treasure, scenic beauty	
	Recreation and ecotourism		Mountain climbing, sea bathing, shellfish hunting, diving, eco-tours	
D Basis service	Soil formation		Soil formation by interaction of organisms	All ecosystems
	Photosynthesis		Oxygen production by plants	
	Primary production		Assimilation/accumulation of energy and nutritive salts by organisms	
	Circulation of nutritive salts		Circulation of nutritive salts necessary for life	
	Water circulation		Water circulation necessary for life	

Source: The table was created based on the Millennium Ecosystem Assessment.
Note: Parenthesized items are provision services that no longer have economic significance.

(3) Biodiversity loss and deteriorated ecosystem services

The loss of biodiversity in Japan as mentioned before is associated with the provision of ecosystem services. Ecosystems function as supported by organisms. If the work of organisms is damaged, ecosystem services will also be deteriorated. There are some ecosystem services such as the food chain and decomposition that cannot be obtained if the interaction of organisms in the intrinsic ecosystem is not maintained.

There are also cases where the factors that damage biodiversity also deteriorate ecosystem services.

For example, the coral reef ecosystem in the Nansei islands provides several ecosystem services that include such sightseeing/recreation activities as diving and snorkeling, the provision of fish habitats for commercial marine products, and protection against high waves and erosion as a natural breakwater. According to calculations made by the Ministry of Environment with limited subjects based on some hypotheses, the annual economic value of the domestic coral reef ecosystem service accounts for 239.9 billion yen in the field of sightseeing/recreation, 10.7 billion yen for providing commercial marine products, and 7.5 to 83.9 billion yen for protection against water and erosion damage.[2)] At present, coral reef ecosystems in Japan have been seriously damaged by bleaching caused by abnormally high seawater temperatures, an abnormal growth of such coral predators as acanthasters, and an inflow of soil from land areas. As a result, services from these coral reef ecosystems might not be sufficiently provided in the future.

Invasive alien species cause biodiversity loss in various ecosystems as stated before. These species also damage such ecosystem services as agriculture, forestry and fishery. For example, raccoons (*Procyon*)—designated an invasive alien species by the Invasive Alien Species Act—consume native organisms that include rare species, thereby damaging those species, livestock feed, melons, watermelons, strawberries, and aquacultured fish. Largemouth bass, also designated an invasive alien species, compete with other fish in consuming fish, shrimp, and land/water insects that include rare species, thereby having an adverse impact. It is also pointed out that largemouth bass damage the fishery in rivers and lakes by consuming sweetfish, Hypomesus olidus and other fish.

The purpose of hunting for shellfish is not only gathering asari or hamaguri clams. It also offers the educational value of contacting, appreciating and nurturing various organisms in tidal flats. Thus, the loss of biodiversity will eventually deteriorate such ecosystem services.

(4) Tradeoff between biodiversity and ecosystem services

The relationship between biodiversity and ecosystem services is not simple. Damaged biodiversity may not directly result in deteriorated ecosystem services. For example, the extinction of a particular species definitely means a loss of biodiversity. However, if the species was not used for industry, the impact on ecosystem services may be overlooked.

The modification of or an approach to ecosystems is often required in order to obtain ecosystem services or the provision of a particular service. However, this process may cause a certain degree of biodiversity loss. In other words, there is a tradeoff between biodiversity and ecosystem services.

During the assessment period in Japan, there was too much focus on certain ecosystem services that caused biodiversity loss, At the beginning of the high economic growth period starting in the 1950s, various ecosystem services, particularly the efficient, large-volume provision service, were necessitated by socioeconomic demand. Forest and mountain systems were needed to provide a large volume of timber in response to growing housing demand promoted by urbanization. Forests with high naturalness were converted into artificial forests. In cultivated systems, the use of agricultural chemicals and fertilizers began in response to the need for efficient food supply, and farmland and canals were improved.

These measures improved the performance to provide part of the provision service. However, as mentioned in Section 1, modifications and approaches accompanied by these efforts functioned as "the first crisis" against biodiversity and caused loss in some cases.

A situation of low diversity would otherwise be created where only one type of plant or tree was grown. Such a situation is known to reduce natural enemies against harmful insects for crops, and heighten the risk of disease and harmful insects.[3] It is pointed out that land features where farmland and forests form intricate mosaic patterns will secure pollination service for crops.

(5) Dependence on ecosystem services from abroad

Ecosystem services may not necessarily be provided by domestic ecosystems. In Japan, the forest, agricultural, inland water, and marine and coastal ecosystems have historically provided food, timber, and fuel. Before the Meiji era and under a national closed-door policy, trading with foreign counties was limited, and thus most of the provision service was procured within domestic ecosystems. However, due to socioeconomic changes after the period of high economic growth, Japan began to rely on many ecosystem services from abroad.

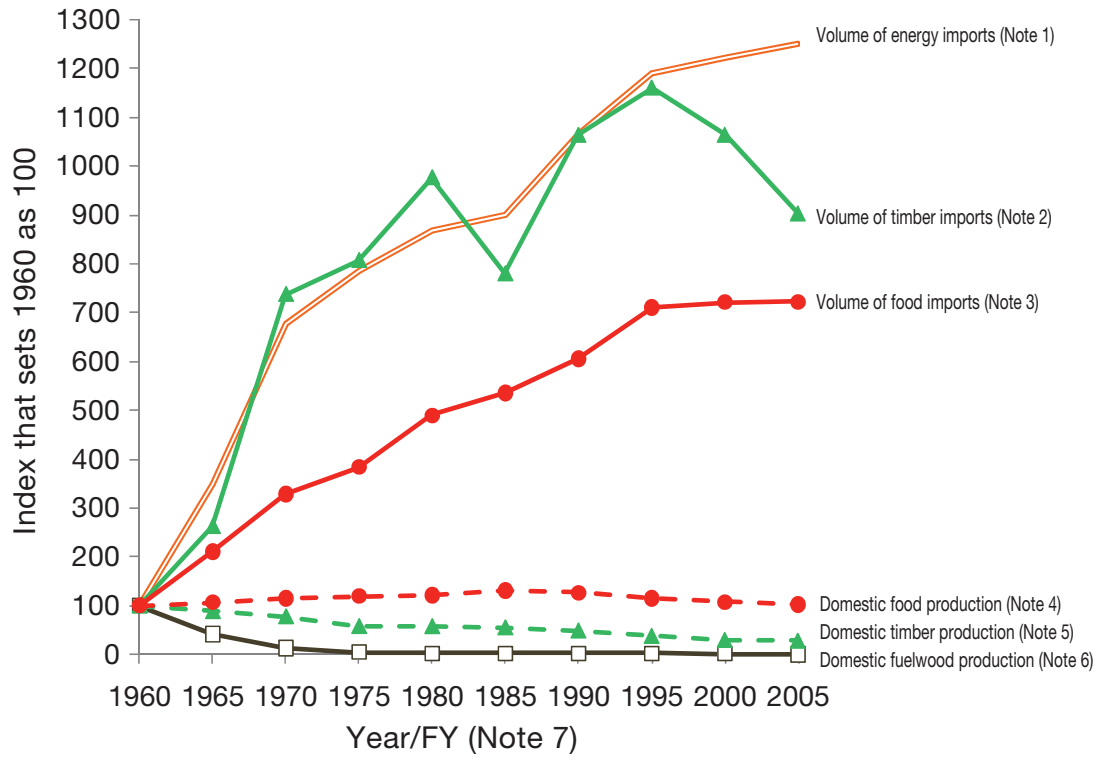
For example, since the 1950s, in line with the introduction of free trade involving timber, a large volume of cheap timber has been provided from abroad.[5] Japan currently relies on imports for about 80% of its domestic timber demand.[5] Conversely, the volume of domestic forests (mainly artificial forests) accumulated has increased over the past 50 years.

Since the 1960s, the volume of food imports has also been rising. Japan now depends on foreign agriculture and fishery[6] for about 60% of its calorie supply. In contrast, domestic farmland is on the decline. The abandonment of more cultivated land area has also been a serious issue since the 1980s.

As for energy, during the 1950s when the period of high economic growth began, imports of foreign oil rapidly increased (in the energy revolution). Since the 1970s Japan has imported approximately 80 to 90% of its energy supply from abroad.[7] The supply of fuelwood provided by domestic secondary forests was already less than the energy supplied from coal and hydraulic power plants in the 1950s, and the production volume of fuelwood rapidly decreased during this period.[5),8]

As already mentioned, Japan depends on overseas ecosystems for most of its ecosystem services. As seen in the greater volume of domestic forests accumulated, even if the potential of domestic ecosystems to provide ecosystem services increases or is maintained, it may not be fully utilized for actual provision. This is explained by the reduced use of ecosystems (the second crisis). It also means that Japan is damaging biodiversity overseas.

The relationship between biodiversity and ecosystem services may not be fully explained regarding its scientific resolution or economic assessment. It is important to set up indicators or conduct monitoring based on the progress of research conducted in the future.



Note 1: Volume of imports against domestic supply of the primary energy (Unit: PJ)
Note 2: Combined total of the volume of timber imports in the timber supply/demand table
Note 3: Combined total of the weight of each imported item in the food supply/demand table
Note 4: Combined total of the weight of domestic production of each item in the food supply/demand table
Note 5: Combined total of the volume of domestically produced timber supply in the timber supply/demand table
Note 6: Combined total of the volume of fuelwood supply in the timber supply/demand table.
Note 7: The volume of timber imports, the volume of domestic timber production, and the volume of domestic fuelwood production are based on the calendar year. All others are based on the fiscal year.
Source: The food supply and demand sheets, Ministry of Agriculture, Forestry, and Fishery; the timber supply and demand sheets, Ministry of Agriculture, Forestry; General Energy Statistics, Agency for Natural Resources and Energy

Figure IV-1 Change of volume of food, timber, and energy imports in Japan (Index that sets 1960 as 100)

References

1) Millennium Ecosystem Assessment (compilation), 2007: United Nations Millennium Ecosystem Assessment, Ecosystem services and the future of mankind, Ohmsha, Ltd., 68-74.
2) Ministry of Environment (compilation), 2009: Annual Report on the Environment, the Sound Material-Cycle Society and the Biodiversity in Japan, NIKKEI PRINTING Inc., 47.
3) Balvanera, P., A.B. Pfisterer, N. Buchmann, J.S. He, T. Nakashizuka, D. Raffaelli, and B. Schmidt, 2006: Quantifying the evidence for biodiversity effects on ecosystem functioning and services, Ecology Letters, 9, 1 — 11, doi: 10.1111/j.1461-0248.2006.00963.
4) Ricketts, T.H., G.C. Daily, P.R. Ehrlich, and C.D. Michener, 2004: Economic value of tropical forests to coffee production, PNAS, 101, 34, 12579 — 12582.
5) The timber supply and demand sheets, Ministry of Agriculture, Forestry
6) The food supply and demand sheets, Ministry of Agriculture, Forestry, and Fishery
7) General Energy Statistics, Agency for Natural Resources and Energy
8) Umemura, M., Compiled by Toyo Keizai Inc., 1982: Long-term Economic Statistics (9) Agriculture and Forestry, Toyo Keizai Inc.

Section 2 Assessment of Progress toward Achieving the 2010 Target

1. What is the 2010 Target?

The 2010 Target is an international target "to achieve by 2010 a significant reduction in the current rate of biodiversity loss" as agreed upon at the Convention on Biological Diversity.

The Strategic Plan for the Convention on Biological Diversity (Resolution VI/26) was adopted at the 6th Conference of the Parties to the Convention on Biological Diversity (2002). In this strategic plan, it was reconfirmed that biodiversity is inevitable for sustainable development, and being lost at an accelerating rate. As a result, the 2010 Target was adopted. The target was approved by the participating governments and leaders at the Johannesburg Summit held two months after the 6th Conference of the Parties to the Convention. At the 7th Conference of the Parties to the Convention in 2004, seven focal areas were agreed upon in order to assess the progress toward achieving this goal (Resolution VII/30). For individual seven areas, 11 goals and 21 targets were established as subordinate targets for the 2010 Target regarding biodiversity in general.

Indicators to assess the status and transition of biodiversity were suggested internationally for each target. The progress made toward the 2010 Target was already assessed. The Global Biodiversity Outlook 3 (GBO3) was prepared by the Convention on Biological Diversity Secretariat and released in 2010. GBO3 revealed that none of the 21 targets were achieved on a global scale, and that nine out of the 15 indicators showed negative transition for biodiversity. This revealed recognition of greater pressure on biodiversity and ongoing biodiversity loss, and that the 2010 Target has not been achieved at the global level.

Based on these global level assessments, this section describes the progress made by Japan toward achieving the 2010 Target as assessed by applying the indicators to the 21 goals.

The concept of assessment of the progress toward achieving the 2010 Target

- ○ The progress toward the goal ("a significant deceleration of biodiversity loss by 2010") shall be assessed by comprehensively judging the progress toward the 21 targets.
- ○ One or several indicators shall be set to evaluate the targets among the 21 targets considered to have significance in terms of biodiversity and socioeconomic status in Japan.
- ○ The targets and indicators do not directly show the speed of deterioration. Assessment is presented by the degree of progress made toward achieving the targets (○ for 'achieved'; △ for 'insufficiently achieved'; × for 'not achieved') and trend (↗ a plus for biodiversity; ↘ a minus for biodiversity; ↑↓ no specific trend).
- ○ The assessment of the degree of progress toward achieving each goal in 2010 shall be the assessment of the 2000s that includes the progress in 2002 when the goals were set and progress in the target year of 2010.
- ○ The degree of progress toward achieving each goal shall be assessed as "achieved" when all factors in the interpretation of the goal are satisfied; "insufficiently achieved" when most factors are satisfied; "not achieved" when most factors are not satisfied.
- ○ The assessment shall be described in a simple manner using the internationally established indicators based on the Strategy Plans of the Convention on Biodiversity, and adopting appropriate indicators and data used in Chapters II and III.

2. Assessment of Progress Toward Achieving the 2010 Target in Japan

(1) Progress toward achieving the 2010 Target

In order to assess the progress toward achieving the 2010 Target, assessment was conducted based on the indicators for individual targets presented in the framework of goals and targets (Table IV-5).

Assessment was conducted for 15 of the 21 targets. As for the degree of progress, two targets were achieved, ten were insufficiently achieved, and three not achieved. As for trends in the 2000s, six targets were assessed as a plus for biodiversity, seven had “no specific tendencies,” and one target was assessed as a minus for biodiversity.

As for the overall progress in such areas as "Efforts to Confront the Threat to Biodiversity" and the " Protection of the Constituent Elements of Biodiversity," measures have been progressed and are functioning to reduce the speed of biodiversity loss as compared with the status in 2002 when the targets were established in some areas. Conversely, for such targets as Target 7-1 (“Maintain and strengthen the resilience of the constituent elements of biodiversity for adaption to climate change”) in the goal and "Promote the conservation of genetic diversity" in the field of "promoting sustainable use," some measures have been taken. However, the trend of biodiversity loss is not considered to have stopped judging from the indicators. By judging all these issues comprehensively, it is concluded that the overall trend of biodiversity loss is not stopped even though the status of biodiversity in Japan have seen partial improvement.

Based on the above, it is necessary to further promote continuous recognition and assessment of the situation and measures against biodiversity loss in order to conserve biodiversity and its sustainable use after 2010.

Table IV-5 Progress toward achieving the 2010 target in Japan

Focal Area	Goal	Target	Content stated in the 2010 target	Indicator	Assessment in Japan: Degree of progress toward the target	Assessment in Japan: Tendency in the 2000s
Protection of the Constituent Elements of Biodiversity	1	To promote biodiversity conservation in ecosystems, habitats, and in biomes				
		1 - 1	Effectively conserve at least 10% of each eco-region in the world.	Total area of protected areas	△	↗
				Efficient management of protected areas		
		1 - 2	Protect the areas particularly important for biodiversity.	The overlap between protected areas and biodiversity	△	↗
	2	To promote conservation of species biodiversity				
		2 - 1	Recover, maintain or mitigate any decrease in the populations of species in a specific taxon.	Living Planet Index (LPI) for forest birds	△	↑ ↓
				Population of shorebirds		
				Distribution and population of other taxons		
		2 - 2	The status of endangered species has been improved.	Past frequencies of extinction of vascular plants (Note 1)	△	↑ ↓
				Factors in the decrease of endangered species (Note 1)		
	3	To promote conservation of genetic diversity				
		3 - 1	Conserve the genetic diversity of farm produce, livestock, plants, fish and wild organisms that human beings gather or hunt, and other valuable species. Also maintain the knowledge of indigenous peoples and their local knowledge.	Genetic diversity of land livestock species	×	↑ ↓
Sustainable use	4	To promote sustainable use and consumption				
		4 - 1	Sustainably controlled supply sources shall produce products based on biodiversity, and be maintained in methods consistent with conserving biodiversity.	The area of a forest certified for its sustainable maintenance	×	↗
		4 - 2	Reduce the unsustainable consumption of living resources or consumption that impacts biodiversity.	Biologically permissible fishing quantity and associated concepts	△	↘
				Ecological footprints and associated concepts		
		4 - 3	There shall be no wild animals and plants endangered by international trade.	None (Note 2)	—	—
Efforts to Confront the Threat to Biodiversity	5	Mitigate the pressure caused by loss of habitat, change or deterioration of land use, and unsustainable water use.				
		5 - 1	Reduce the speed of natural habitat loss or deterioration.	Change in the area of forests	○	↑ ↓
				Change in the area of tidal flats (Note 1)		
				Change in the area and cover degree of coral community		
				Change in the area of underwater forests		
	6	To control over the threat of invasive alien species				
		6 - 1	Control the entry pathways for major species highly likely to become invasive alien species.	Invasive alien species	△	↗
		6 - 2	Formulate plans to control major invasive alien species that could threaten ecosystems, habitats and species.	Prevention of invasive alien species (Note 1)	△	↗

Degree of progress toward the targets: ○ for 'achieved'; △ for 'insufficiently achieved'; × for 'not achieved'
Tendency: ↗ a plus for biodiversity; ↘ a minus for biodiversity; ↑↓ no specific tendency
Note 1: Indicators that have replaced the indicators presented in the 2010 Target or added to the 2010 Target based on the status of biodiversity, its conservation and use, or accumulation of related data in Japan.
Note 2: Indicators not treated this time will be future tasks due to the need for sufficient analysis from a socioeconomic perspective or a lack of necessary data for assessment.

Table IV-5 Progress toward achieving the 2010 target in Japan (continued)

Focal Area	Goal	Target	Content stated in the 2010 target	Indicator	Assessment in Japan	
					Degree of progress toward the target	Tendency in the 2000s
Efforts to Confront the Threat to Biodiversity	7	To make efforts to address the problems of biodiversity caused by climate change and contamination				
		7 - 1	To maintain/strengthen resilience of the Constituent Elements of Biodiversity for adaption to climate change	None (Note 2)	×	—
		7 - 2	To mitigate contamination and its impact on biodiversity	Ratio of detection of major contaminants (fish, etc.) (Note 1)	○	↑ ↓
				Nitrogen accumulation		
Maintenance of the assets and services provided by biodiversity that supports the welfare of mankind	8	To maintain the performance of biodiversity that provides assets and services, and supports our life				
		8 - 1	The performance of biodiversity that provides assets shall be maintained.	Marine food chain index	△	↑ ↓
				Water quality		
				Fragmentation of rivers		
				Fragmentation of forests		
				Forest accumulation volume (Note 1)		
		8 - 2	Biodiversity that supports sustainable life, local food security, and medicine especially for the poor shall be maintained.	None (Note 2)	—	—
Protection of traditional knowledge, ingenuity and practices	9	To maintain socio-cultural biodiversity of indigenous peoples and local communities				
		9 - 1	To protect traditional knowledge, ingenuity and practices	None (Note 2)	—	—
		9 - 2	To protect the right of indigenous peoples and local communities over traditional knowledge, ingenuity and practices, including the right to receive allocated benefits	None (Note 2)	—	—
Securing of fair, balanced allocation of benefits generated by the use of genetic resources	10	To secure fair, balanced allocation of benefits generated by the use of genetic resources				
		10 - 1	All access to genetic resources shall conform to the Convention on Biological Diversity and related regulations.	None (Note 2)	—	—
		10 - 2	Benefits generated by commercial use of genetic resources shall be shared with the countries that provide the resources in a fair, balanced manner in accordance with the Convention on Biological Diversity and related regulations.	None (Note 2)	—	—
Securing of sufficient supply of resources	11	The member nations shall improve their human, scientific, technological and engineering capabilities in order to conform to the Convention.				
		11 - 1	New or additional financial resources shall be transferred in accordance with Article 20, in order for member developing countries to effectively fulfill their promises based on the Convention.	Official Development Assistance (ODA) in the field of biodiversity	△	↑ ↓
		11 - 2	Technologies shall be transferred in accordance with Article 20, in order for member developing countries to effectively fulfill their promises based on the Convention.	Technological support in the field of biodiversity	△	↗

Degree of progress toward the targets: ○ for 'achieved'; △ for 'insufficiently achieved'; × for 'not achieved'
Tendency: ↗ a plus for biodiversity; ↘ a minus for biodiversity; ↑↓ no specific tendency
Note 1: Indicators that have replaced the indicators presented in the 2010 Target or added to the 2010 Target based on the status of biodiversity, its conservation and use, or accumulation of related data in Japan.
Note 2: Indicators not treated this time will be future tasks due to the need for sufficient analysis from a socioeconomic perspective or a lack of necessary data for assessment.

(2) Target field: Protection of the constituent elements of biodiversity
Goal 1: To promote biodiversity conservation in ecosystems, habitats, and biomes
Target1-1: Effectively conserve at least 10% of each eco-region in the world.

Assessment:

At this point, the target will be considered achieved when approximately 10% of individual eco-regions (by the degree of vegetation naturalness as mentioned here) are effectively conserved. The tendency will be assessed as a plus if efforts toward achieving the target are promoted during the 2000s.

At present, the area covered as a protected region has reached 10% in major land ecosystems, but has not reached 10% in marine and coastal ecosystems. The degree of protection is not sufficient in marine and coastal ecosystems. Plans for maintenance have been formulated with the participation of local people involved in 28 national parks in 71 regions. However, national parks only cover 6% of the national land, meaning that the target of effectively conserving at least 10% of each eco-region has not been achieved. The tendency in the 2000s is assessed as a plus, but further efforts are required especially in marine regions.

Indicator: The total area of protected areas

Presently, major protected areas (nature conservation areas, nature parks, habitat protection areas, wildlife protection areas, forest reserves, green space conservation areas, etc.) cover 17% of the national land. However, it is only 9% when limited to protected areas with strict restrictions on activities (areas where permission from the central or local government is required for development). Practically, special areas and special sea areas in wilderness conservation, nature conservation and prefectural nature conservation areas, and those in natural parks, management area in habitat protection areas, special protection areas in wildlife protection and forest/mountain system protection areas are mentioned (see Data 5- ②).

These protected areas cover 10% or more of the major land ecosystems. As for forests and grasslands, natural forests, natural grasslands and secondary forests with high naturalness account for 29%, secondary forests 14%, artificial forests 15%, and secondary grasslands 19% (see Data 5- ②).

As for the overall marine area (territorial waters), the protected area covers only 6%. And it drops further to less than 1% for protected areas with strict restrictions on activities (see Data 5- ②).

From 2002 up to now, among these protected areas, natural parks wildlife protection areas, forest reserves, green space conservation areas, etc. have been additionally designated or expanded, some of which include sea areas.

Indicator: Efficient management of protected areas

Even if protected areas are designated or expanded, the environment must be efficiently managed in order to be effectively protected.

For efficient management, it is useful to set a management plan with the participation of local people involved in individual protected areas. Such management plans have been formulated for only a few major protected areas. However, as for national parks that cover 6% of the national land, all 28 national parks in 71 regions have established management plans with the participation of local governments and related organizations.

Target 1-2: Protect the areas that are especially important for biodiversity.

Assessment:

The target will be considered achieved when most of the areas that are especially important for biodiversity are protected at a higher level than other areas. And the tendency will be assessed as a plus if such areas are expanded in the 2000s.

Although the protection ratio of important areas selected by the nation and local bodies is higher than for other areas, there are still quite a few important areas beyond the reach of protection. At present, it is assessed as insufficient achievement. In the 2000s additional protected areas were designated, and thus the tendency indicates somewhat of a plus.

Indicator: Overlap between protected areas and biodiversity

In land areas, among the ecosystems with less alteration (natural forests and natural grasslands), 31% of natural forests and 47% of natural grasslands are covered by major protected areas (nature conservation areas, nature parks, habitat protection areas, wildlife protection areas, forest reserves, green space conservation areas, etc.). Moreover, 22% and 36%, respectively, are covered by protected areas with strict restrictions on activities (see Data 5- ②).

These major protected areas cover 30% of second meshes (where the total kinds are ranked among the top 150) in which endangered vascular plants are concentrated, and protected areas with strict restrictions on activities account for 17%. They also cover 70% of specific plant communities (1978, 1988, 2000 by the Ministry of the Environment), and protected areas with strict restrictions on activities account for 56%.

These major protected areas cover 52% of "important areas" chosen as areas where biodiversity as the core of maintaining biological characteristics of the national land has been established (2001 by the Ministry of the Environment), and protected areas with strict restrictions on activities account for 40%. (see Data 5- ②).These major protected areas cover 29% of "500 important Japanese wetlands" chosen as basic data of wetland conservation based on scientific information and expertise (2001 by the Ministry of the Environment), and protected areas with strict restrictions on activities account for 20% (see Data 5- ②).

As for the major coastal ecosystems (tidal flats, underwater forests, and coral reefs), these major protected areas cover more than 10%, but protected areas with strict restrictions on activities account for 6% of tidal flats and underwater forests, and only 3% of coral reefs (see Data 5- ②).

Additionally designated protected areas from 2002 up to now include some of these important areas.

Goal 2: To promote the conservation of species diversity
Target 2-1: Recover, maintain or mitigate decreases in species populations in a specific taxon.

Assessment:

The target will be considered achieved when the populations and distributions of all taxons for which available national data are listed, and where a population has clearly increased or its distribution expanded, remained unchanged, or where most showed no tendency to decrease or contract. The tendency will be assessed as a plus if such efforts are apparently observed during the 2000s.

As for the taxons for which national data are available, populations have tended to be maintained or restored since the 1970s, although a slight decrease in population is observed in many taxons. Significant deterioration was not observed from the beginning, but there is still no evidence of restoration, maintenance or mitigation. Thus the target has not been achieved. Data after the 2000s are not available in many cases. Individual indicators are also inconsistent, making it difficult to consider whether there are any specific tendencies.

Indicator: Living Planet Index (LPI) for forest birds

As for forest birds (103 kinds of birds dependent on domestic forest and mountain systems), the Living Planet Index (LPI) that indicates the range of distribution from 1997 to 2002 against 1978 slightly decreased (with an average value of 94). The species that migrate long distances or those that use early successional forests have significantly declined, while species that migrate short distances or resident birds have slightly increased. The tendency after 2002 is not known (see Data 17- ②).

Indicator: Population of shorebirds

Shorebirds depend on marine and coastal, inland water, and cultivated systems. The population index of major shorebirds that pass over Japan during spring migration has not showed specific tendencies from 1975 to 2008.

The population index of major shorebirds that pass over Japan during autumn migration, however, shows a tendency of slight decrease among species that mainly use tidal flats and beaches in marine and coastal systems. That of inland species does not show any tendency of decreasing, but the populations of species that are highly dependent on paddy fields in cultivated systems are decreasing. The same tendency was reported as for the 2000s (see Data 20-①, 28- ①).

Indicator: Distributions and populations of other species

In forest and mountain systems, the previously mentioned LPI of forest birds shows a slight decrease. The distributions of brown bears (Ursus arctos) and Asiatic black bear (Ursus thibetanus)—the higher species in forest and mountain systems—expanded greatly from 1978 to 2003. However, their distributions shrank in parts of western Japan, thereby raising concern about the possible extinction of those populations (see Data 17- ①).

In urban systems, such as in the special wards of Tokyo, the distribution of white-eyes that apparently adapted to park green spaces expanded from the 1970s to the 1990s, and that of skylarks (which depend on farmland and grassland) contracted (see Data 23- ① and 23- ②).

In inland water systems, the distribution of charophyte that grows in lakes of good water quality decreased to a great extent from 1964, and particularly from 1992 to 1998 (see Data 26- ①).

In coastal systems, the harvested quantities of clams that grow in tidal flats and on sandy beaches were drastically reduced from the second half of 1950s to the 1960s, and have been gradually declined thereafter in the 2000s (See Data28- ②).

As for marine systems, among approximately 80 kinds of fish caught by Japan, the ratio of those whose catches tend to be decreasing has been rising since the 1980s (see Data29- ③).

Target 2-2: Improve the status of endangered species.

Assessment:

The target will be considered achieved when the following tendencies are obvious in data for the most endangered species in a certain period: a lower threat of extinction, a mitigated speed of extinction or weakened factors of decrease. The tendency will be assessed as a plus if such changes are observed in the 2000s.

The frequency of assessing vascular plants as "Extinct/ Extinct in the Wild" is decreasing each year. However, no decrease is considered when including "nearly extinct." In the 2000s (compared with the high economic growth period), the speed of development—the greatest factor causing the decrease of endangered species—slowed down. Still, past development continues to have an impact. And there are concerns about the impact of such factors as natural succession and alien species becoming stronger. In the 2000s, there was no evidence showing an apparent improvement in the status of endangered species; thus, the target has been insufficiently achieved. No specific tendency has been observed.

Indicator: Past frequency of extinction of vascular plants

Based on the number of endangered vascular plant species by period in the latest Red List issued by the Ministry of the Environment, 40 kinds were assessed as "extinct/extinct in the Wild," and 22 were "nearly extinct" after the 1920s. The average ratio of extinction was 8.6 kinds every 10 years over the past 50 years. The species confirmed to be "extinct/ extinct in the Wild" were declining each year after the 1970s. No decrease is considered at least up to 1990s when including "nearly extinct" (see Data 4- ③).

Indicator: Factors of decrease of endangered species

Approximately one-fourth of the vertebrate animal species (mammals, birds, reptiles, amphibians, brackish/freshwater fish) assessed for the Red List issued by the Ministry of the Environment, and about one-fourth of vascular plant species have already gone extinct or are threatened with extinction (see Data 4- ①).

Development was the largest factor causing such loss. Moreover, development is considered to have caused the loss of approximately 90% of vertebrate species and 50% of vascular plant species. Most of these factors have recently declined when compared to the high economic growth period (from the second half of 1950s to the 1970s) and other periods. The economic growth and population migration as its background is also decelerating. However, it is not easy to restore habitats once modified (see Data 4- ⑤ , and Data 1- ⑥ , 1- ⑦ , 15- ② , 18- ① , 19- ② , 22- ① , 25- ① , 27- ① , 27- ② , 27- ③).

Water pollution, which is considered the cause of reducing about 40% of amphibians and 60% of brackish/freshwater fish, has been alleviated in recent years (see Data 4- ⑤ , or Data 3- ①).

As for the capture and gathering for gardening and ornamental use, which are considered causes of reducing about 60% of reptiles, 30% of brackish/freshwater fish and amphibians, and 20% of vascular plants, there is no evidence showing any reduction in recent years. Natural succession, which is regarded as a factor in reducing approximately 30% of vascular plants, tends to be rising as a factor due to the ongoing tendency of grasslands, farmlands and secondary forests being used less (see Data 4- ⑤ or Data 7- ① , 7- ② , 7- ③ , 19- ④ , 19- ⑤).

Alien species are considered the cause of reducing about 70% of reptiles, 30% of brackish/freshwater fish, and 20% of amphibians and mammals, and tend to be rising as a factor, because the invasion and settlement by additional species or the expanded distributions of some invasive alien species have not been prevented (see Data 4- ⑤ or Data 9- ① , 9- ② , 9- ③ , 9- ④).

Goal 3: To promote the conservation of genetic diversity

Target 3-1: Conserve the genetic diversity of farm produce, livestock, plants, fish and wild organisms that human beings gather or hunt, and other valuable species. Also maintain the knowledge of indigenous peoples and their local knowledge.

Assessment:

The target will be considered achieved when the kinds or populations of native species in farm produce and livestock are maintained in a certain period in the data, thereby maintaining genetic diversity. The tendency will be assessed as a plus if the circumstances surrounding native species are improved or population growth is apparent in the 2000s.

There are small populations of native species among livestock that lack genetic diversity since being diminished; thus, the target has not been achieved. Native species in livestock have declined since the Meiji Era (late 19th century to early 20th century), resulting in only very small existing populations. Conservation efforts have just begun regarding most species, though no apparent restoration has been confirmed and no specific tendency observed.

Indicator: Genetic diversity of land livestock species

Most of the approximately 50 species of native Japanese horses cross-bred with Western horses in the Meiji era and identified by names of the breeding locations have died out. The number of domestic horses was reportedly about 86,000 in 2006, among which only 2,000 were from eight Japanese native species (see Chapter III, Section 2). Native cattle were also bred with European species in the Meiji and Taisho eras. About 4.4 million cattle are now being raised mainly for beef and dairy purposes, among which no more than 100 head of only two native species (Mishima cattle and Kuchinoshima cattle) are maintained (see Chapter III, Section 2). Recent efforts to conserve these species were initiated in cooperation of zoos.

(3) Target field: Sustainable use

Goal 4: To promote sustainable use and consumption

Target 4-1: Ensure that sustainably controlled supply sources produce products based on biodiversity, and be maintained using methods consistent with biodiversity conservation.

Assessment:

The target will be considered achieved when most production areas are sustainably managed using a method consistent with biodiversity conservation. And the tendency will be assessed as a plus if such ratio increases in the 2000s.

The total area of forests certified in Japan remains small compared to that of all Japanese forests. Not all sustainably managed forests will be certified, but the indicator stipulated in the 2010 target focuses on sustainable forest management through forest certification, meaning that the target is not considered achieved. However, since the introduction of such certification, the certified area increased during the 2000s, and thus the tendency is considered a plus.

Indicator: The area of forests certified for sustainable maintenance

The area of forests in Japan with forest management certification (FM certification) issued by the Forest Stewardship Council (FSC) totaled about 100 square kilometers in 2003, and then rose to 3,700 square kilometers in 2010.[1)] And the area of forests certified by the "Sustainable Green Ecosystem Council (SGEC)," the domestic forest recognition system, expanded from about 1,800 square kilometers at initial recognition in 2005 to approximately 8,200 square kilometers in 2010.[2)]

The area of such certified land tends to be rising, however, the FSC certified area accounts for 1%, 3% and 3%, and the SGEC certified area accounts for 3%, 7% and 8%, respectively, in the total area of forests (about 0.251 million square kilometers in 2007), the area of forests managed by planting, mowing and thinning (about 0.113 million square kilometers in 2007), and the area of artificial forests (about 0.104 million square kilometers in 2007).

Target 4-2: Reduce the unsustainable consumption of living resources or consumption that impacts biodiversity.

Assessment:

The target will be considered achieved when an apparent decrease is observed in the unsustainable consumption of biological resources or consumption that impacts biodiversity in a certain period in the data. If such change was observed in the 2000s, the tendency will be assessed as a plus.

The target will be considered insufficiently achieved when there is no apparent decrease in the unsustainable consumption of biological resources or consumption that impacts biodiversity. The tendency will be assessed as a minus.

Indicator: Biologically permissible fishing quantity and related concepts

As for major 13 species of Japanese fish (saury, red sea bream, Pleurogrammus azonus, cod, anchovy, Etrumeus teres, queen crabs, walleye pollack, sagittated calamary, Scomberomorus niphonius, chub mackerel, jack mackerel, and true sardine), biologically permissible fishing quantity remained within the range of 2 to 2.5 million tons in the 2000s.[3] The current fishing quantity including other fish species for all of Japan is approximately 3.5 million tons.

Resource assessment is underway for 82 biomes of 52 kinds that include 17 biomes of seven fish species controlled as resources by the Total Allowable Catch (TAC) in Japan. At present, the volume of resources is assessed as being low for 8 biomes among the 17 biomes of 7 fish species under the control of TAC, and 37 biomes among the 84 biomes of 52 fish species subject to resource assessment (see Data 29- ①).

As for the tendency of fishing quantity regarding approximately 80 fish species above, the ratio of species that show a decreasing trend such as true sardine, walleye pollack and prawns against all fish species is rising (see Data 29- ③).

Indicator: Ecological footprints and related concepts

Ecological footprints refer to the following: "The global demand of mankind as expressed in the form of areas of land and ocean that provide biological productivity necessary for supplying resources and adsorbing waste." This is an indicator to show the dependence of human beings on the natural environment.

According to the World Wide Fund for Nature (WWF), the ecological footprint (per person) in Japan rapidly increased from the 1960s (about 2 gha) to the 1970s (about 4 gha).The cycles of increase and decrease were subsequently repeated up to the 2000s, showing a tendency of a slight increase.[4]

The ecological footprint (per person) in Japan was 4.9 gha in 2005. It is 1.8 times as much as 2.7 gha, the world average of biological productivity (per person), and reaches 2.3 times as much as 2.1 gha, the sustainable level (per person) in considering the intrinsic productivity and waste collectability of the earth.[4]

Target 4-3: Ensure that no wild animals or plants are endangered by international trade.

As for indicators to properly assess the progress of achieving the target, thorough discussions are considered necessary based on socioeconomic analyses of the current status. We therefore decided to pass on the selection of an indicator and assessment, leaving both as future tasks. In consideration of the current status where Japan is importing a large quantity of fauna and flora from abroad for ornamental use and other purposes (see Data 9- ② , 9- ③), future discussions are expected to focus on the importation of animals and the living/growth status of such fauna and flora in their homeland, in addition to the exportation of domestic animals and plants.

(4) Target field: Efforts to confront the threat to biodiversity

Goal 5: To mitigate pressure caused by loss of habitat, change or deterioration of land use, and unsustainable water use.

Target 5-1: Assess that the speed of loss or deterioration of natural habitats is reduced.

The target will be considered achieved when the speed of loss or deterioration of natural habitats is apparently reduced in a certain period in the data. If such change was observed in the 2000s, the tendency will be assessed as a plus.

Compared with the period of high economic growth (in the second half of 1950s to the first half of 1970s), development pressure causing loss or deteriorated habitats has been weakened. Partly because the loss and deterioration of ecosystems has already progressed significantly, the speed of loss or deterioration has apparently decreased. As for the 2000s, the pressure remained relatively weak, but the speed of loss or deterioration was not considered to have decreased. Ongoing caution is thus required. The target was achieved, but with no specific tendency observed at present.

Indicator: Change in the area of forests

Forests account for about 70% of Japan's national land. The area of forests is relatively stable and has remained at about 0.25 million square kilometers since the 1960s to this day. However, during the same period, natural forests and secondary forests decreased by 14%, and artificial forests increased by 31%. Most of this change occurred from the 1960s to the 1980s, followed by moderate change after the 1980s. Forests showed no apparent tendencies in the 2000s and have remained stable (see Data 15- ①).

Indicator: Change in the area of tidal flats

The area of tidal flats in Japan was approximately 840 square kilometers in 1945, and then decreased to 550 square kilometers in 1978, and then 500 square kilometers in the 1990s, thereby losing 40% of such area (see Data 27- ⑤). The area of tidal flats in Tokyo Bay decreased from 100 square kilometers to 20 square kilometers during the period of high economic growth (in the second half of 1950s to first half of 1970s) when coastal areas were proactively modified, thereby losing about 80% of such area (see Data 27- ⑥). The tendency in the 2000s is unknown though, and based on the transition of reclamation area, a tendency of decreasing is likely to be shown instead of a rapid decrease (see Data 27- ①).

Indicator: Change in the area/cover degree of coral communities

The area of coral communities in coral ponds within coral reef areas in Japan decreased from approximately 360 square kilometers in 1978 to 340 square kilometers in the 1990s. The cover degree of most coral communities in coral ponds remained less than 50% in 1992 (see Data 27- ⑧).

In the Sekisei Lagoon, damage caused by large-scale bleaching and coral predators has increased since the second half of 1990s. The cover degree of coral communities has remained within the range of 30 to 40% with some fluctuation (see Data 27- ⑨).

Among the 1000 monitoring sites (used in a coral reef survey), most coral communities at 24 sites mostly had a cover degree ranging from 20 to 30%. Most sites maintained the same level or showed a tendency of decreasing from 2004 to 2008.[3)]

Indicator: Change in the area of underwater forests

The area of underwater forests (consisting of marine algae and sea grass) in Japan decreased from about 2,100 square kilometers in 1973 to 2,010 square kilometers around the 1990s (see Data 27- ⑦). It is estimated that the area decreased even further from the 1990s to the 2000s.[5)]

Goal 6: To control the threat of invasive alien species

Target 6-1: Control the entry pathways for major species that are highly likely to become invasive alien species.

Assessment:

The target will be considered achieved when major species that are highly likely to become invasive alien species are identified, and intentional/unintentional entry pathways are practically controlled in a certain period in the data. If such change was observed in the 2000s, the tendency will be assessed as a plus.

The Invasive Alien Species Act (enacted in 2004) and other regulations have controlled the intentional entry pathways of invasive alien species to a considerable extent. However, the pressure imposed by the entry of invasive alien species is considered to be rising. There is also a lack of measures being taken against unintentional entry. The progress toward achieving the target is insufficient. In the 2000s, efforts by the central and local governments were expanded and considered to have improved the control. The tendency is therefore assessed as a plus.

Indicator: Invasive alien species

The number of alien insect species and spermatophyte that have settled in Japan continued to increase in the 20th century, and such settlement is gradually increasing (see Data 9- ①). Some invasive alien species have expanded their distributions throughout Japan since the 1950s (see Data 9- ④).

In addition to the Plant Protection Act (enacted in 1950) and the Act on Prevention of Infectious Diseases (enacted in 1998), the Invasive Alien Species Act was enacted in 2004 to prohibit the import, growth, storage, transport, transfer or outdoor release of designated alien species that damage or may damage ecosystems, human life or health, or the agriculture, forestry and fishery industries. Currently 97 species from taxons consisting mainly of species already regarded as problematic in Japan and those that have caused problems overseas have been designated as such alien species. This has enabled the control of intentional entry pathways for additional species that are highly likely to become invasive alien species (see Data 11- ①).

The quantity of live animals and fish imported for ornamental use has increased or remained the same since the 1990s. That of some taxons such as mammals and reptiles has showed a tendency of decreasing in the 2000s.

From the 1990s, local governments introduced regulations on the entry of largemouth bass that causes damage to inland water fisheries. In the 2000s, more local governments began preparing lists of alien species and introduced regulations on the outdoor release of alien species. However, effective measures for unintentional entry as extraneous material among cargo or in ballast water from ships have yet to be prepared.

Target 6-2: Formulate plans to control major invasive alien species that could threaten ecosystems, habitats or species.

Assessment:

The target will be considered achieved when effective plans have been formulated in order to control major invasive alien species from the standpoint of preventing threats to ecosystems, habitats and species, and such measures have demonstrated effectiveness in such control in a certain period in the data. If such change was observed in the 2000s, the tendency will be assessed as a plus.

In the 2000s, prevention plans were formulated for some invasive alien species, and prevention is underway. However, in terms of containing the expanding distributions of invasive alien species, notable results have yet to be except for island areas. The target was “insufficiently achieved,” but the tendency was assessed as a plus.

Indicator: Prevention of invasive alien species

In the 2000s, the Plant Protection Act and some ordinances (on hunting, gathering, eradication, measures to prevent damage, etc.) issued by local governments stipulated the prevention of invasive alien species that have already settled. As for some invasive alien species such as raccoons and small Indian mongooses, the central and local governments are promoting the formulation of prevention plans, preparation of manuals on preventive techniques, implementation of preventive measures, and other efforts (see Data 11- ②).

As for largemouth bass, local governments and private organizations are promoting efforts for its control. In island areas where some endangered species live and grow, the national government is promoting efforts for control. For example, on Okinawa Island in the Nansei Islands and the island of Amami Oshima, the populations of small Indian mongooses were largely reduced in the 2000s, and bullfrogs were successfully eradicated on the Ogasawara islands.

As stated above, species that live on an island or have limited distribution can be successfully eradicated or controlled in terms of population. However, controlling the expanding distributions of invasive alien species that have already settled on the mainland is difficult. Various entities must therefore make ongoing efforts.

Goal 7: To make efforts to address problems of biodiversity caused by climate change and contamination

Target 7-1: Maintain and strengthen the resilience of the constituent elements of biodiversity for adapting to climate change.

Assessment:

The target will be considered achieved when measures are formulated and enacted to address the impact of climate change on biodiversity, and demonstrate effectiveness in a certain period in the data. Japan is currently engaged in discussions on measures to adapt to climate change. Thus, the target has not been achieved.

Indicator (none):

The central government shall prepare guidelines for adapting to climate change. There are currently only a few cases of measures being implemented for adaptation. Given this situation, selecting an indicator for this target shall be a task to be discussed in the future. The target has been assessed based on efforts observed thus far.

Target 7-2: Mitigate contamination and its impact on biodiversity.

Assessment:

The target will be considered achieved when apparent reduction is confirmed regarding the impact of water pollution and contamination caused by persistent chemical substances on living organisms in a certain period in the data. If such change was observed in the 2000s, the tendency will be assessed as a plus.

There still are concerns and further questions about pollution and its impact on biodiversity. However, pollution and its impact have apparently been reduced. The target has been achieved. The overall tendency in the 2000s remained the same.

Indicator: Nitrogen accumulation

Nitrogen causes eutrophication in water areas. The total nitrogen concentration in lakes in Japan has been about 0.6 mg/L since the mid-1980s (see Data 3- ①). The total nitrogen concentration in marine areas rapidly decreased since the mid-1990s to a range of 0.03 to 0.05 mg/L, and now remains stable within a range of 0.01 to 0.02 mg/L (see Data 3- ①).

Indicator: Ratio of detection of major contaminants (fish, etc.)

The production and use of major contaminants (PCB, DDT, HCH, dieldrin, HCB, and TBT) were regulated by such legislation as the Act on the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc. from the 1970s to the 1990s. Controls on such production and use have been improved to this day. The ratio of these chemical substances being detected in fish and other organisms tended to decrease since the second half of 1970s or after the mid-1980s. It tended to remain the same or decrease in the 2000s (see Data 10- ①).

(5) Target field: Maintenance of the assets and services provided by biodiversity that supports the welfare of mankind

Goal 8: To maintain the performance of biodiversity that provides assets and services, and supports our life

Target 8-1: The performance of biodiversity that provides assets and services is maintained.

Assessment:

The target will be considered achieved when major ecosystems that provide ecosystem services apparently maintain the capabilities (including potential) of providing ecosystem services in a certain period in the data. The tendency will be assessed as a plus if those capabilities are maintained or restored in the 2000s.

The indicator of the 2010 Target is the capability of proving ecosystem services, and quite similar to indicators that show the general soundness of an ecosystem. As for marine and coastal systems, effectiveness is somewhat limited and the marine trophic index remains a relatively high standard. The water quality of inland water systems and marine and coastal systems is considered to have been improved compared to the period of high economic growth. The tendency remained the same in the 2000s. The fragmentation of rivers is ongoing. As for forest and mountain systems, fragmentation progressed before but now has become moderate. Based on these indicators in the 2010 Target, the tendency of deterioration seems to have become relatively moderate. However, the assessment is apparently affected by some factors unique to Japan. Also, the assessment indicated some inconsistency among the kinds of ecosystem services. Therefore, it is questionable whether these indicators fully demonstrate the capability of providing ecosystem services. If forest accumulation volume is selected as an indicator separate from the indicators shown in the 2010 Target, a consistent increase is confirmed. With all these indicators are comprehensively taken into account, ecosystem are not considered to maintain the capability of providing assets and services in the 2000s. Thus, the target is not sufficiently achieved. There is no apparent tendency because individual indicators show different tendencies in the 2000s.

Indicator: Marine Trophic index

The Marine Trophic index (MTI) shows the average trophic level by fish based on fishing quantity. Japan's MTI is higher than the international average of 3.3. It has remained at the same level in the 2000s (see Data 29- ②).

As previously stated, the effectiveness of this index is limited when applied to Japan. As the index dropped due to the impact of fluctuations in the true sardine resource in the 1980s, we utilize fish at low trophic levels. And maintaining the level of this index does not necessarily indicate the capability of providing ecosystem services. As a source of information, FishBase lacks information about squid and other marine life utilized in Japan.

Indicator: Water quality

The total nitrogen concentration in rivers has remained the same since 1980s as stated before. The total phosphate concentration tends to gradually decrease (see Data 3- ①).

The total nitrogen concentration in marine areas has been improved since mid-1990s as stated above, and remained the same in the 2000s. The total phosphate concentration thus shows the same tendency (see Data 3- ①). The degree of achieving environmental criteria in enclosed coastal sea areas such as inner bays and inland seas was partly improved from the1970s to the 1980s, but tends to worsened after the 1990s and in the 2000s (see Data 27- ⑬).

Indicator: Fragmentation of rivers

In the second half of 1990s, research was conducted over the research zones (middle and down streams in rivers) in the major 113 rivers in Japan. There were 17 rivers (15%) that allow fish to swim up to the range of less than 25% from the river mouth, and 46 rivers (41%) that allow up to 50% (See Data 25- ②).

Since the 1950s, more dams have been continuously constructed on rivers, thereby expanding the total water storage. This tendency continued during the 2000s (see Data 25- ①).

Indicator: Fragmentation of forests

Forests mainly in western Japan are currently fragmented by land use for other purposes. Relatively tall forests are concentrated along mountainous backbones. These forests are surrounded by forests fragmented by farmland and urban districts. No data are available regarding the tendencies of this indicator in the 2000s. However, the pressure of development that fragments forests is decreasing (see Data 16- ①).

Indicator: Forest accumulation volume

Forest accumulation volume has consistently increased since the 1960s when data mainly on artificial forests were first recorded. It totaled about 1.89 billion m3 in 1966, about 4.04 billion m3 in 2002, and increased to about 4.43 billion m3 in 2007. This tendency is continuing in the 2000s (see Data 18- ①).

Target 8-2: Maintain biological resources that support sustainable life, local food security and medicine, especially for the poor.

This target was selected in consideration of developing nations. However, our economic activities might affect it indirectly. For that reason, thorough discussions are considered necessary based on socioeconomic analyses of the current status for selecting an indicator to properly assess our progress toward achievement. We therefore decided to pass on selection of an indicator and assessment, leaving both as future tasks.

(6) Target field: Protection of traditional knowledge, ingenuity and practices

Goal 9: To maintain the socio-cultural biodiversity of indigenous peoples and local communities

Target 9-1: Protect traditional knowledge, ingenuity and practices.

This target was selected mainly by focusing on developing nations that possess biological resources. However, it also involves important domestic issues. However, we could not develop satisfactory indicators in our discussions this time. We decided to pass on selection of an indicator and assessment, leaving both as future tasks.

Target 9-2: Protect the right of indigenous peoples and local communities over traditional knowledge, ingenuity and practices, including the right to receive allocated benefits.

This target was selected in consideration of developing nations that possess biological resources. However, our economic activities might affect it indirectly. For that reason, thorough discussions are considered necessary based on socioeconomic analyses of the current status for selecting an indicator to properly assess our progress toward achievement. We therefore decided to pass on selection of an indicator and assessment, leaving both as future tasks.

(7) Target field: Securing of fair, balanced allocation of benefits generated by the use of genetic resources

Goal 10: To secure fair, balanced allocation of benefits generated by the use of genetic resources

Target 10-1: Ensure that all access to genetic resources conforms to the Convention on Biological Diversity and related regulations.

This target was selected to focus on the economic activities of developing nations with rich genetic resources and those of advanced nations. Japanese companies have already been engaged in activities in accordance with agreements on the use of genetic resources in tropical nations, but data on these activities remain limited. We therefore decided to pass on selection of an indicator to properly assess the progress of achievement and assessment, leaving both as future tasks.

Target 10-2: Ensure the sharing of benefits generated by the commercial use of genetic resources, etc. with countries that provide the resources in a fair, balanced manner.

This target was selected to focus on the economic activities of developing nations with rich genetic resources and those advanced nations. Japanese companies have already been engaged in commercial use of genetic resources in tropical nations, but data on efforts to secure a fair, balanced allocation remain limited. We therefore decided to pass on selection of an indicator to properly assess the progress of achievement and assessment, leaving both as future tasks.

(8) Target field: Securing of sufficient supply of resources

Goal 11: To ensure that member nations improve their financial, human, scientific, technological and engineering capabilities in order to conform to the Convention

Target 11-1: Transfer new or additional financial resources in accordance with Article 20 to member developing countries, in order to effectively fulfill their promises based on the Convention.

Assessment:

As stipulated in Article 20 of the Convention, the target will not be considered achieved unless new or additional financial resources are transferred by Official Development Assistance and other sources.

The aid for the field of biodiversity accounts for about one-third of Official Development Assistance in the environmental field, and remained roughly the same in the 2000s. New or additional financial resources were not considered transferred. Thus the target was insufficiently achieved.

Indicator: Official Development Assistance (ODA) in the field of biodiversity

The amount of aid provided by ODA in the environmental field showed a tendency of increasing during 1990s, and thereafter remained within the range of 300 to 400 billion yen per year. Among Environmental ODA from 2003 to 2005, biodiversity-related fields accounted for 160 million dollars (24%), and biosphere protection-related fields for 77 million dollars (11%) (see Data 14- ①).

Target 11-2: Ensure that technologies are transferred in accordance with Article 20 to member developing countries, in order to effectively fulfill their promises based on the Convention.

Assessment:

The target will be considered achieved when technologies are transferred to the extent where developing member countries can effectively fulfill their promises. If technology transfer increases in the 2000s, the tendency will be assessed as a plus.

In recent years, Japan has annually conducted 70 to 80 projects involving technological cooperation in various areas of the world. However, the target is considered not sufficiently achieved because our efforts have yet to reach the level where developing member countries can effectively fulfill their promises. The tendency was assessed as a plus because Japan has extended its technological cooperation in the field of biodiversity in the 2000s.

Indicator: Projects of technological cooperation in the field of biodiversity

Japan has extended its technological cooperation in the field of biodiversity. The Japan International Cooperation Agency (JICA) conducted about 30 projects for technological cooperation in the field of biodiversity in the first half of 2000s, and then shifted to a range of 70 to 80 projects per year in the second half of 2000s. The projects involving technological cooperation targeted 79 nations in Southeast Asia, Central and South America, and Africa (see Data 14- ③).

References

1) Forest Stewardship Council Japan, 2010: The status of FM recognition in Japan
http://www.forsta.or.jp/fsc/
2) "Sustainable Green Ecosystem Council" Convention for recognition, 2010: The List of SGEC recognized forests and certified entities.
http://www.sgec-eco.org/
3) Hiroyuki Matsuda, Hirotaka Ijima, 2010: Ecological Footprint and the United Nations Millennium Ecosystem Assessment, co-authored by Kiichiro Hayashi, "Basic knowledge on Biodiversity/Ecosystem and Economy," Chuohoki Publishing Co., Ltd., 124-146.
4) WWF, 2005: ASIA-PACIFIC, The Ecological Footprint and Natural Wealth.
5) Ministry of Environment, 2009: Monitoring Site 1000 Research on Coral Reefs, 2008, Quick Estimation.
http://www.biodic.go.jp/moni1000/
6) Fisheries Agency, 2008: FY 2008 Fisheries White Paper.
http://www.jfa.maff.go.jp/j/kikaku/wpaper/index.html

Section 3 Measures to Deal with Biodiversity Loss after 2010

1. Biodiversity Loss Observed after 2010

The 10th Conference of the Parties of the Convention on Biological Diversity (COP10) to be held in October 2010 is expected to select post-2010 targets. Earlier, Japanese ideas and proposals for post-2010 targets to be discussed by COP10 were submitted in January 2010. Based on these ideas and proposals, medium and long-term targets to be achieved by 2050 and short-term targets to be achieved by 2020 were decided for the National Biodiversity Strategy 2010.

< Medium and Long-term Targets (2050)>

○ Enhance the harmony between human beings and nature at national and local levels, improve the status of biodiversity in Japan from the current level, and sustainably increase the benefits of ecosystem services.

<Short-term Targets (2020)>

○ To stop biodiversity loss by 2020, Japan will:

(1) Conduct full observations and analyses of the status of biodiversity in Japan based on scientific evaluation. Expand activities for biodiversity conservation, conserve indigenous species of fauna and flora and ecosystems, and build ecological networks that can maintain and restore biodiversity at the national level.
In particular, stabilize and restore populations of species currently threatened with extinction, and take proper measures to prevent new species from becoming endangered.

(2) Establish mechanisms for reducing the adverse effects of human activities on biodiversity, and promote practical methods for the sustainable use of national land and natural resources across generations.

(3) Have ecosystem services respected in every aspect of human society. Make the conservation of biodiversity and its sustainable use mainstream in socioeconomic activities of the general public, by ensuring new steps taken by various stakeholders.

In order to achieve these targets, it is necessary to predict future trends of the social and natural environments in Japan, in order to comprehensively promote various measures to solve problems, and focus internally on conserving biodiversity and its sustainable use in socioeconomic activities.

Japan is heavily dependent on other countries for such biological resources as timber, agricultural and aquatic products, and natural resources such as fossil fuels and mineral resources. The consumption of goods and economic activities in general in Japan have a major impact on global biodiversity. Based on this understanding, in order for Japan as well as all nations around the world to make the status of biodiversity richer than it is now by 2050, it is important to promote efforts within and outside Japan by recognizing global linkages and a wide-area view in cooperation with other nations regarding their sustainable use of resources in consideration of biodiversity, and by promoting further utilization of domestic resources.

<Future Changes Now Expected>

We need to expect that our social conditions as well as natural conditions will change to a certain extent in the future when considering such a time scale.

According to the medium variant provided by the National Institute of Population and Social Security Research, Japan's future population is expected to decline by 4% by 2020 from that in 2005, with the rate of people aged 75 and older expected to increase significantly by 1.6 times. In comparing 2005 with 2050, rapid depopulation and an increasingly aging society are expected. Modern society has never experienced such a situation where the total population declines to three-fourths or less of the current level, and the rate of people aged 75 and older has now more than doubled.

As for temperature as shown in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, assuming a society where both environmental conservation and economic growth are achieved at a global level, the best expectation will be a 1.8˚C rise in the world average by 2100. The temperature is expected to rise by 0.2 ˚C every 10 years starting about 20 years from now.

Huge changes in energy costs and other factors through changes in energy demand and technological innovation regarding energy sources are also expected.

<Discussion on Biodiversity Loss After 2010>

As stated in Section 1, the biodiversity loss by 2010 covers all ecosystems. The loss is still continuing as a whole. Losses are caused by such direct factors as "the first crisis" and indirect factors behind the "the first crisis," such as socioeconomic changes. As described in Section 2, assessment of the 2010 Target indicates that the status of biodiversity loss in Japan has slightly improved, but the tendency of biodiversity loss as a whole cannot be considered to have stopped.

Based on these facts, with various entities taking actions in order to mitigate the loss of biodiversity, it is need to discuss that the expected biodiversity loss by assuming a transition in future social and natural conditions as currently expected, and take necessary measures to counter such losses until around 2050 as the target year for the medium and long-term target in the National Biodiversity Strategy 2010.

The following summarizes the discussions in this section.

○ As for the "the first crisis," the speed of development will further decrease based on declining population, lower economic growth, sufficient housing facilities, and social capital. However, the impact caused by past development is expected to continue. It will thus be an important task to restore past loss by forming national/local ecosystem networks by restoring nature.

○ As for the "the second crisis," Satochi-Satoyama areas are expected to increase the seriousness of inadequate management/use as depopulation and the aging of residents in farming villages advances. It is important to promote the sustainable use of biological resources based on a local consensus. Moreover, the populations and distributions of medium-size and large mammals are expected to rapidly expand.

○ As for the "the third crisis," the intentional and unintentional invasion, settlement and expansion of alien species are expected to continue. Therefore, preventing such invasion, strictly controlling settled alien species, and pursuing technological development for such efforts will be important tasks.

○ As for "the climate change crisis," it is highly likely for such fragile ecosystems as alpine zones and coral reefs will be subject to irreversible impact. Thus, our task is to set and implement practical measures to adapt to the impact of global warming on biodiversity as soon as possible.

○ One key issue to be noted in setting and implementing practical measures is that some ecosystem changes may be irreversible. There are some regions where such a situation is already apparent (see each section for specific examples).

○ In order to mitigate the loss of biodiversity, "mainstreaming biodiversity" is important and shall be promoted not only through measures by the national and local governments but also through the actions of all social entities. For example, local communities are expected to form a consensus on the ideal status of biodiversity in their own areas.

2. Loss and Measures Regarding the First Crisis

<Mitigation of the Speed of Development and Restoration of Past Loss>

This assessment has reconfirmed that land development for housing and industrial use, reclamation, and improvement of social capital over the past 50 years have caused a huge impact on biodiversity in Japan. Socioeconomic demands were also found in response to the dependence on foreign energy sources, rapid industrialization, and population concentrated in cities since the period of high economic growth as the background.

These socioeconomic demands have been currently been met to a certain degree. And the speed of development has become somewhat moderate. Assuming the current level of low economic growth at less than 3% annually, and ongoing dependence on foreign sources of food, timber and energy due to rapid depopulation, it is unlikely that these indirect factors will have greater impact again toward 2050.Thus the speed of development will largely decrease compared to the peak periods such as the high economic growth period. Land development for housing and industrial use, reclamation, and improvement of social capital will decrease and change direction to focus more on reorganization of existing infrastructure, such as recreating the relationship between cities and farming villages based on demographic structure and industrial location. It is less likely that areas with high naturalness such as natural forests and natural coasts will be newly altered. However, there are concerns about the impact on ecosystems already lost by past development being continued, and that specific impacts such as a decrease of species will be observed after a certain period passes after conversion.

In response to changes in these indirect factors, it will be our major tasks to control new development in important areas for conserving biodiversity by establishing protected areas, and seek measures for restoring biodiversity lost by past development. Technical review is needed in consideration of restoring nature and other projects, and based on a grand design with national and regional perspectives, it is important to construct a network of ecosystems of various scales by making use of decreasing social capital.

If the supply of foreign food, timber and energy decreases, the use of domestic biological resources will be promoted. And it will be a new task to discuss a new form of their sustainable use.

<Gathering Resources for Maintenance/Renewal of Existing Housing/Industrial Facilities, Social Capital and Assessment of Impact>

The impact accompanied by procuring raw materials and disposing of waste as needed for the maintenance and renewal of existing housing, industrial facilities and social capital will continue, however. In particular, the gathering of sand and gravel from sandbanks in coastal areas is ongoing on a certain scale. If such gathering continues at the current scale for decades, it might cause irreversible impact on marine life that uses these ecosystems.

The impact on ecosystems accompanied by the discarding and gathering of resources, for example, could continue in the future, and may damage the resilience of ecosystems. If socioeconomic activities possibly have such impact, intensive research shall be conducted on the status and assessment of that impact on an ongoing basis. If the impact is assessed as being huge, alternative methods and technological development must be promptly discussed and implemented to avoid such impact.

<Existing Measures for Ecosystems that must be Improved>

As for marine and coastal systems, the Basic Act on Ocean Policy was recently enacted. The conservation of biodiversity and its sustainable use must also be improved. As for neritic areas including inland seas such as underwater forests, tidal flats, coral reefs and natural beaches, it should be noted that invasive alien species, coastal erosion, and global warming in addition to development could interact in a complex manner and cause irreversible change. Preventative measures such as monitoring and holding technological discussions about restoring nature are required. As coastal areas in Japan have been utilized by fishers cooperatives for a long time, discussions on marine protected areas also available for fisheries use will be important. As for natural coasts, there are only a few locations in Japan where the sea and land maintain natural continuity. These areas must be carefully monitored because the nature of high-water and intertidal zones in such areas could be lost, even due to small-scale development or water pollution.

As for inland water systems, the deteriorated continuity in rivers and lowered riverbeds could be changed irreversibly. Consequently, improved monitoring, technological discussions on restoring nature, and other preventative measures are needed. Some inland water systems include small-scale habitats such as springs, hot springs, groundwater, caves and limestone areas where specific biodiversity exists, though extensive study has yet to be conducted. Attention is therefore necessary to prevent loss caused by development.

<Others>

The direct use of wild animals will further decrease due to fewer hunters in land areas. In sea areas, resource management must be further improved. Water pollution has been improved to this day, but further attention is needed on the huge amounts of nitrogen being accumulated as accompanied by food and feed imported from abroad.

3. Loss and Measures Regarding the Second Crisis

<Depopulation, Aging Society, and Promoting the Use and Management of Biodiversity>

Given the rapid pace of decreases in population, depopulation and our aging society are progressing, and energy costs in such socioeconomic activities as changes in long-distance movement, the reorganization of infrastructure, and reconstruction of the relationship between cities and rural areas will be unavoidable tasks. When focus is placed on such indirect factors, even less use of biological resources can be expected in cultivated systems such as Satochi-Satoyama areas and some forest and mountain systems such as farmland, secondary grasslands, secondary forests and artificial forests. Future research on the impact shall be awaited, though there are concerns that "the second crisis" will become even more serious.

As for secondary forests, it is even more difficult to implement management for maintaining bright forest floors in all areas. The habitats and living environments of such species as Cephalanthera falcate and luehdorfias that are dependent on exploited environments in Satochi-Satoyama areas will be lost. As for secondary grasslands, if their economic value as meadows and for grazing is lost, relict plants of the glacial age that depend on secondary grasslands, and such animals as golden eagles that use grasslands as feeding grounds might further decrease. There are concerns that if unmanageable areas are expanded in artificial forests, such forest functions as preventing sediment discharge and slope disruption could deteriorate, thereby leading to rapid and irreversible change.

In order to deal with the factors of loss in the first place, the use of biological resources must be promoted in such places as Satochi-Satoyama areas based on a social consensus. Promoting the use of biological resource is limited when based on legal procedures. It is important to deal with this matter based on forming a local consensus in consideration of an autonomous framework for resource management as traditionally nurtured in local communities. With such ideas presented in the SATOYAMA Initiative, and in order to secure social incentives, such practical measures as promoting new types of use such as utilizing Satoyama biomass as an energy source, the participation of various entities such as urban residents and companies, and accumulating and providing technological know-how for local activities are expected.

It is also important to focus on restructuring the relationship between cities and rural areas, and construct ecosystem networks of various scales based on a grand design from the perspective of national and local lands by using social capital of lowered necessity. For these efforts, it will also be necessary to discuss the proactive conversion of secondary forests into natural forests needing no manpower for management. There may be a need to conserve fauna and flora dependent on disturbed environments in secondary forests and secondary grasslands. To meet such need, using the cost for limited locations enabling intensive management in view of distributed populations, etc. must be considered.

New forms of sustainable use shall be discussed in cases of a reduced supply of foreign food, timber and energy, while promoting the use of domestic biological resources.

<Population Growth and Expanded Distribution among Medium-size and Large Mammals, and Broad-based Population Control>

If decreasing hunting pressure cannot be stopped, the populations of medium-size and large mammals will increase, and their distributions will further expand. These animals will consequently cause more damage to agriculture and forestry industries, escalate friction with humans, and deteriorate the quality of forest and mountain systems. In particular, the population growth and expanded distribution of deer could worsen the destruction of forest vegetation. There are concerns that such a situation could cause rapid, irreversible change in Japan's forest and mountain systems.

From a broad-based perspective that extends beyond prefectural boarders, the populations of birds and other animals must be controlled in terms of long-term trends of regional populations including the sizes of core habitats, inhabitation conditions, fertility, and whether seasonal migration is involved. It is also necessary to nurture human resources to protect and control wild birds and animals, including such persons as hunters to capture animals and birds.

4. Loss and Measures Regarding the Third Crisis

Assuming an active international movement of humans and other matters as is currently the case, the intentional and unintentional entry of alien species, and their settlement and expansion remain serious concerns. The invasive alien species that have already entered and settled in Japan could further expand their distribution and cause major impact on ecosystems. In particular, there would be a higher risk of alien species settling and expanding if their habitats expand due to rising temperatures. Above all, rapid and irreversible change could be caused by invasive alien species in such isolated ecosystems such as inland water systems and island systems.

The costs of preventing invasive alien species, particularly the cost of containing or eradicating species that have already settled and expanded their distributions, are very high. Therefore, vulnerable systems should preferably be improved to prevent new settlement by strengthening the monitoring system. As for alien species that have already settled, impact assessment to implement intensive prevention over species with a high priority of prevention, and further technological development on effective and efficient prevention are expected to be promoted.

5. Loss and Measures Regarding the Climate Change Crisis

As temperatures continue to rise as predicted, the distributions, populations and phenology of organisms will also change to a large extent, some of which has already been confirmed. There are concerns that such changes might cause changes in the interaction between organisms in various ecosystems and in that between organisms and their environments. Moreover, fragile ecosystems such as alpine zones and coral reefs are highly likely to experience rapid and irreversible impact.

To counter these changes, measures for adapting to the impact of global warming on biodiversity shall be promptly realized and implemented. In order to find environmental changes caused by global warming as early as possible and promptly take practical measures, the monitoring system in an ecosystem particularly susceptible to global warming must be improved and strengthened. It is also important to construct a system to intensively monitor environmental changes and set such monitoring sites as promoted by the Monitoring Site 1000 project, and implement monitoring with the participation of the various persons involved such as private citizens, and hold discussions on the sharing of information.

6. Impact of Irreversible Change

The loss of biodiversity is usually considered to progress slowly, leaving enough time to take measures in hopes of strengthening the resilience of ecosystems. However, if such loss exceeds a certain threshold, ecosystems could undergo rapid or even irreversible change.

Such changes that are debated as "tipping points" could cause irretrievable loss of biodiversity in Japan. Grasping those changes at an early stage is important in order to take measures against future loss. Such tipping points are almost certainly expected to occur, though it is difficult to predict the exact timing of such occurrence given existing scientific levels.

As stated before, among the ongoing losses over the past 50 years, the cases that might possibly cause such irreversible changes are listed in the table below (Table IV-6). These losses require especially careful monitoring and adaptive management to deal with uncertainty.

Table IV-6 Examples of losses that might cause irreversible changes

Ecosystem classification	Examples of loss
Forest and mountain systems	Impact of global warming on alpine zones; Impact of slope disruption caused by insufficient management on artificial forests; Impact of destruction of forest vegetation caused by population growth and expanded distribution of deer
Inland water systems	Impact of deteriorated continuity on rivers and lowered riverbeds; Impact of invasive alien species on rivers and lakes; Impact of global warming on lakes
Marine and coastal systems	Combined impact of development on marine and coastal systems (including the gathering of sand and gravel); Impact of global warming on coral reefs
Island systems	Impact of invasive alien species on islands

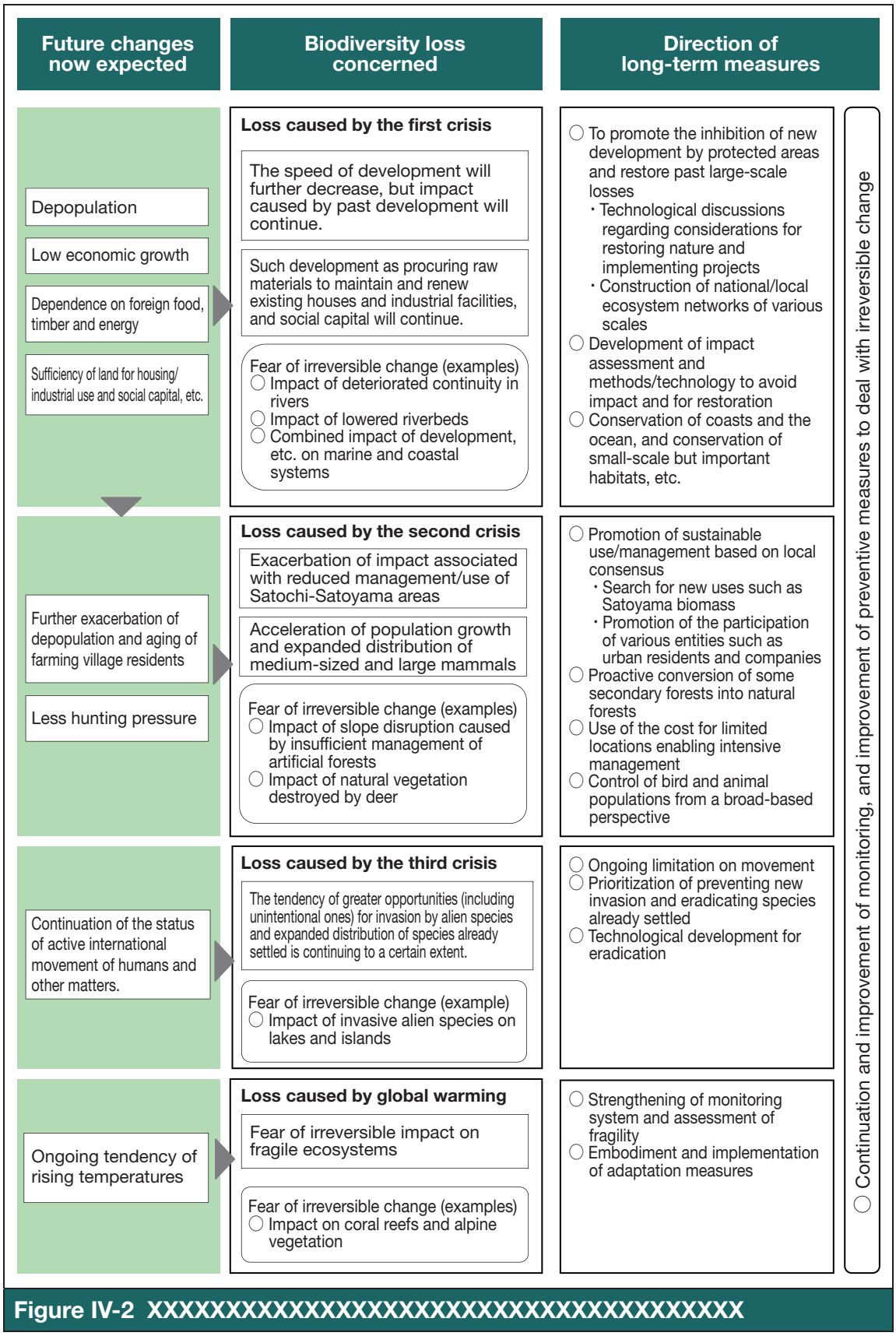
7. Mainstreaming of Biodiversity

Nowadays, the recognition of biodiversity is increasing somewhat, but the recognition of biodiversity loss is not widely accepted. There is an undeniable possibility that such recognition is not shared in society and greater loss may occur in the future.

It is important to promote the "mainstreaming of biodiversity" on both a mid-term and long-term basis. This does not simply mean to disseminate the importance of biodiversity. This is a project where not only the national and local governments but also all entities in society (including the private sector) shall take practical measures and actions to mitigate the losses, and secure the provision of human and physical resources for that purpose.

Forming a local consensus is also important for the "mainstreaming of biodiversity." Biodiversity is unique to individual areas, where measures promoted by local communities may be more appropriate. Prefectural and ordinance-designated city governments have now begun formulating local biodiversity strategies. To promote this effort even further, it is important for local societies such as municipalities and settlements close to nature to form a consensus on the ideal status of biodiversity in their own areas.

One approach for the "mainstreaming of biodiversity" is being able to recognize the economic value of biodiversity and ecosystem services. Through this effort, not only governments and local societies, but also various entities, such as consumers and those companies that produce products and services using biodiversity, will be able to take action for conserving biodiversity and its sustainable use. More advanced efforts have recently been announced in the form of biodiversity offset and biodiversity banking, where biodiversity and ecosystem services are taken into the market mechanism for trading in order to promote the conservation and sustainable use of biodiversity.



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Chapter V
Problems in the Future

The Comprehensive Assessment of Biodiversity functions as a mediator between observing the loss of biodiversity and formulating targets and practical actions to mitigate the loss, thereby promoting specific actions to mitigate and restore biodiversity loss (see Figure V-1).

In other words, it comprehensively analyzes the results of observing biodiversity by governmental agencies, researchers and NGOs nationwide, and assesses the factors and status of loss from scientific viewpoints. It also presents its own assessment results to point out what to focus on when the central and local governments formulate targets, and various entities take specific actions (such as governmental measures and activities conducted by companies and NGOs.

The Comprehensive Assessment of Biodiversity conducted this time was the first of its kind at the national level. Although this assessment may still fall short of being sufficient, it is widely expected to play an important role in the future.

This chapter confirms the tasks in which individual entities are engaged.

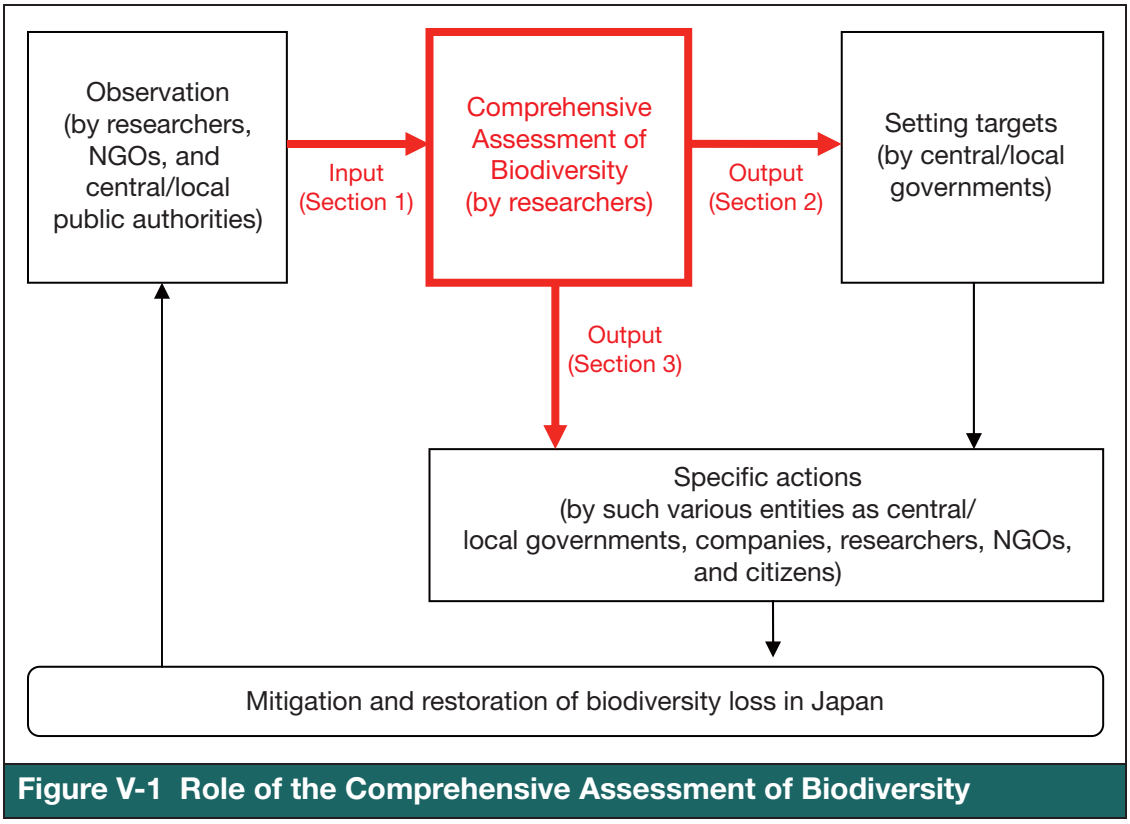


Figure V-1 Role of the Comprehensive Assessment of Biodiversity

Section 1 Problems Regarding Input from Observation

The Comprehensive Assessment of Biodiversity is conducted through a process of collecting and summarizing existing data and expertise in fields related to organisms and the changes thereof. It is important to smoothly reflect the scientific basis—data and expertise possessed by researchers, NGOs and central/local public authorities in charge of observation—in the assessment. Moreover, the quality and quantity of data and expertise to be reflected in the assessment as observation results must also be improved.

1. Improvement of observation regarding biodiversity

Japan is blessed with information and human resources in the field of biology. Extensive study results regarding biodiversity have been accumulated. Statistical information has also been organized in the areas of national land management and agriculture, forestry and fishery. Moreover, research is being conducted in terms of the natural environment through National Surveys on the Natural Environment initiated in the 1970s and a recently established nationwide monitoring system. Many results have thus been accumulated.

Longitudinal data of good quality and data covering broad areas are easy to use for determining indicators, and are particularly indispensible for the Comprehensive Assessment of Biodiversity in the future. However, such data may not necessarily directly relate to organisms or even be available for assessment due to a lack of accuracy.

The volume of data regarding species (in lists covering distributions, populations, etc.) also remains insufficient. Under such circumstances, the assessment conducted this time mainly dealt with data regarding ecosystems. More data directly related to individual species should be gathered in order to conserve the biodiversity of species.

With the above situation in mind, researchers and NGOs in the field of biology are expected to continue observing biodiversity. It is important that the central and local governments support such efforts to promote the collection of data from broader areas. In addition, the governmental offices involved in other fields and those responsible for industrial statistics are also expected to collect information from the perspective of biodiversity.

2. Improvement of the openness and usability of data

Even though data on the status of biodiversity have been accumulated through observation, some kinds of data were not available for the assessment because of not being open to the public or due to poor usability. Of course, necessary restrictions (regarding information about endangered species, etc.) must be maintained. Should the cost necessary to use such data be too high, using the data as determinants of the indicators may prove too difficult. The central and local governments must therefore publicize the data under their control in a usable form, among other things.

3. Presentation of data including factors and measures

Even though data on the status of biodiversity have been accumulated through observation, some kinds of data revealed nothing more than that status, making it difficult to interpret such data when conducting assessment from the perspective of biodiversity loss. It will thus become easier to indicate specific measures and actions when using data that not only shows the status of biodiversity but also information that includes the factors of change and necessary measures.

4. Improvement of knowledge regarding ecosystem services and “tipping points”

It is important to show assessment regarding ecosystem services and the “tipping points” of ecosystems when various entities make decisions and form a consensus for implementing specific efforts. Despite the high demand for such assessment, the knowledge regarding the status of ecosystem services and the “tipping points” in certain ecosystems remains inadequate. Studies in these fields are currently in progress. Therefore, the knowledge in these fields is expected to be further improved.

5. Prioritized observation of ecosystems with severe loss

The Comprehensive Assessment of Biodiversity is a general assessment using the best existing data currently available in order to urge individual entities to take specific actions. Accordingly, additional data that will form the basis of formulating measures must be prioritized for ecosystems assessed as having a huge loss and those assessed as facing greater loss in the future. For example, the affluence of marine and coastal systems is one characteristic of Japan's natural environment, but data related to marine and coastal biodiversity remains inadequate. Ongoing research must therefore be conducted to better understand the status of change in such ecosystems as alpine zones that predominantly and clearly show deterioration caused by the impact of global warming.

Section 2 Problems Regarding Output for Setting Targets

The national and local governments are expected to be the driving forces behind formulating plans and setting targets for actions to mitigate the loss of biodiversity. The Comprehensive Assessment of Biodiversity will contribute to setting and achieving such targets. The task at hand is to strengthen the following points.

1. Association with the Post-2010 Targets

At the 10th Conference of the Parties to the Convention on Biological Diversity (COP10) to be held in October 2010, "post-2010 targets" will be formulated as the international goals for action. Japan proposed the idea behind setting these targets in January 2010. The newly formulated post-2010 targets may therefore become the targets for action to mitigate biodiversity loss in Japan through the Basic Act on Biodiversity and National Biodiversity Strategy.

The comprehensive assessment of biodiversity shall be improved so as to urge various entities to take more specific actions by strengthening its relationship with the post-2010 targets and improving the current indicators by enhancing scientific knowledge and clarifying the correspondence between each indicator and target.

2. Multilayered spacial scale of assessment

The loss of biodiversity is caused by numerous direct and indirect multilayered factors, ranging from those of an international scale such as global warming to individual local development and production activities. Entities that can effectively work on those factors are also multilayered as part of international society, national and local governments, such groups such as NGOs and companies, and local societies. Measures for these factors must also be implemented on various spacial scales. Likewise, it is also important to assess biodiversity in multiple layers and on various scales. Indicators suitable for each scale are thus expected to be formulated for use in assessment operation.

From now on, the Comprehensive Assessment of Biodiversity is expected to share information with, and contribute to implementing local-scale assessments that will help formulate and implement local biodiversity strategies as stipulated by the Basic Act on Biodiversity, and assessments at the international level such as the Asia-Pacific region.

Section 3 Problems Regarding Output for Action

In order to mitigate the loss of biodiversity, the "mainstreaming of biodiversity" is necessary. Various entities such as the general public, companies, NGOs, researchers, and national and local governments are requested to understand the need for action and initiate specific actions. The Comprehensive Assessment of Biodiversity identifies the points that various entities should focus on when taking such actions. The task at hand is to strengthen the following points from now on.

1. Raising awareness among the general public.

In order for the Comprehensive Assessment of Biodiversity to generate specific actions to mitigate loss, the general public, companies, NGOs, researchers, schools, and national and local governments must be effectively informed of the assessment results, as well as increasing their awareness of the need for action (see Table V-1).

In the first place, biodiversity is unique to individual areas. Consequently, there are different methods of conserving biodiversity and its usage in different areas. Measures also differ among areas. As the basis of action to mitigate loss, local residents are thus expected to reach a consensus regarding the ideal status of local biodiversity on their own.

Given the circumstances described above, researchers involved in biodiversity and governments must use assessments to proactively promote the dissemination of assessment results. Such dissemination shall not be limited to assessment results. Efforts to promote the forming of a local consensus by publicizing information on the method of assessment and the sources of information, and supporting the formulation of local biodiversity strategies and assessments unique to individual areas are therefore expected.

Table V-1 Actions requested to individual entities based on the Comprehensive Assessment of Biodiversity

	Specific action to mitigate losses (example)
National government	To prioritize research and policies based on assessment, and promote actions to mitigate biodiversity loss by indicating targets on a national scale
Local governments	To assess biodiversity on a local scale, and make use of the assessment in formulating such policies as local biodiversity strategies
Researchers/NGOs	To relate and contribute to assessment through improved observation of biodiversity and by accumulating knowledge about ecosystem services and "tipping points"
Companies	To grasp and assess the impact of their own economic activities on biodiversity, and devise measures to mitigate that impact
General public	To get involved in forming a local consensus and taking actions of their own regarding the ideal status of local biodiversity

2. Mapping of assessment regarding biodiversity

Biodiversity differs dramatically among areas. The nature and degree of the factors of loss are not common nationwide. Necessary actions to mitigate loss will also differ according to individual areas. This is why the factors and degree of loss must be assessed according to each area. This Comprehensive Assessment of Biodiversity prioritized the time-line assessment on a national scale, and did not focus much on certain aspects of local differences.

In order to urge individual entities to take specific actions to mitigate loss from now on, it is important to organize (map) biodiversity assessment as spacial information at the local level.

3. Assessment of ecosystem services

Presenting an assessment of ecosystem services is important for making decisions and forming a consensus when various entities take practical measures. This Comprehensive Assessment of Biodiversity prioritized the factors of biodiversity loss and assessed the status thereof. However, it did not adequately assess ecosystem services as a whole in Japan.

In order to follow up the Millennium Ecosystem Assessment, it is necessary to improve the assessment of ecosystem services in Japan by adopting the "Satoyama-Satoumi Sub-global Assessment" (SGA) promoted by the United Nations University Institute of Advanced Studies and other entities, and the latest results such as studies regarding a quantitative assessment of ecosystem services.

4. Presentation of options for actions

The Comprehensive Assessment of Biodiversity is expected to promote decision-making and consensus-forming in order to mitigate biodiversity loss for the future by presenting options for future actions to various entities such as national and local governments, researchers and NGOs, organizations such as companies, and the general public, and by showing them the costs and effects of such actions. This Comprehensive Assessment of Biodiversity prioritized the assessment of the factors and status of past losses of biodiversity. However, research on optional measures and their effects have not been sufficiently promoted. Thus it was unable to adequate describe such aspects.

The functions of assessment must be strengthened to present options for actions by summarizing the knowledge of experts in wide-ranging fields. Efforts to strengthen such functions shall include improving the assessment of ecosystem services, analyzing different scenarios, generalizing existing measures and discussing their directions, and presenting actions and measures to be taken by various entities including the private sector. It is also necessary to discuss the presentation of options for actions and policies based on the results of "The Economics of Ecosystems & Biodiversity (TEEB)," an economic assessment of biodiversity being promoted by the German government and others.

Appendices

Appendix 1 Results of Questionnaire Survey Designed for Experts

Appendix 2 Summary of Opinions Shared by Experts

Appendix 3 References for data used in the Report of Comprehensive Assessment of Biodiversity in Japan

Appendix 4 Data Used in the Report of the Comprehensive Assessment of Biodiversity

Appendix 1 Results of Questionnaire Survey Designed for Experts

1. Purpose and Outline of the Questionnaire Survey

With the intention of summarizing the negative factors associated with major human activities that were considered to cause crises of biodiversity in Japan over the past 50 years (from the end of World War II to the present), a questionnaire survey was conducted by mail in FY 2008 for experts in the field of biology in Japan.

In the responses, participants were to select up to five major factors from the list of factors of loss (listed below) and freely state the reasons why they selected those factors, along with citing specific examples.

List of factors of impact

01	Deforestation	09	Road construction	17	Feeding damage caused by animals
02	Conversion to artificial forests	10	Dam construction	18	Influence of alien species
03	Development of lakes, rivers, and wetlands	11	Collection of plants for gardening, appreciation and medicines	19	Contamination by pesticides and chemical substances
04	Development of coasts	12	Hunting and fishing	20	Water contamination
05	Development of grasslands	13	Abandonment of forest management	21	Accumulation of nitrogen
06	Urban development	14	Abandonment of grassland management	22	Global warming
07	Development of golf courses and ski area	15	Abandonment of cultivation	23	Others
08	Tourism Development	16	Less hunting pressure		

Note: Factors of impact are based on the items of "factors of decrease" in the Red Data Book issued by the Ministry of the Environment.

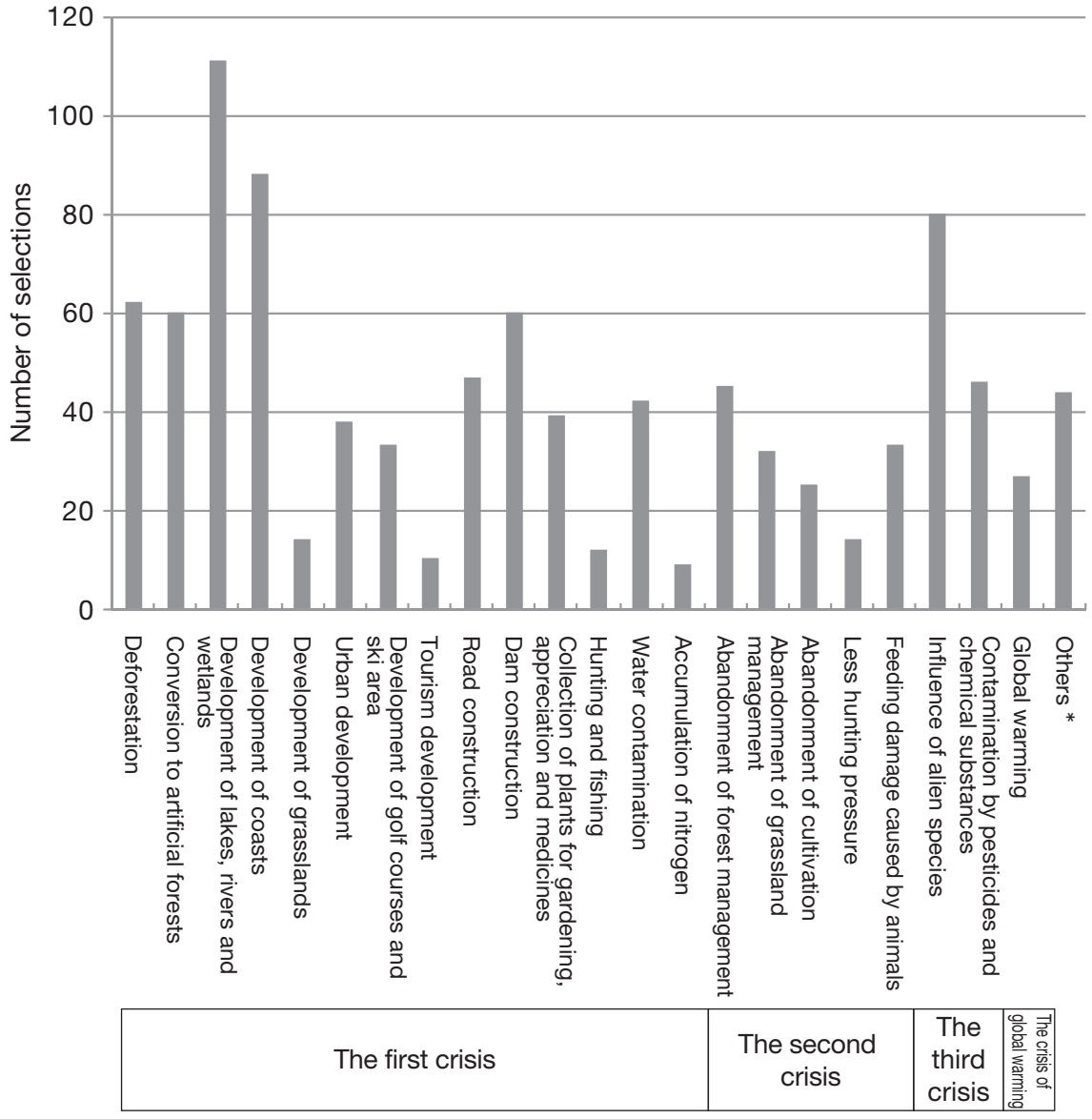
2. Target Respondents of the Questionnaire Survey

In addition to members of the review committee, there were 581 respondents in total including members and the administrators in charge of nature protection in the following investigative committees associated with the Ministry of the Environment, as well as major scientific entities in the field of biology in Japan.

Members of investigative committees associated with the Ministry of the Environment (shown in right column)	Investigative committee and its workshop to select and assess endangered wildlife, investigative committee for basic research on conservation of the natural environment, vegetation workshop and its vegetation research working group, investigative committee for bird-banding research, Investigative committee and its workshop for the monitoring promotion project for important ecosystem monitoring areas (1000 Monitoring Sites)
Committee members and administrators involved in nature protection at major scientific entities in biological fields (shown in right column)	Ecological Society of Japan, Japanese Forest Society, Japanese Society of Grassland Science, Japanese Society of Limnology, Oceanographic Society of Japan, Japanese Society of Systematic Zoology, Japanese Society for Plant Systematics, the Mammalogical Society of Japan, Ornithological Society of Japan, the Herpetological Society of Japan, Ichthyological Society of Japan, Entomological Society of Japan, Japanese Association of Benthology, Botanical Society of Japan

3. Results of the Questionnaire Survey

There were 213 effective responses, reflecting a collection rate of 36.7%. Among the responses, two were excluded from the survey due to more than five factors being selected. Each respondent selected up to five factors, which were counted as one response in respective fields when said factors related to multiple fields. An average number of 4.6 factors was selected by each respondent, with the number of all factors selected being counted. Major comments in the free response were also summarized.



* See the free comments on the following page for other survey results.

Figure: Number of selections according to the factor

Table: Major comments in the free responses (Examples)

Crisis	No.	Factor of impact	Response	Major comments in the responses (example)
The first crisis	1	Deforestation	62	○ Broadleaf natural forests such as fagaceae forests decreased nationwide due to their conversion into artificial forests after World War II. ○ The crisis impacted forest animals and plants, and the river environment.
	2	Conversion to artificial forests	60	○ Artificial forests of cryptomeria and Japanese cypress and simple biota expanded to a large extent due to expanded afforestation from the 1950s to the 1970s.
	3	Development of lakes, rivers and wetlands	111	○ Straightened rivers and concrete-reinforced riverbanks have simplified the waterside environment. ○ Low wetlands in coastal areas and wetlands in land areas were converted into farmland and other landforms after World War II.
	4	Development of coasts	88	○ Many tidal flats and underwater forests were lost due to landfills, reclamation, and the construction of harbors and ports since the 1960s. ○ Changes in habitat environments and the separation of land and sea were caused by the construction of structures and roads along the coast.
	5	Development of grasslands	14	○ Conversion to land for housing, farmland, and artificial grasslands
	6	Urban development	38	○ Secondary forests, wetlands, grasslands, and paddy fields around cities were converted into sites for housing and factories. ○ Development of hills to construct new towns around a city
	7	Development of golf courses and ski area	33	○ Alteration of forests in hills caused by the construction of golf courses ○ Impact of agricultural chemicals/fertilizers drained from golf courses on land-water areas
	8	Tourism development	10	○ Impact of constructing mountain paths and hiking trails on surrounding areas
	9	Road construction	47	○ Separation of forests, coasts, and water systems ○ Inhibited movement of wild animals, roadkill ○ Spread of alien species through roads
	10	Dam construction	60	○ Construction of dams and estuary barrages cause separation in rivers and inhibit the movement of migratory organisms. ○ Changes in water volume/temperature/turbidity, changes in sediment supply
	11	Collection of plants for gardening, appreciation and medicines	39	○ The number of orchidaceous plants decreased due to illegal digging during the gardening boom beginning in the 1980s. ○ Certain reptile and insect populations probably declined due to illegal capture.
	12	Hunting and fishing	12	○ Organism community structures changed drastically due to overfishing, selective and mixed fishing of specific fish species, and the release of newly hatched fish.
	20	Water contamination	42	○ The crisis is associated with eutrophication in lakes, inner bays, and along coasts caused by water discharge from industries and households from the 1950s and 1960s to the 1990s.
	21	Accumulation of nitrogen	9	(Most comments are the same as those on eutrophication in “20. Water contamination.”)

Table: Major comments in the free responses (Examples) (continued)

Crisis	No.	Factor of impact	Response	Major comments in the responses (example)
The second crisis	13	Abandonment of forest management	45	○ The transition in artificial/secondary forests progressed due to the abandonment of management from the 1960s. Biota became simplified especially in Satoyama forests. ○ Bears and other wild animals intrude into residential areas.
	14	Abandonment of grassland management	32	○ Fauna and flora living in grasslands decreased due to the reduced management of secondary grasslands (fields of Japanese silver grass) in mountains and around farmland from the 1960s to the 1970s. ○ Conversion of secondary grasslands into artificial grasslands
	15	Abandonment of cultivation	25	○ Abandoned cultivation, especially in mountainous paddy fields from the 1970s, caused decreases in the populations of amphibians, insects and other fauna and flora.
	16	Less hunting pressure	14	○ Deer populations rapidly expanded due to fewer large predators and less hunting pressure.
	17	Feeding damage caused by animals	33	○ Rapid increases in deer populations expanded the damage to vegetation in some mountains and other areas. ○ Feeding damage on farmland caused by medium-size and large mammals ○ Rocky-shore denudation caused by feeding damage by fish and sea urchins in underwater forests; Feeding damage caused by acanthasters in coral reefs
The third crisis	18	Influence of alien species	80	○ Impact of predation/competition/cross-breeding of alien organisms brought in as pets or for gardening/industrial use. ○ The impact is particularly serious in land-water areas and on islands.
	19	Contamination by pesticides and chemical substances	46	○ Sharp decrease of fauna and flora in paddy fields, etc. caused by agricultural chemicals (mainly herbicides), especially during the 1950s to 1980s. Signs of improvement are now being seen. ○ Agricultural chemicals/chemical substances accumulated in organisms. Note 1: The direct impact of agricultural chemicals is categorized as part of the first crisis.
Climate change crisis	22	Global warming	27	○ Expanded distributions of living organisms in high latitude/high elevation areas in land and sea areas ○ Impact on alpine zones, coral reefs, underwater forests, and the fauna and flora that live and grow there
	23	Others	44	○ Conversion of paddy fields into dry fields through field adjustment; concrete-finished channels; channel/sewage separation causing impact on amphibians, freshwater fish, aquatic plants, etc. Note 2: Most comments in "Others" are related to field adjustment.

Appendix 2 Summary of Opinions Shared by Experts Regarding the Gist of the Report of the Comprehensive Assessment of Biodiversity (draft)

1. Purpose and Outline of Sharing Opinions

Experts in the field of biology in Japan were requested to share their opinions regarding the gist of the Report of the Comprehensive Assessment of Biodiversity (draft), in order to collect remarks from scientific and technical viewpoints regarding the appropriateness of descriptions of assessment and judgments on more useful data to support the assessment (conducted in FY 2009).

The respondents were asked to point out the pages, lines and items of their choice, and freely state their opinions and reasons for each item.

2. Selection of Respondents

The respondents were 208 committee members and the administrators in charge of nature protection in the following investigative committees associated with the Ministry of the Environment, as well as major scientific entities in the field of biology in Japan.

Table: Selected respondents for sharing opinions

Committees for assessment related to the Ministry of Environment	Committee and Sub-committee for Selection and Assessment of Wildlife Threatened with Extinction, Sub-committee for Vegetation Science under the Committee for Basic Assessment of Natural Environment Conservation, Department of Vegetation Science Research, Committee for Bird Banding Assessment, Committee and Sub-Committee for Assessment of Monitoring Promotion in Significant Ecosystem Surveillance Areas (Monitoring Site 1000 project)
Committee members and directors related to nature conservation at major academic institutions of biology	The Ecological Society of Japan, Japanese Forest Society, Japanese Society of Grassland Science, Japanese Society of Limnology, Oceanographic Society of Japan, Japanese Society of Systematic Zoology, Japanese Society for Plant Systematics, Mammalogical Society of Japan, Ornithological Society of Japan, Herpetological Society of Japan, Ichthyological Society of Japan, Entomological Society of Japan, Japanese Association of Benthology, and Botanical Society of Japan

3. Results of Sharing Opinions

There were 51 effective responses to the request for sharing opinions, reflecting a collection rate of 24.5%. A total of 404 opinions were obtained and categorized into "assessment indicators" by "Chapter/Section level," and then used as references when preparing the assessment report.

1. The sharing of opinions was requested to 208 respondents from among the 581 persons selected for the "Questionnaire survey conducted in 2009 for experts regarding factors causing the "crisis of biodiversity. "

Appendix 3 References for data used in the Report of Comprehensive Assessment of Biodiversity in Japan

Data No.	Data Name	Source
1- ①	Trend of Use of Land	White Paper on Land, Ministry of Land, Infrastructure, Transport and Tourism
		Survey on State of Forest Resources, Ministry of Agriculture, Forestry and Fisheries
		Statistics on Cultivated Land and Planted Area, Ministry of Agriculture, Forestry and Fisheries
		Basic Survey for Land Use Infrastructure Development, Ministry of Agriculture, Forestry and Fisheries
1- ②	Scale of Ecosystem in Land Area	White Paper on Land, Ministry of Land, Infrastructure, Transport and Tourism
		Survey on State of Forest Resources, Ministry of Agriculture, Forestry and Fisheries
		Statistics on Cultivated Land and Planted Area, Ministry of Agriculture, Forestry and Fisheries
		Basic Survey for Land Use Infrastructure Development, Ministry of Agriculture, Forestry and Fisheries
		Statistical Analysis of Agricultural Land Construction Activities, Ministry of Agriculture, Forestry and Fisheries
1- ③	Distribution of vegetation with little conversion	Natural Environment Information GIS Data in Fundamental Survey of 5th Natural Environment Conservation, Ministry of the Environment
1- ④	Changes in land use from the early 20th century to the 1980s	LUIS (Land Use Information System), Yukio Himiyama
1- ⑤	Changes in land use from the 1980s to the 1990s	Natural Environment Information GIS Data in Fundamental Survey of 2nd and 3rd Natural Environment Conservation, Ministry of the Environment
		Natural Environment Information GIS Data in Fundamental Survey of 5th Natural Environment Conservation, Ministry of the Environment
1- ⑥	Transition in the area of farmland converted into land for housing and factories (area of artificially converted fields no longer used for agriculture)	Statistics on Cultivated Land and Planted Area, Ministry of Agriculture, Forestry and Fisheries
1- ⑦	Transition in the area of forests converted into urbanized land use (by purpose of use)	White Paper on Land, Ministry of Land, Infrastructure, Transport and Tourism
2- ①	Trend of hunting population	Statistics on Wildlife, Forestry Agency
		Statistics on Wildlife, Environment Agency
		Statistics on Wildlife, Ministry of the Environment
3- ①	Trends of density of total nitrogen and total phosphorus in lakes, marshlands and the marine areas	Measurement Results of Public Water Quality and Groundwater Quality in Fiscal 2008, Ministry of the Environment
3- ②	Impact of nitrogen through the atmosphere	Tabayashi Y and Yamamuro M, 2009: Changes in the impact of anthropogenic effects on river water quality during the last 50 years in Japan, Wetlands Ecology and Management, 17(4), 409-415.
		Tabayashi Y, 2009: Influence of Human Activities on River Water Quality after Modernization, Graduate School of Frontier Sciences, the University of Tokyo, Thesis for a degree
4- ①	The ratios of extinct species, extinct wild species and endangered species by taxon	2007: Red List (Mammal), Ministry of the Environment
		2006: Red List (Bird), Ministry of the Environment
		2006: Red List (Amphibia), Ministry of the Environment
		2007: Red List (Brakish and Freshwater Fish), Ministry of the Environment
		2007: Red List (Insect), Ministry of the Environment
		2007: Red List (Plant I: Vascular Plant), Ministry of the Environment
4- ②	Era and name of animals already in extinction or extinction in the wild	2002: Revised Red Data Book - 1 (Mammal), Ministry of the Environment
		2002: Revised Red Data Book - 2 (Bird), Ministry of the Environment
		2000: Revised Red Data Book - 3 (Crawler and Amphibia), Ministry of the Environment
		2003: Revised Red Data Book - 4 (Brakish and Freshwater Fish), Ministry of the Environment
		2006: Revised Red Data Book - 5 (Insect), Ministry of the Environment
		2006: Revised Red Data Book - 7 (Arachnid and Crustacea), Ministry of the Environment
		2007: Red List (Mammal), Ministry of the Environment
		2006: Red List (Bird), Ministry of the Environment
		2006: Red List (Amphibia), Ministry of the Environment
		2007: Red List (Brakish and Freshwater Fish), Ministry of the Environment
		2007: Red List (Insect), Ministry of the Environment
		2006: Red List (Crustacea), Ministry of the Environment
		2006: Red List (Arachnid and Myriapods), Ministry of the Environment
4- ③	No. of extinct species by period (vascular plants)	Taku Fujita, Makoto Ogawa, Teruo Katsuyama, Yasuro Kadono, Nobumitsu Kawakubo, Shunsuke Serizawa, Hideki Takahashi, Masayuki Takamiya, Shinji Fujii, Hiroyuki Matsuda, Kazuo Muneda, Masatsugu Yokota, Koji Yonekura, Tetsukazu Yahara, unpublished.
4- ④	Name and era of species already extinct or extinct in the wild (vascular plants)	Taku Fujita, Makoto Ogawa, Teruo Katsuyama, Yasuro Kadono, Nobumitsu Kawakubo, Shunsuke Serizawa, Hideki Takahashi, Masayuki Takamiya, Shinji Fujii, Hiroyuki Matsuda, Kazuo Muneda, Masatsugu Yokota, Koji Yonekura, Tetsukazu Yahara, unpublished.
4- ⑤	Cause of decrease of endangered species by biological classification	2002: Red Data Book - 1 (Mammal), Ministry of the Environment
		2000: Red Data Book - 3 (Crawler and Amphibia), Ministry of the Environment
		2003: Red Data Book - 4 (Brakish and Freshwater Fish), Ministry of the Environment
		2000: Red Data Book - 8 (Plant I: Vascular Plant), Ministry of the Environment
4- ⑥	Factors of extinction for extinct species and extinct species in the wild	2002: Red Data Book - 1 (Mammal), Ministry of the Environment
		2002: Red Data Book - 2 (Bird), Ministry of the Environment
		2000: Red Data Book - 3 (Crawler and Amphibia), Ministry of the Environment
		2003: Red Data Book - 4 (Brakish and Freshwater Fish), Ministry of the Environment
		2006: Red Data Book - 5 (Insect), Ministry of the Environment
		2006: Red Data Book - 7 (Arachnid and Crustacea), Ministry of the Environment

Data No.	Data Name	Source
4- ⑦	Number of species listed in the Red Data Book (vascular plants) by prefecture	2000: Red Data Book - 8 (Plant I: Vascular Plant), Ministry of the Environment
4- ⑧	Major factors causing adverse effects on tideland environments in Japan and their relative significance for individual tideland environments	1996: WWF Japan Science Report, Current Conditions of Tidal Wetlands in Japan and Benthic Organisms Living There, 3, 181pp.
5- ①	Trend of areas in major conservation areas	Documents of the Ministry of the Environment
		Documents of the Forestry Agency
		Documents of the Ministry of Land, Infrastructure, Transport and Tourism
5- ②	Coverage ratio of conservation areas in each ecosystem	Documents of the Ministry of the Environment
		Digital National Land Information, Ministry of Land, Infrastructure, Transport and Tourism
5- ③	Protected area cover ratios in ecosystems (according to designated entity) (15) Natural forests/natural grasslands, secondary forests with high naturalness (with a degree of naturalness of 8, 9 or 10)	Documents of the Ministry of the Environment
		Digital National Land Information, Ministry of Land, Infrastructure, Transport and Tourism
6- ①	Transition of the numbers of designations as "Natural Monument designated by species" and "National Endangered Species of Wild Fauna and Flora"	Documents of the Ministry of the Environment
		Documents of the Agency for Cultural Affairs
6- ②	Transition of the number of prefectures which have prepared prefectural version of Red List or Red Databook or have established rare species ordinance	Documents Published by Local Prefectural Governments
7- ①	Production of firewood and charcoal	Historical Statistics of Japan, Ministry of Internal Affairs and Communications
		Historical Statistical Series of Japan, Ministry of Internal Affairs and Communications
7- ②	Transition in the use of working cattle	1995: Development History of Agriculture Technology in Showa Era (Vol. 4) – Livestock and Silk, Compilation Committee of the Development History of Agriculture Technology in Showa Era in Agriculture, Forestry and Fisheries Research Council of Ministry of Agriculture, Forestry and Fisheries, Rural Culture Association
7- ③	Transition of abandoned farmlands	Japan Census of Agriculture and Forestry, Ministry of Agriculture, Forestry and Fisheries
7- ④	Transition of the ratio of Satochi-Satoyama meshes in national land	2003: FY2002 Survey Report of Nature Conservation Measures of Satochi, Ministry of the Environment
8- ①	Transition of the numbers of occasions of formulating the Specified Wildlife Conservation and Management Plans	Documents of the Ministry of the Environment
9- ①	Changes in the entry/ number of settled alien insect/weed species	Nobuo Morimoto, Keiji Kiriya, 1995: Fauna of Exotic Insects in Japan, Report of National Institute for Agro-Environmental Sciences, 12, 87-120
		Keiji Kiriya, 2000: Invasive Insects Swept the World, Insectarium, 37(8), 226-227
		Osamu Watanabe, 2007: Invasive Condition and Distribution of Alien Weeds in Forage Crop Fields, Bulletin of the Faculty of Agriculture, Shinshu University
9- ②	Transition of the quantity of "living animals" imported from abroad	Monthly Return of the Foreign Trade of Japan, Ministry of Finance
9- ③	Transition of the quantity of "living animals" imported from abroad in recent years	Monthly Return of the Foreign Trade of Japan, Ministry of Finance
9- ④	Expansion of the distribution of invasive alien species	Yoshun Kaneko, Tsutomu Wakabayashi, 1998: Angler's Novels
		National Survey On Natural Environment in River and Watershore, Ministry of Land, Infrastructure, Transport and Tourism
		Taiga Yodo, Keiichiro Iguchi, 2004: History and Background of Bass Problem, Research Report of Fisheries Research Agency, No. 12, 10-24
		Statistics on Wildlife, Environmental Agency
		Statistics on Wildlife, Ministry of the Environment
9- ④ Reference	Transition in the number of captured raccoons	7th Report of Biodiversity Survey of Natural Environment Conservation Basic Research Species (Racoon Inhabitation Information Collection) (FY 2006), Ministry of the Environment
10- ①	Transition of the status of detecting major pollutants over years (in fishes and shellfishes)	Documents of the Ministry of the Environment (Environmental Survey of Chemical Substance)
11- ①	Number of types of specified alien, undetermined alien, and suspicious alien species	Documents of the Ministry of the Environment
11- ②	The number of confirmed cases of prevention by prefecture	Documents of the Ministry of the Environment
12- ①	Decrease in sea ice in the Sea of Okhotsk	Keiichiro Oshima, Takuya Nakanowatari, Masataka Wakatsuchi, 2006: Sea of Okhotsk that is a highly-sensitive area of global warming: Impact on North Pacific Ocean, Low Temperature Science, 65, 67-75
12- ②	Relationship between bleaching of corals and temperature in Sekisei Lagoon	Okamoto M, S Nojima and Y Furushima, 2007: Temperature environments during coral bleaching events in Sekisei Lagoon, Bulletin of the Japanese Society of Fisheries Oceanography, 71 (2), 112-121, and others
12- ③	Decrease in alpine plants on Mount Apoi	Takehiro Masuzawa, Jun Koda, Masato Tanaka, Toshiki Natori, Sadamoto Watanabe, 2005: Alpine Floras in Mt. Apoi, Hokkaido, Report of Ecological Society of Japan, 55, 85-89
		Sadamoto Watanabe, 2001: Change of Ultrabasic Rock Floras in Mt. Apoi for 45 Years (1954-1999), Global Environment Research, 3, 25-48
12- ④	Changes in the distribution of great Mormons	Masahiko Kitahara, 2008: Distribution Expansion Phenomenon of Butterflies, Insect and Nature, 43(4), 19-23
12- ⑤	Changes in the distribution of Ictinogomphus pertinax	Takashi Aoki, 2000: Distribution Expansion of Ictinogomphus Pertinax in Japan based on Records, TOMBO, XL II, 47-50
12- ⑥	Changes in the distribution of Nezara viridula	Kenji Fujisaki, 2007: The time when living of creatures changes: Conservation of nature, 499, 6-7
		Junichi YUKAWA, Keizi KIRITANI, Naohisa GYOUTOKU, Nami UECHI, Daisuke YAMAGUCHI and Satoshi KAMITANI, 2007: Distribution range shift of two allied species, Nezara viridula and N. antennata (Hemiptera: Pentatomidae), in Japan, possibly due to global warming. Appl. Entomol. Zool. 42 (2), 205?215.
		Documents of Agricultural Experiment Stations in local prefectural governments
12- ⑦	Changes in the fish fauna in the Chikuzen Sea, Fukuoka Prefecture	Takashi Nishida, Akinobu Nakazono, Makoto Oikawa, Seiichi Matsui, 2005: Change of Fish Fauna in Chikuzen Coasts due to Recent Seawater Temperature Rise, Liberal Arts Magazine of the Graduate School of Agriculture, Kyushu University
12- ⑧	Changes in population of overwintering Cygnus columbianus in Japan	Hiroyoshi Higuchi, Shigeto Koike, Mayumi Shigeta, 2009: Influence of Global Warming on Phenology, Distribution, and Number of Population, Global Environment, 14(2), 189-198
12- ⑨	Relationship between flowering dates of cherry (Somei-Yoshino) and temperature	Hiroyoshi Higuchi, Shigeto Koike, Mayumi Shigeta, 2009: Influence of Global Warming on Phenology, Distribution, and Number of Population, Global Environment, 14(2), 189-198
12- ⑩	Changes in the egg-laying period of Sturnus philippensis	Koike, S and H, Higuchi,2002：Long-term trends in the egg-laying date and clutch size of Red-cheeked Starlings Sturnia philippensis. IBIS, 144(1), 150-152.

Data No.	Data Name	Source
13- ①	Recognition of biodiversity	Review Results of Implementation of National Strategy for the Conservation and Sustainable Use of Biological Diversity (2nd) (Determined by the liaison conference of governments and agencies on National Strategy for the Conservation and Sustainable Use of Biological Diversity in September 13, 2004)
		2009: National Census Concerning Environmental Problems, Cabinet Public Relations Office, Cabinet Secretariat
14- ①	Transition of ODA amounts in the area of environment in Japan and the rate of biodiversity-related amount to the total	OECD/DAC Documents
		OECD/DAC, CRS On-line Database
14- ②	Japan's proportions of contributions to funds, etc. related to the conservation of biodiversity	Documents of Conservation International
		FCPF Documents
		Documents of World Bank
14- ③	Number of technical cooperation projects for each region in the area of biodiversity by the Japan International Cooperation Agency (JICA)	2010: Report on Analysis of Cooperation Examples in Biodiversity for CBD COP10 and Examination of Activity Development (Project Research), Japan Wildlife Research Center
15- ①	Transition of forest area (highly natural forests/artificial forests)	Forest Resources Assessment, Forestry Agency
		Forest Area Statistics, Forestry Agency
15- ②	Transition of artificial forest area	Historical Statistics of Japan, Statistics Bureau, Ministry of Internal Affairs and Communications
		Forest and Forestry Statistics Directory, Forestry Agency
15- ③	Changes in the distribution of Japanese deer, and transition in number of deer captured	1985: 2nd Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Animal Distribution Survey Report (Mammal) (1980/nationwide version), Environment Agency
		2004: 6th Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Mammal Distribution Survey Report (2004), Ministry of the Environment
		Statistics on Wildlife, Forestry Agency
		Statistics on Wildlife, Environmental Agency
		Statistics on Wildlife, Environmental Agency
15- ④	The amount of damage caused by pine wood nematode (total volume of damaged timber)	Documents of Forestry Agency URL http://www.rinya.maff.go.jp/seisaku/sesakusyoukai/mamoru/1.html
16- ①	Status of forest fragmentation	2009: Dynamic Change Analytical Report by Forest Resource Survey Data, Forestry Agency
17- ①	Changes in distribution of Ursus arctos and Ursus thibetanus	1985: 2nd Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Animal Distribution Survey Report (Mammal) (1980/ nationwide version), Environment Agency
		2004: 6th Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Mammal Distribution Survey Report (2004), Ministry of the Environment
17- ②	Living Planet Index (LPI) Changes in the distribution range of bird species from 1997 to 2002 relative to 1978	Yamaura Y., Amano T., Mitsuda Y., Taki H. and Okabe K 2009: Does land-use change affect biodiversity dynamics at macroecological scale? A case study of birds over the past 20 years in Japan, Animal Conservation, 12, 110-119.
18- ①	Transition in the volume of forest accumulation (natural forests/ artificial forests)	Forest Resources Assessment, Forestry Agency
18- ②	Volume of domestic production of uncut timber of broadleaf trees/coniferous trees, and self-sufficient rate in timber	Lumber Supply/Demand Report, Ministry of Agriculture, Forestry and Fisheries
18- ③	Changes in the area of forests worldwide and in Japan	FAO STAT. URL: http://faostat.fao.org/
		Forest Resources Assessment, Forestry Agency
		Lumber Supply/Demand Chart, Forestry Agency
19- ①	Transition of cultivated areas	Statistics on Cultivated Land and Planted Area, Ministry of Agriculture, Forestry and Fisheries
19- ②	Transition in the area of readjusted paddy field and the ratio of readjusted paddy field compartments	Basic Survey for Land Use Infrastructure Development, Ministry of Agriculture, Forestry and Fisheries
		Statistical Analysis of Agricultural Land Construction Activities, Ministry of Agriculture, Forestry and Fisheries
19- ③	Transition in the production of agricultural chemicals and chemical fertilizers	Basic Statistics of Japanese Agriculture, Agriculture and Fishery Productivity Increase Committee
		Handbook of Agricultural Chemicals, Japan Plant Protection Association
		Pocket Handbook of Fertilizers, Ministry of Agriculture, Forestry and Fisheries
19- ④	Area of grasslands (native grasslands) other than forests	2003: Historical Analysis of Forestry Census (1960 – 2000), Ministry of Agriculture, Forestry and Fisheries
		Agriculture and Forestry Census, Ministry of Agriculture, Forestry and Fisheries
19- ⑤	Changes in the number of reservoirs in Japan	Kazuko Uchida, 2003: Ponds in Japan – Disaster Prevention and Environmental Conservation, Kaiseisha, 270pp
		1955: Register of Ponds, Resource Division, Farmland Bureau, Ministry of Agriculture, Forestry and Fisheries
		1991: Survey for Long-term Disaster Prevention Activities - Register of Ponds (Nationwide Aggregative Version), Regional Planning Division, Agricultural Structure Improvement Bureau, Ministry of Agriculture, Forestry and Fisheries
20- ①	Trends of population of snipes and plovers that come inland during the autumn migration season	Tatsuya Amano, Kazuo Koyama, Hitoha Amano, Tamas Szekely and William J. Sutherland, unpublished
21- ①	Transition of crop acreage of foxtail millet, Japanese millet, and buckwheat (cereals)	Crop Statistics, Ministry of Agriculture, Forestry and Fisheries
		2006: Revised Revision of Cereal Products Characteristics, Agriculture, Forestry and Fisheries Promotion Foundation
22- ①	Transition of land use in the special districts of Tokyo	1996-2008: Tokyo Statistical Yearbook, Tokyo Metropolitan Government
22- ②	Transition of the ratio of green coverage in the special wards of Tokyo	2004: Environmental White Paper, Tokyo Metropolitan Government
22- ③	Transition in the area of city parks	Survey of Current Conditions of Public Park Maintenance, Ministry of Land, Infrastructure, Transport and Tourism
23- ①	Changes in the distribution of larks in Tokyo	1998: Survey Report of Bird Breeding Conditions in Tokyo (1993-1997), Tokyo Metropolitan Government
		1980: Survey Report of Bird Breeding in Tokyo (1973-1978), Tokyo Metropolitan Government
23- ②	Changes in the distribution of white-eyes in Tokyo	1998: Survey Report of Bird Breeding Conditions in Tokyo (1993-1997), Tokyo Metropolitan Government
		1980: Survey Report of Bird Breeding in Tokyo (1973-1978), Tokyo Metropolitan Government
23- ③	Changes in the distribution of Corvus macrorhynchos in Tokyo	Ueta, M., R. Kurosawa, S. Hamao, H. Kawachi and H. Higuchi, 2003：Population Change of Jungle Crows in Tokyo. Global Environmental Research, 7(2), 131-137.
		1998: Survey Report of Bird Breeding Conditions in Tokyo (1993-1997), Tokyo Metropolitan Government
		1980: Survey Report of Bird Breeding in Tokyo (1973-1978), Tokyo Metropolitan Government
24- ①	Changes in wetland areas from the Meiji and Taisho eras to this day	Survey of Lakes and Wetlands, Geographical Survey Institute URL http://www1.gsi.go.jp/geowww/lake/chousahoukokusho.html
24- ②	Changes in wetland area in the Kushiro Wetland	Data Center URL of Kushiro Marsh Restoration Project http://kushiro.env.gr.jp/saisei/
24- ③	Area of reclamation or landfill in major lakes	3rd Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Lake Survey Report (1987/ nationwide version), Ministry of the Environment
24- ④	Lowering of riverbeds and removal of soil and sand from river channels	2002: Sand Drift System Map, Ministry of Land, Infrastructure, Transport and Tourism

Data No.	Data Name	Source
25- ①	Transition in the number of dams completed and cumulative total water storage since 1900	National Land Numerical Information, Dam Data, Ministry of Land, Infrastructure, Transport and Tourism
25- ②	Ascendable range for fish in Class A rivers in the 1990s	2000: 5th Report of Biodiversity Survey of Natural Environment Conservation Basic Research: River Survey Report (2000), Ministry of the Environment
25- ③	Transitions in status of the river waterfront line	1981: 2nd Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Inland Sea Survey Report (Rivers) (1981/nationwide version), Environment Agency
		1987: 3st Report of Biodiversity Survey of Natural Environment Conservation Basic Research: River Survey Report (1987/ nationwide version), Ministry of the Environment
		2000: 5th Report of Biodiversity Survey of Natural Environment Conservation Basic Research: River Survey Report (2000), Ministry of the Environment
25- ④	Alteration of the lakeshores of major lakes around 1990	1993: 4th Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Lake Survey Report (1993/ nationwide version), Ministry of the Environment
25- ⑤	Changes in the area of phragmites community in Lake Biwa	2000: Mother Lake Plan, Fishery Division, Shiga Prefectural Government
26- ①	Observed number of charophyte species in lakes nationwide	Fumie Kasai, 2006: Growth Survey of Endangered Algae, News of National Institute for Environmental Studies, Vol. 25, No. 5
		Booklet "Shajikumo", Conservation of Chara, Homepage of National Institute for Environmental Studies
		2007: Red List (Algae), Ministry of the Environment
26- ②	Number of alien species observed in Class A rivers	2008: Census of Rivers and Waterfronts, Examination of General Overview of 1, 2, and 3 Times Survey Results (River Version) (Creature Survey) Report, Ministry of Land, Infrastructure, Transport and Tourism
27- ①	Transitions of reclamation area in neritic areas	National Land Area Survey, Geographical Survey Institute
27- ②	Transitions in the amount of gravel gathered	Aggregate Supply/Demand Chart, Ministry of Economy, Trade and Industry
27- ③	Extension of riverbanks/shore protection and its ratio	Seashore Statistics, Ministry of Land, Infrastructure, Transport and Tourism
27- ④	Transition in the extension of natural/semi-natural/artificial coasts	1981: 2nd Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Sea Area Survey Report, Seashore Survey, Sea Area Environment Survey, Tidal Land, Marine Forest, and Coral Reef Distribution Survey (1981/nationwide version), Environment Agency
		1985: 3st Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Seashore Survey Report (1985/ nationwide version), Ministry of the Environment
		1994: 4th Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Seashore Survey Report (1994/ nationwide version), Ministry of the Environment
		1998: 5th Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Seashore Survey Comprehensive Report (1998), Ministry of the Environment
27- ⑤	Transition of the area of tidelands	1981: 2nd Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Sea Area Survey Report, Seashore Survey, Sea Area Environment Survey, Tidal Land, Marine Forest, and Coral Reef Distribution Survey (1981/nationwide version), Environment Agency
		1994: 4th Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Marine Creature Environment Survey Report, Vol. 1 Tidal Land (1994), Ministry of the Environment
		1998: 5th Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Seashore Survey Comprehensive Report (1998), Ministry of the Environment
27- ⑥	Transition in tideland areas in Tokyo Bay and the Seto Inland Sea	1981: 2nd Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Sea Area Survey Report, Seashore Survey, Sea Area Environment Survey, Tidal Land, Marine Forest, and Coral Reef Distribution Survey (1981/nationwide version), Environment Agency
		1994: 4th Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Marine Creature Environment Survey Report, Vol. 1 Tidal Land (1994), Ministry of the Environment
27- ⑦	Transition in the area of underwater forests	1981: 2nd Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Sea Area Survey Report, Seashore Survey, Sea Area Environment Survey, Tidal Land, Marine Forest, and Coral Reef Distribution Survey (1981/nationwide version), Environment Agency
		1994: 4th Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Marine Creature Environment Survey Report, Vol. 2 Marine Forest (1994), Ministry of the Environment
		1998: 5th Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Seashore Survey Comprehensive Report (1998), Ministry of the Environment
27- ⑧	Transition in the area of coral reef communities and cover degree of coral reefs	1981: 2nd Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Sea Area Survey Report, Seashore Survey, Sea Area Environment Survey, Tidal Land, Marine Forest, and Coral Reef Distribution Survey (1981/nationwide version), Environment Agency
		1994: 4th Report of Biodiversity Survey of Natural Environment Conservation Basic Research: Marine Creature Environment Survey Report, Vol. 3 Coral Reef (1994), Ministry of the Environment
27- ⑨	Examples of changes in the coral cover degree in the Sekisei Lagoon	Documents of the Ministry of the Environment
27- ⑩	Long-term changes in the concentration of hydrogen ions (pH) on the surface of seawater in winter at 137 degrees East longitude	Ishii et al., 2008; 2nd International Symposium on the Ocean in a High-CO2 World.
		FY2008 Report, Global Environment Research Comprehensive Promotion Division, Ministry of the Environment
27- ⑪	Changes in the speed of beach erosion	Documents of the Ministry of Land, Infrastructure, Transport and Tourism
27- ⑫	Incidence of red tide/blue tide in Tokyo Bay, Ise Bay and the Seto Inland Sea	Documents of the Ministry of the Environment
27- ⑬	Degree of achieving environmental standards (BOD or COD) in enclosed coastal seas	Public Water Quality Measurement Results, Ministry of the Environment
28- ①	Population trends of snipes and plovers passing through Japan during autumn migration	Tatsuya Amano, Kazuo Koyama, Hitoha Amano, Tamas Szekely and William J. Sutherland, unpublished
28- ②	Transitions of clam species catches	Fishery and Cultivation Production Survey Yearbook, Ministry of Agriculture, Forestry and Fisheries
29- ①	Assessment of fishery resources in the sea area surrounding Japan	Fishery Resource Assessment in Waters Surrounding Japan, Fisheries Agency and Fisheries Research Agency
29- ②	Fishing quantity and Marine Trophic Index (MTI)	Cumulative Survey of Fish Catches of Sea-level Fisheries (nationwide), Fisheries Agency
29- ③	Long-term trends of fish catches	Cumulative Survey of Fish Catches of Sea-level Fisheries (nationwide), Fisheries Agency
30- ①	Ratios of endemic species and endangered endemic species on the Nansei Islands	2006: Consigned Report of Important Area Survey of Candidate Sites for World Heritage around Ryukyu Islands in 2005, Ministry of the Environment
		2006: Red List (Amphibia), Ministry of the Environment
		2006: Red List (Crawler), Ministry of the Environment
		2007: Red List (Mammal), Ministry of the Environment
		1989: Selection and Survey of Animal and Plant Species that Need Urgent Protection, Ministry of the Environment
30- ②	Ratios of endemic species and endangered endemic species on the Ogasawara Islands	Recommended Book for Noting on the List of World Heritages, Ogasawara Islands, Government of Japan
		2007: Red List (Land Shell), Ministry of the Environment
		2007: Red List (Insect), Ministry of the Environment
		2007: Red List (Plant I: Vascular Plant), Ministry of the Environment
30- ③	Factors of decrease in endangered species on the Nansei islands	2002: Revised Red Data Book - 1 (Mammal), Ministry of the Environment
		2000: Revised Red Data Book - 3 (Crawler and Amphibia), Ministry of the Environment

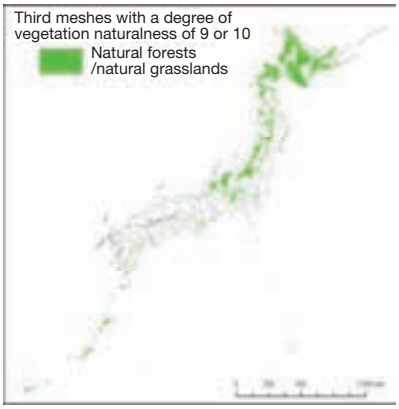
Appendix 4 Data Used in the Report of the Comprehensive Assessment of Biodiversity

Some data used for assessment in this report are shown in the form of figures in Chapters II and III. The data not shown in said chapters and that combined with other data in the form of graphics are indicated here.

Sources of individual data are basically not shown except where necessary. See Appendix 3 for the sources.

Data 1-③: Distribution of vegetation with little conversion

Ratio of cases with a degree of naturalness of 9 or 10	Prefectures corresponding to the condition
40%～	Hokkaido and Okinawa
20～30%	Yamagata, Toyama, and Kagoshima
10～20%	Aomori, Akita, Miyagi, Iwate, Fukushima, Niigata, Nagano, Gifu, Gunma, Yamanashi, Ishikawa, and Miyazaki (12 in total)
0～10%	Others (30 in total)

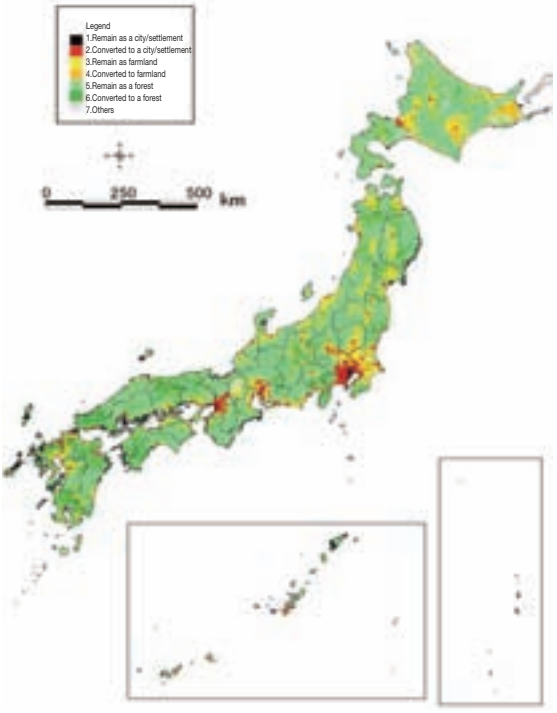


* The distributions of meshes with vegetation having little artificial conversion [with a degree of vegetation naturalness of 9 (natural forests) or 10 (natural grasslands)] are shown.

Data 1-④: Changes in land use from the early 20th century to the 1980s

	Area of land with converted use	
	1900→1985	1950→1985
Others → Others	325	321
Others → Forests	328	195
Others → City	13	10
Others → Farmlands	62	40
Forests → Others	70	74
Forests → Forests	2275	2409
Forests → City	34	25
Forests → Farmlands	197	154
City → Others	0	0
City → Forests	0	1
City → City	10	39
City → Farmlands	3	7
Farmlands → Others	11	11
Farmlands → Forests	72	70
Farmlands → City	85	68
Farmlands → Farmlands	397	457

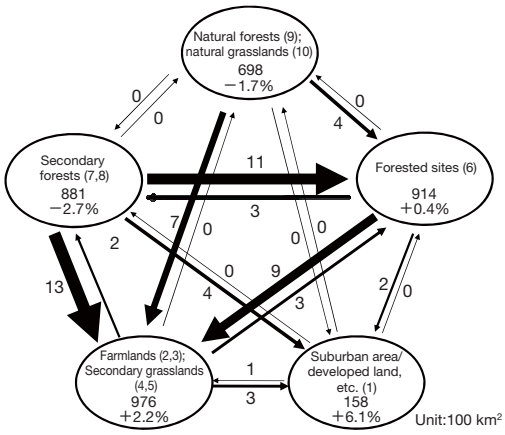
Unit:100 km²
City: Roads, railroads, city/settlement, schools, municipal offices, temples, shrines
Farmland: Dry fields, paddy fields, swamp fields, cultivated fields, open space/pastures, mulberry plantation fields, tea plantation fields, orchards, others: fields of trees, fields of seedlings
Forest: Broadleaf forests, coniferous forests, bamboo forests, mixed forests
Others: Grasslands, wilderness, land where dwarf stone pine grows, gravel land, wetlands, isolated trees, rivers, lakes, swamps, seas, land where bamboo grass grows, golf courses, dry vegetation, Edgeworthia chrysantha, salt field, palm trees



Reference: Changes in land use from 1900 (Meiji era) to 1985 (late Showa period)

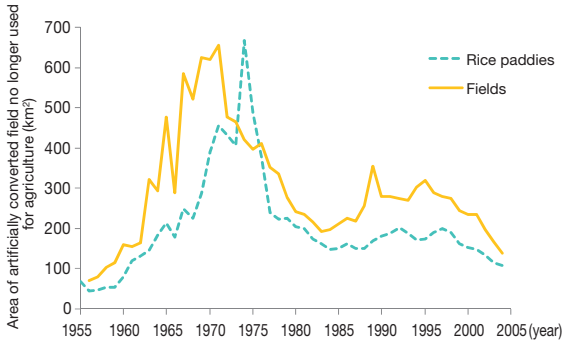
* Long-term changes in land use are shown from data based on the 1:50,000 terrain maps issued by the Geographical Survey Institute in each period.

Data 1-⑤: Changes in land use from the 1980s to the 1990s



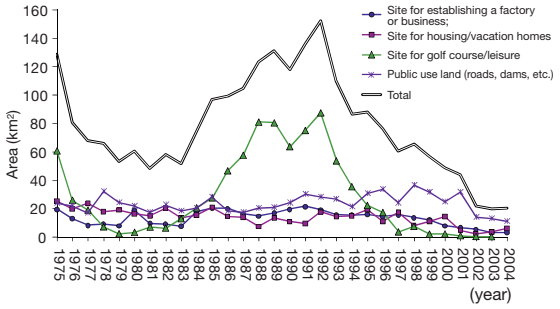
Note 1: Parenthesized figures indicate the degree of vegetation naturalness.

Data 1-⑥: Transition in the area of farmland converted into land for housing and factories (area of artificially converted fields no longer used for agriculture)



Note 1: Artificially converted field used for other than agriculture, such as for housing, factories, construction sites, roads, railroads, rivers, channels, grounds or abandoned fields for cultivation

Data 1-⑦: Transition in the area of forests converted into urbanized land use (by purpose of use)

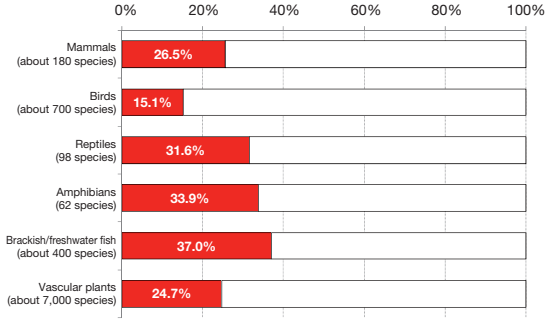


Data 3-②: Impact of nitrogen through the atmosphere

○ : Nitrate concentrations in the mountain streams in the 2000s are lower than the concentrations in the mid- to downstream area in the 1950s.
● : Nitrate concentrations in the mountain streams in the 2000s are higher than the concentrations in the mid- to downstream area in the 1950s.

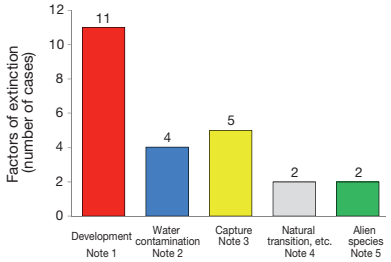
Figure shows the difference between water samples taken from the mid- to downstream area of about 225 rivers across Japan in the 1950s and from 1278 points in mountain streams across Japan in the 2000s. Because we could not compare the nitrate concentration at different times with the data sampled from the same and/or a close position, we averaged the data within the eight regions. Thus, the average nitrate concentration of the river waters in each district using the data would represent the downstream part at around 50 years ago, while the same average using the data would represent the mountain streams at present.

Data 4-①: The ratios of extinct species, extinct wild species and endangered species by taxon



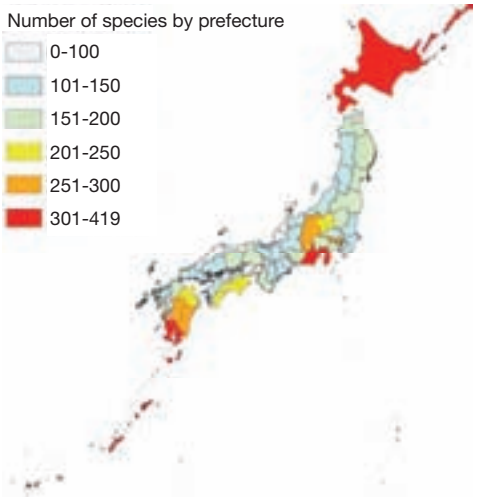
* The ratios of species categorized as Extinct (EX), Extinct in the wild (EW), and Group 1 [Critically endangered (CR) + Endangered (EN)), and Group II (Vulnerable (VU)] are shown here.
Note 1: The presented data concern taxons with the following characteristics: nearly the same number of species subject to assessment as the number of known species, and relative progress of research conducted on species subject to assessment.
Note 2: Parenthesized figures indicate the number of species and subspecies subject to assessment.

Data 4-⑥: Factors of extinction for extinct species and extinct species in the wild



* Using the Revised "Endangered Species of Wild Animals and Plants in Japan as compiled by the Ministry of the Environment regarding mammals, birds, reptiles, amphibians, brackish/freshwater fish, insects, Crustacea, arachnid/ myriapoda, and vascular plants, the factors of extinction for extinct species and extinct species in the wild were categorized into such groups such as "development," "water contamination (including agricultural chemicals)," "gathering/hunting," "natural transition," and "alien species (transplanted species)" for summarization.
Note 1: Logging, lake and river development, coastal and wetland development, grassland development, coal mining, golf courses, ski resorts, land development, and road and dam construction are included.
Note 2: Water contamination and agricultural chemical contamination are included.
Note 3: Collection for gardening/hunting for ornamental use, collection for medicinal use, and other illegal collection activities are included.
Note 4: Abandoned management and the progress of transition/changes in vegetation are included.
Note 5: The intrusion of predators, competition over domestication, cross-breeding, and release are included.

Data 4-⑦: Number of species listed in the Red Data Book (vascular plants) by prefecture



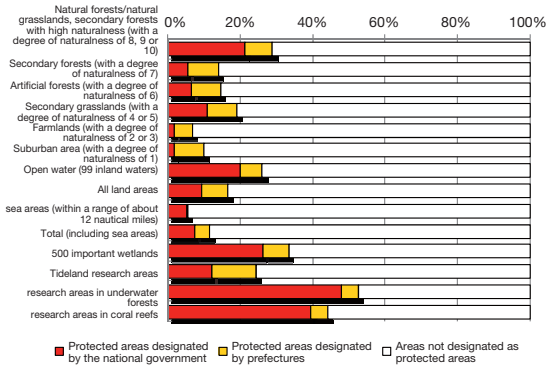
Note 1: The number of species categorized as EX, EW, CR, EN and VU are totaled.

Data 4-⑧: Major factors causing adverse effects on tideland environments in Japan and their relative significance for individual tideland environments

Factor	Saline wetland (Note 1)	River mouth (Note 2)	Tideland (Note 3)	Subtidal zone (Note 4)	Mangrove (Note5)	Sea grass zone (Note 6)
Landfill	+++	+	+++	+	+	+
Artificial shore protection	+++	+++	++	+	+	+
Eutrophication	++	+++	+++	+++	+	+
Contamination	++	+++	+++	+++	+	+
Red clay inflow		+	+	+	+++	+++
Port construction/dredging		+	++	+++		+
Estuary barrage construction	+	+++	+			
Sea sand import			+	+		+
Excessive use of tideland			+			+
Entry of domesticated species		+	+	+		

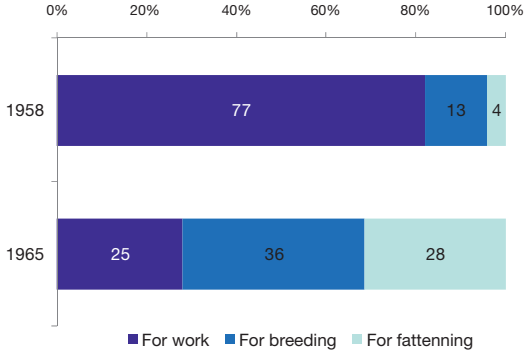
Note 1: Saline wetlands are formed in places from the upper intertidal zone to the supratidal zone susceptible to impact of the ebb and flow of tides in inner bays and around the mouths of rivers.
Note 2: River mouth zones where a river flows into the sea
Note 3: Intertidal zones covered with plants that appear at low tide
Note 4: The seaside of a tideland not dried out at a low spring tide
Note 5: Mangrove swamps in intertidal zones of a subtropical marine area
Note 6: A vast shallow sea area located inside a well-grown coral reef

Data 5-③: Protected area cover ratios in ecosystems (according to designated entity)

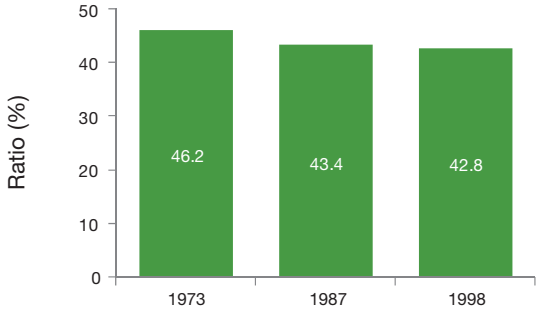


Note 1: Areas designated by multiple authorities are treated as national protected areas.

Data 7-②: Transition in the use of working cattle



Data 7-④: Transition of the ratio of Satochi-Satoyama meshes in national land



Note 1: The year indicated is the fiscal year when research was conducted. For example, "1973" refers to data of research conducted in FY 1973, "1987" refers to data of research conducted from FY 1983 to FY 1986, and "1998" refers to data of research conducted from FY 1994 to FY 1998.
Note 2: Satochi-Satoyama areas are ecosystems where farmland, secondary grasslands, farming forests around farmland, channels and ponds form intricate mosaic patterns. "Satochi-Satoyama mesh" is defined as a second mesh where area having a degree of vegetation naturalness of 7 or 8 (secondary forests) covers no less than half the total area, including areas having a degree of vegetation naturalness of 2 or 3 (farmland) and those of 4 or 5 (secondary grasslands) (Ministry of the Environment).

Reference: Distribution of Satochi-Satoyama second meshes

Data 9-①: Changes in the entry/ number of settled alien insect/weed species

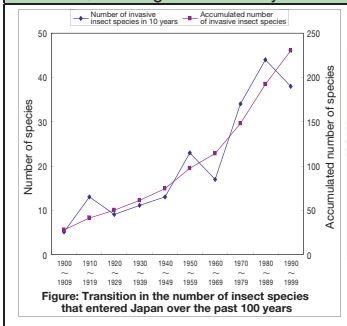


Figure: Transition in the number of insect species that entered Japan over the past 100 years

Note 1:The figure includes 231 species having data on their entry year among the 311 invasive insect species.

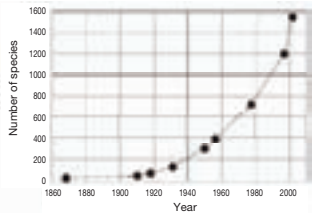
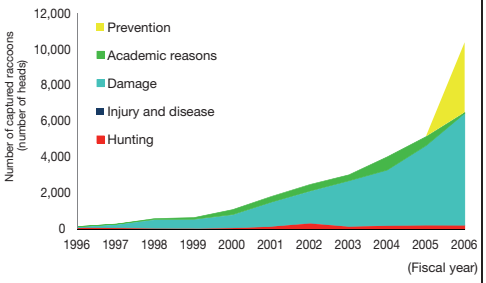


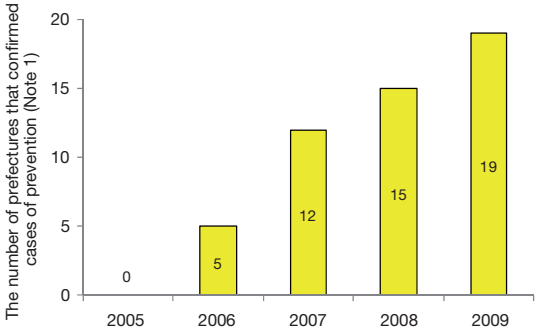
Figure: Changes in the number of alien weed species in Japan

Source: Osamu Watanabe, 2007: Status of invasion and distribution of alien weed species in forage fields, bulletin of Shinshu University, Faculty of Agriculture, 43 (1·2)

Data 9-④: Reference: Transition in the number of captured raccoons

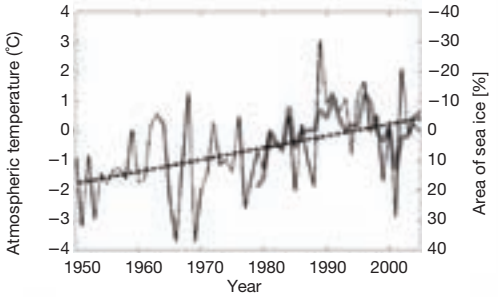


Data 11-②: The number of confirmed cases of prevention by prefecture



Note 1: The Invasive Alien Species Act stipulates that local governments can obtain confirmation from the state minister in charge regarding the prevention of designated alien species as conducted in accordance with public notification.

Data 12-①: Decrease in sea ice in the Sea of Okhotsk



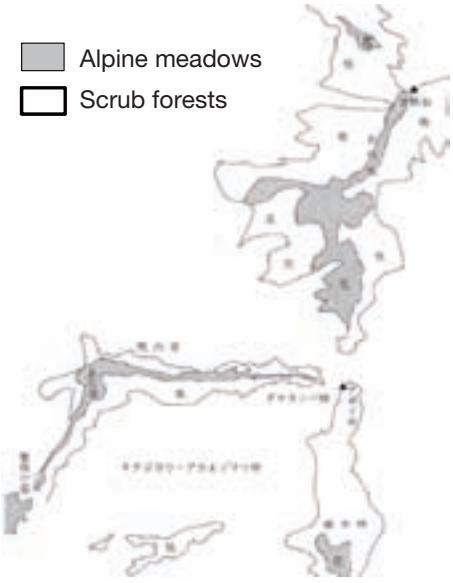
* Yearly changes in the area of sea ice in the Sea of Okhotsk and temperature as checked on land windward of the sea ice

Note 1: The gray solid line indicates deviation in sea ice area (1979 - 2003) in February in the Sea of Okhotsk as confirmed by satellite observation; the black solid line indicates deviation in surface temperature (1950–2005) during fall and winter (October–March) in the area east of the Eurasian continent (50° -65°N, 110°, -140°E). The black dashed line indicates the linear trend components of deviation in temperature. The temperature data adopts the Jones' data set. The left axis indicates the deviation in temperature. The right axis indicates the deviation in sea ice area. The symbols are shown upside down.

Source: Keiichiro Ohshima, Takuya Nakanowatari, and Masaaki Wakatsuchi, 2006: Global warming observed in the high latitude area in the Sea of Okhotsk: Impact on the northern Pacific Ocean, Low Temperature Science, 65, 67-75

Data 12-③: Decrease in alpine plants on Mount Apoi

Alpine zones on Mount Apoi in 1959

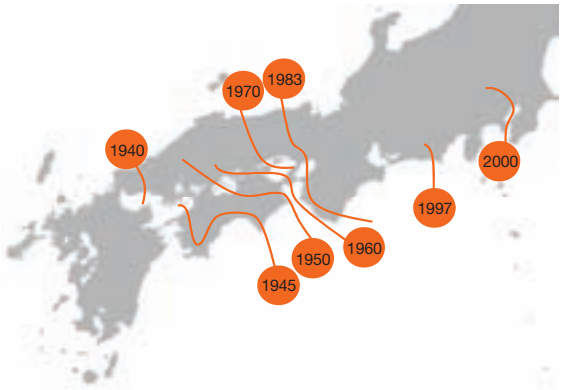


Alpine zones on Mount Apoi in 1988

* On Mount Apoi, coverage of the alpine plant habitat is rapidly decreasing due to an invasion of woody plants—dwarf stone pines and Pinus parviflora Sieb. et Zucc. var. pentaphylla (Mayr) Henry.

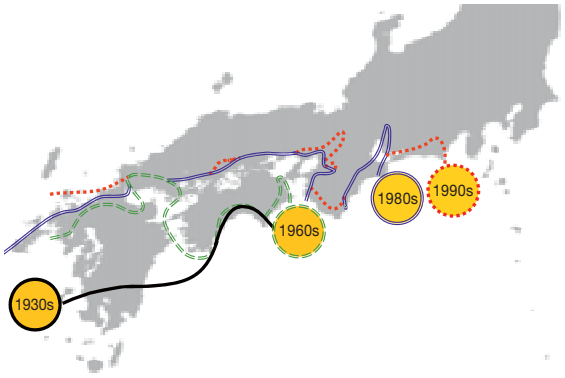
Source: Sadamoto Watanabe, 2001: Changes in ultrabasicosaxicolous flora on Mount Apoi for 45 years (1954- 1999), Global Environmental Research, 3, 25-48

Data 12-④: Changes in the distribution of great Mormons



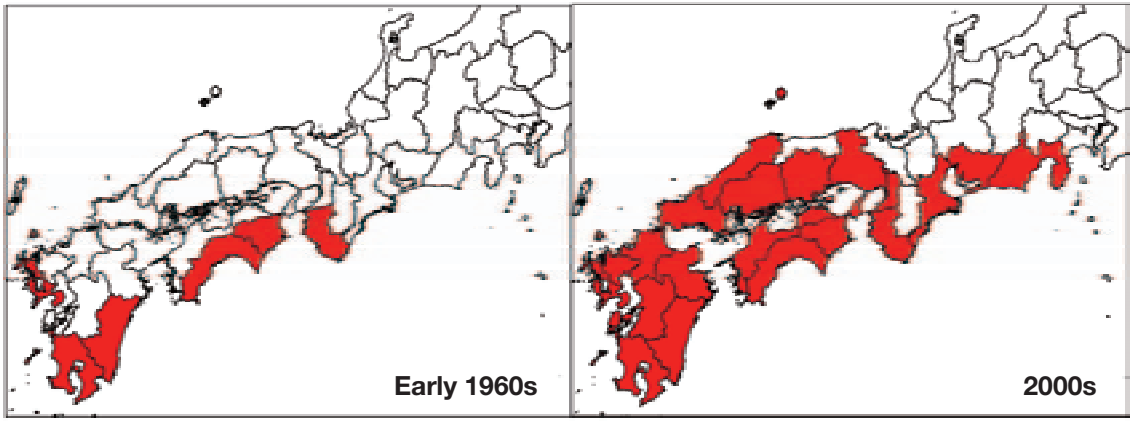
Source: Masahiko Kitahara 2008: The phenomenon of butterfly species' distribution expansion and global warming, Insects and Nature, 43(4), with19-23 modified

Data 12-⑤: Changes in the distribution of Ictinogomphus pertinax



Source: Takashi Aoki, 2000. Phases of distribution expansion of Ictinogomphus pertinax in Japan based on records, TOMBO, XLII, with 47-50 modified

Data 12-⑥: Changes in the distribution of Nezara viridula



Source: Kenji Fujisaki, 2007: When the life of living creatures changes, Nature Protection, 499, 6-7
Junichi YUKAWA, Keizi KIRITANI, Naohisa GYOUTOKU, Nami UECHI, Daisuke YAMAGUCHI and Satoshi KAMITANI, 2007: Distribution range shift of two allied species, Nezara viridula and N. antennata (Hemiptera: Pentatomidae), in Japan, possibly due to global warming. Appl. Entomol. Zool. 42 (2), 205-215.
Data by agricultural experiment stations in each prefecture

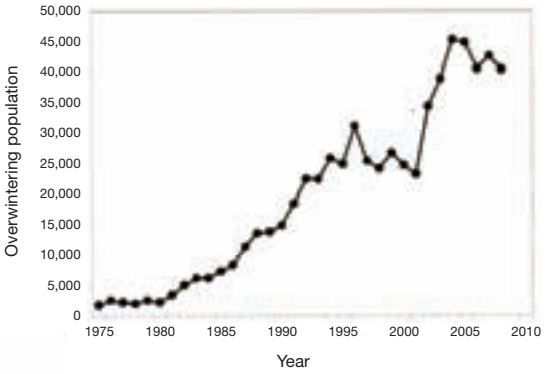
Data 12-⑦: Changes in the fish fauna in the Chikuzen Sea, Fukuoka Prefecture

	1957-1964	1986-1996	2001-2004
Temperate species	104	127	110
Species with broad distribution	18	22	19
Southern species	46	95	118

* Southern fish species are mainly distributed in semitropical and tropical zones; Temperate fish species are mainly distributed in the warm temperate zone; Fish species with broad distribution range over two zones. The composition ratios of all three groups were compared according to the period.

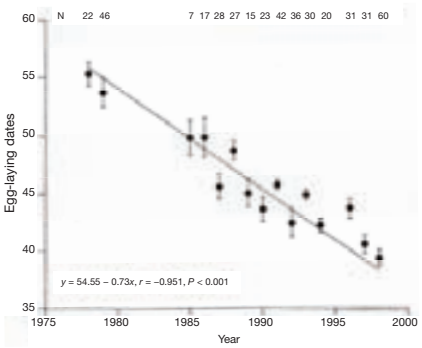
Source: Takashi Nishida, Akinobu Nakazono, Shin Oikawa, and Seiichi Matsui, 2005: Changes in fish fauna in the Chikuzen Sea caused by recently rising seawater temperature, Science bulletin of the Faculty of Agriculture, Kyushu University, 60(2), 187-201

Data 12-⑧: Changes in population of overwintering Cygnus columbianus in Japan



Source: Hiroyoshi Higuchi, Shigeto Koike, and Mayumi Shigeta, 2009: Impact of global warming on phenology, distribution, and population, Global Environment, 14(2), 189-198

Data 12-⑩: Changes in the egg-laying period of Sturnus philippensis



* Changes with age in the average date of initial laying of Sturnus philippensis in the city of Niigata.
Note 1: The average date of initial laying refers to the average based on the day when breeding begins in each case of breeding every year. April 1st is counted as one for indicating the number of days.
Source: Koike, S and H, Higuchi,2002: Long-term trends in the egg-laying date and clutch size of Red-cheeked Starlings Sturnia philippensis.IBIS, 144(1),150-152.(We acknowledge permission to reproduce this figure by the British Ornithologists' Union.)

Data 15-④: The amount of damage caused by pine wood nematode (total volume of damaged timber)

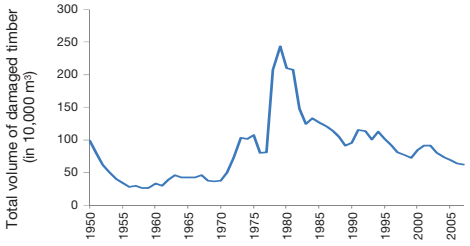


Figure: Transition in the total volume of damaged timber caused by pine wood nematode in Japan

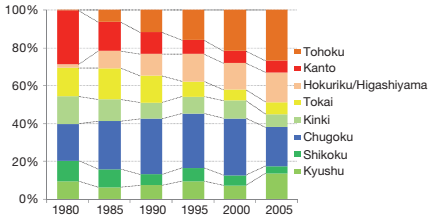
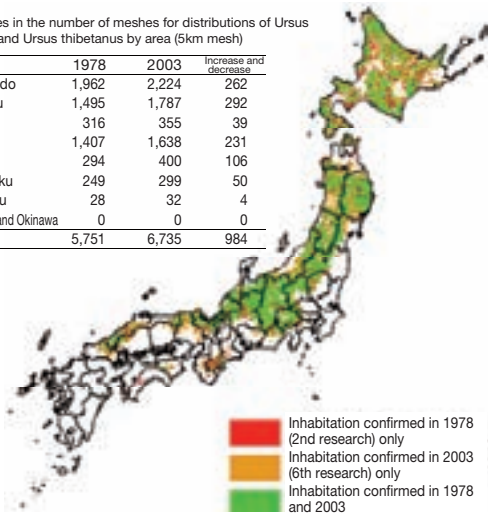


Figure: Transition in the amount of damage caused by pine wood nematode in private forests by area

Data 17-①: Changes in distribution of Ursus arctos and Ursus thibetanus

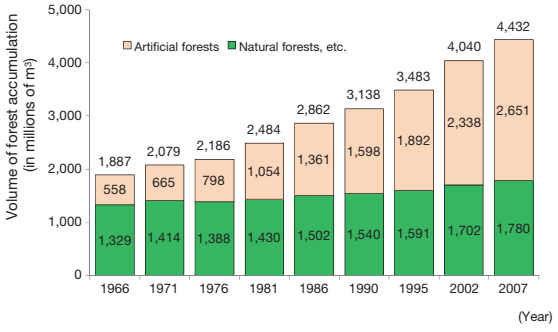
Changes in the number of meshes for distributions of Ursus arctos and Ursus thibetanus by area (5km mesh)

	1978	2003	Increase and decrease
Hokkaido	1,962	2,224	262
Tohoku	1,495	1,787	292
Kanto	316	355	39
Chubu	1,407	1,638	231
Kinki	294	400	106
Chugoku	249	299	50
Shikoku	28	32	4
Kyushu and Okinawa	0	0	0
	5,751	6,735	984

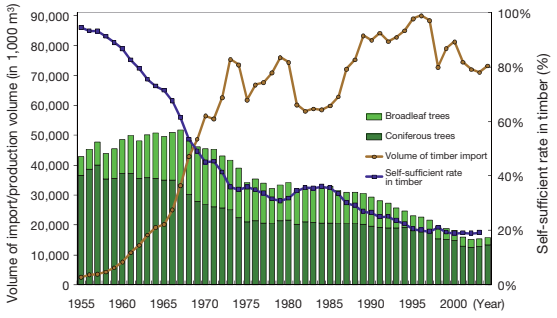


Note 1: The year indicates when research was conducted. This does not strictly denote the year when research was actually conducted. For example, "1978" refers to research data obtained in 1978; "2003" refers to research data obtained from 2000 to 2004.

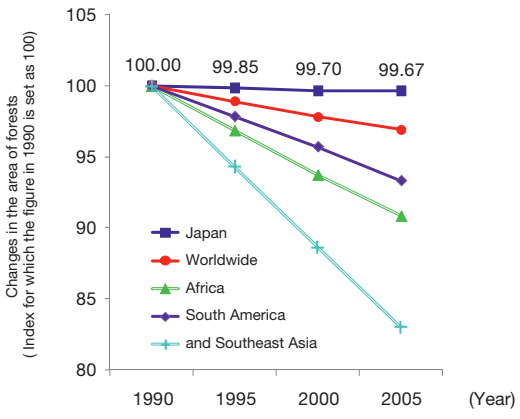
Data 18-①: Transition in the volume of forest accumulation (natural forests/ artificial forests)



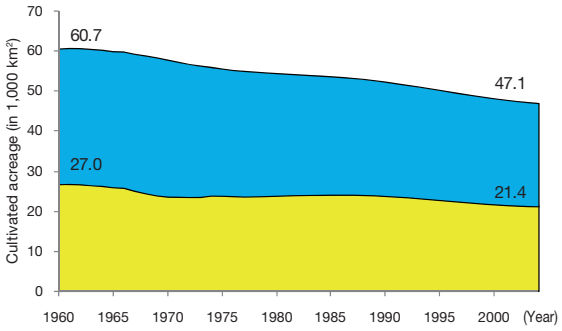
Data 18-②: Volume of domestic production of uncut timber of broadleaf trees/ coniferous trees, and self-sufficient rate in timber



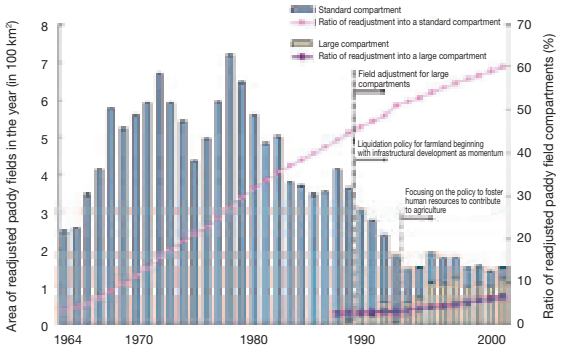
Data 18-③: Changes in the area of forests worldwide and in Japan



Data 19-①: Transition of cultivated areas

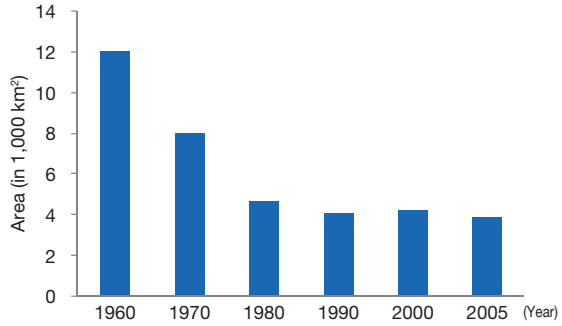


Data 19-②: Transition in the area of readjusted paddy field and the ratio of readjusted paddy field compartments



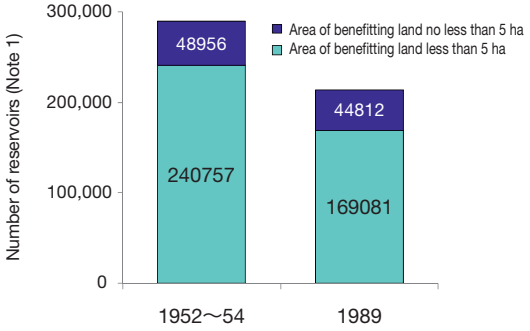
Note 1: A standard compartment refers to one 30 a or larger; a large compartment refers to one 1 ha or larger.
Source: Ministry of Agriculture, Forestry and Fishery, Basic research on land use and infrastructural development, Statistical survey on farmland construction work

Data 19-④: Area of grasslands (native grasslands) other than forests



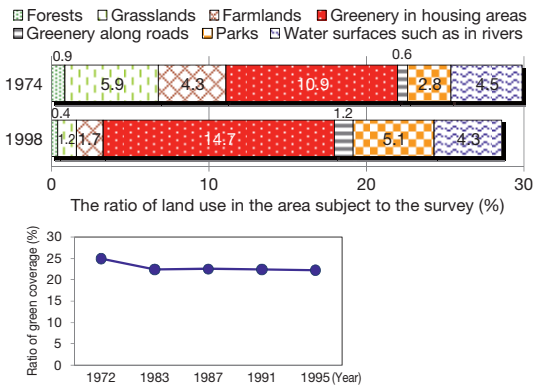
Note 1: Native grasslands other than forests (including permanent pastures, obsolescent pastures, and cultivation-abandoned land turned into native grassland) and the land of shrub communities are included. Dry riverbeds, dikes, banks, road sites, golf courses, etc. are excluded even if grass grows there.

Data 19-⑤: Changes in the number of reservoirs in Japan



Note 1: Reservoirs in Okinawa Prefecture are not included in the survey conducted from 1952 to 1954. There were 75 reservoirs in Okinawa Prefecture in 1989.
Note 2: "The area of benefitting land at 5 ha" is the unit of classification used in the survey conducted by the Ministry of Agriculture, Forestry and Fishery, Bureau of Agricultural Land, Resource Department in 1955.

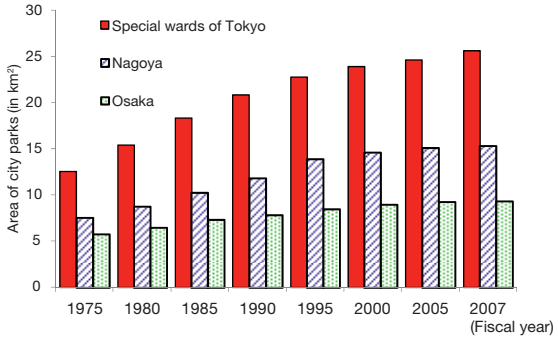
Indicator 22-②: Transition of the ratio of green coverage in the special wards of Tokyo



Transition in the ratio of green coverage in the special wards of Tokyo (Note 1)

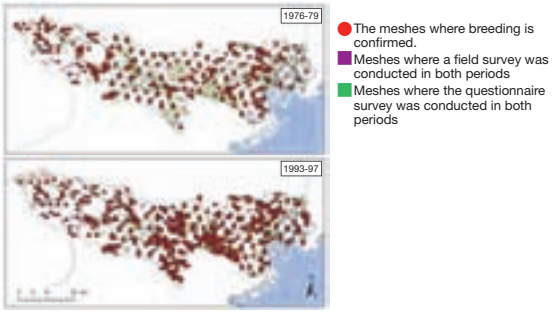
Note 1:The ratio of green coverage refers to the ratio of area covered with greenery as compared to the total area in the special wards of Tokyo. Forests, grasslands, farmland, greenery in housing areas (including greenery on rooftops), and greenery along roads and in parks are included, but water surfaces such as in rivers are excluded.

Indicator 22-③: Transition in the area of city parks



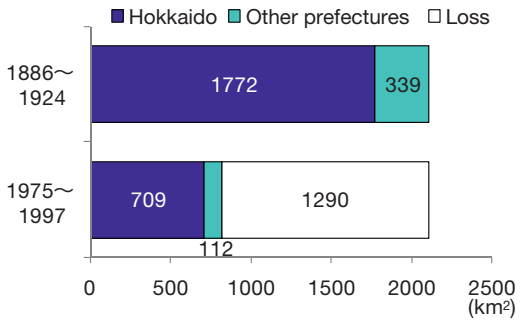
City Park Law published and enacted in 1956
Source: Ministry of Land, Infrastructure, Transport and Tourism, Survey on the status of city park development

Data 23-③: Changes in the distribution of Corvus macrorhynchos in Tokyo

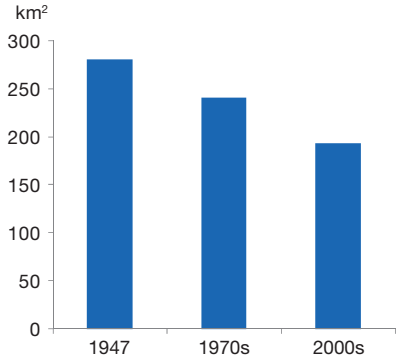


Source: Ueta, M., R. Kurosawa, S. Hamao, H. Kawachi and H. Higuchi, 2003: Population Change of Jungle Crows in Tokyo. Global Environmental Research, 7(2), 131-137.
Tokyo, 1998: Report on the survey of breeding status of birds in Tokyo (1993-1997)
Tokyo, 1980: Report on the survey of breeding status of birds in Tokyo (1973-1978)

Data 24-①: Changes in wetland areas from the Meiji and Taisho eras to this day

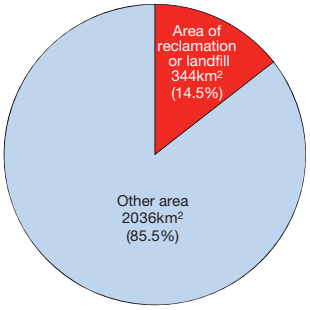


Data 24-②: Changes in wetland area in the Kushiro Wetland



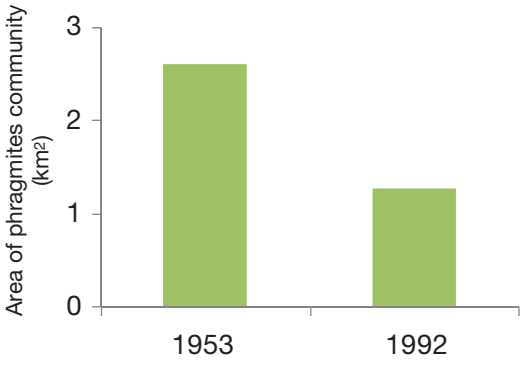
Source: Ministry of the Environment, Kushiro Wetland Restoration Project Data Center website
http://kushiro.env.gr.jp/saisei/

Data 24-③: Area of reclamation or landfill in major lakes

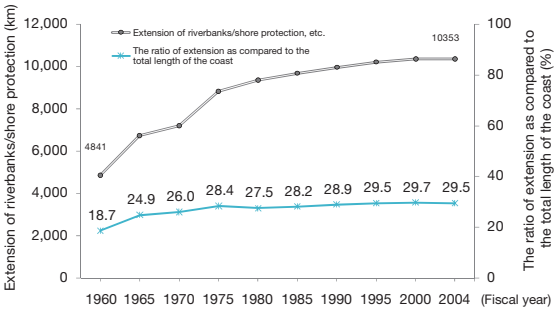


Note 1: The ratio of lake and tideland areas where some form of reclamation or landfill was conducted from 1945 to 1985 as compared to all sites subject to the survey. The survey was conducted on 484 major lakes among natural lakes with area of 1 ha or more.

Data 25-⑤: Changes in the area of phragmites community in Lake Biwa

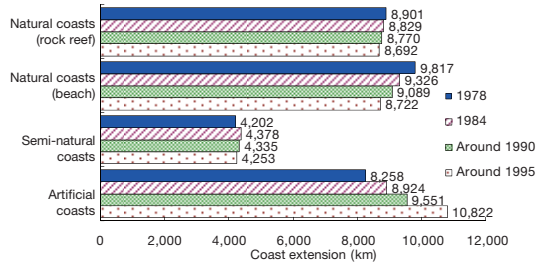


Data 27-③: Extension of riverbanks/shore protection and its ratio



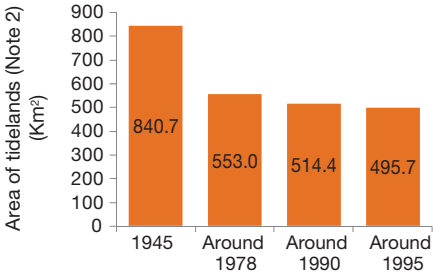
Note 1: "Extension of riverbanks/shore protection" here refers to the extension of coastal conservation structures (such as riverbanks and shore protection), railroad and roadside protection, and the extension of airports. The redundancies in data among the authorities in 1960 are not deducted.

Data 27-④: Transition in the extension of natural/semi-natural/artificial coasts



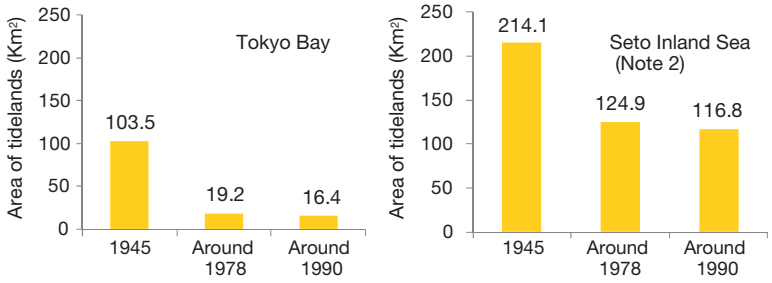
Note 1: Natural coasts refer to coasts where the shoreline is not artificially modified and nature is maintained, and with no artificial structures along the shoreline, regardless of any artificial structures in the backland.
Note 2: Semi-natural coasts refer to coasts where part of the shoreline is artificially modified. If the coast (shoreline) maintains nature in intertidal zones and there are no artificial structures along the shoreline, but there are structures such as bank protection in the area, the coast is regarded as a semi-natural coast.
Note 3: Artificial coasts refer to coasts where ports, landfill, dredging work or reclamation have been artificially created or conducted; artificial structures are located in intertidal zones.
Note 4: The year indicates the fiscal years when the survey was conducted, but does not strictly refer to conditions during a given year. For example, "1978" indicates survey data obtained from 1978 to 1979; "1984" indicates survey data in 1984. "around 1990" indicates survey data in 1993; "around 1995" indicates survey data obtained from 1995 to 1996.

Data 27-⑤: Transition of the area of tidelands



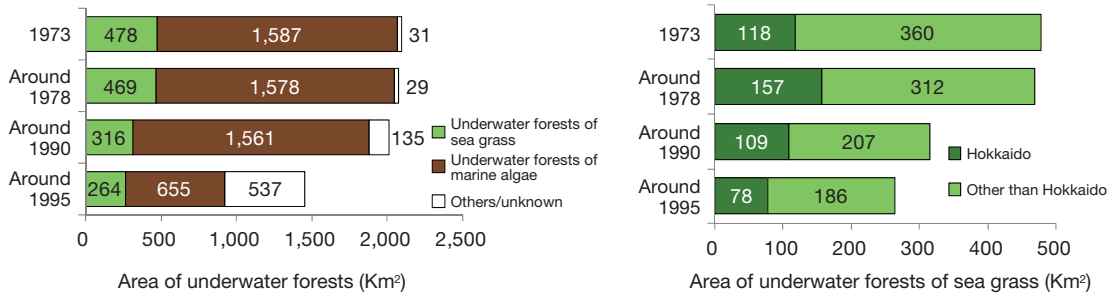
Note 1: The area around 1978 consisted of the area around 1990 and the area of tidelands lost around 1990. The area in 1945 includes the area around 1978 as calculated above and the area of tidelands lost from 1945 to around 1978.
Note 2: Tideland refers to existing tideland that meets all of the following conditions:
①The maximum width of dry area between the high tide line and low tide line is no less than 100 meters.
②The area of continuous dry area at a spring tide is no less than 1 ha.
③The bottom consists of loose objects (such as gravel, sand, muddy sand, or mud).
Note 3: The year indicates the fiscal years when the survey was conducted, but does not strictly refer to conditions in a given year. For example, "around 1990" indicates survey data obtained from 1989 to 1992; "around 1995" indicates survey data obtained from 1995 to 1996.
Note 4: The prefectures of Tokushima and Hyogo were not surveyed around 1995. The data around 1990 were used as supplemental data.

Data 27-⑥: Transition in tideland areas in Tokyo Bay and the Seto Inland Sea



Note 1: The area around 1978 consists of the area around 1990 and the area of tidelands lost around 1990. The area in 1945 includes the area around 1978 as calculated above and the area of tidelands lost from 1945 to around 1978.
Note 2: Data on the Seto Inland Sea represents all data on the following sea areas: west Suonada, east Suonada, west Iyonada, Beppu Bay, Bungo Channel, east Iyonada, Hiroshima Bay, Aki Bay, Bingonada, Hiuchinada, west Bisanseto, east Bisanseto, north Harimanada, south Harimanada, northern part of Osaka Bay, southern part of Osaka Bay, and the western part of the Kii Channel.
Note 3: The year indicates the fiscal years when the survey was conducted, but does not strictly refer to conditions in a given year. For example, "around 1990" indicates survey data obtained from 1989 to 1992.

Data 27-⑦: Transition in the area of underwater forests



Note 1: The area of underwater forests consisting of sea grass and marine algae is the total area multiplied by individual ratios.
Note 2: The prefectures of Tokushima and Hyogo were not surveyed around 1995. The data around 1990 were used as supplemental data.
Note 3: The area around 1978 consists of the area around 1990 and the area of underwater forests lost around 1990.
Note 4: The area in 1973 includes the area around 1978 as calculated above and the area of underwater forests lost around 1978.
Note 5: "Others/unknown" indicates marine algae and sea grass that are not categorized as the types of underwater forests designated in the survey (e.g., eelgrass beds, kelp beds, sargassum beds). Underwater forests where different types coexisted in 1998 are also categorized as "Others/unknown."
Note 6: The year indicates the fiscal years when the survey was conducted, but does not strictly refer to conditions in a given year. For example, "around 1990" indicates survey data obtained from 1989 to1992; "around 1995" indicates survey data obtained from 1995 to 1996.

Data 27-⑧: Transition in the area of coral reef communities and cover degree of coral reefs

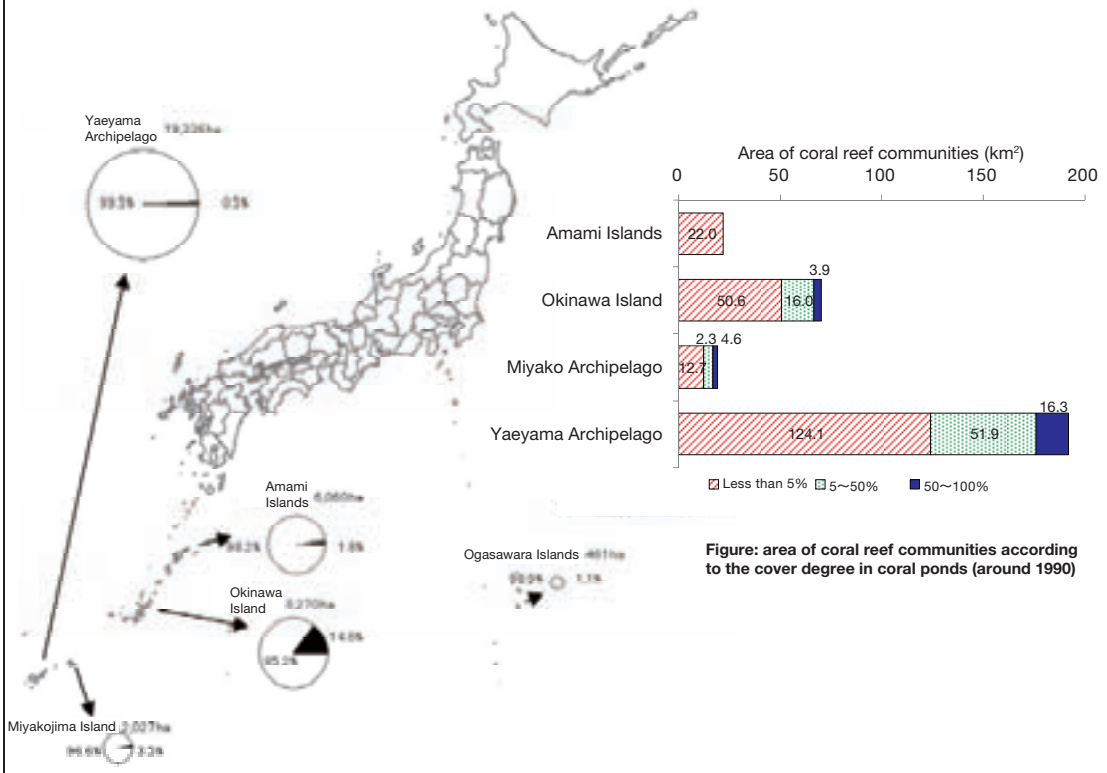
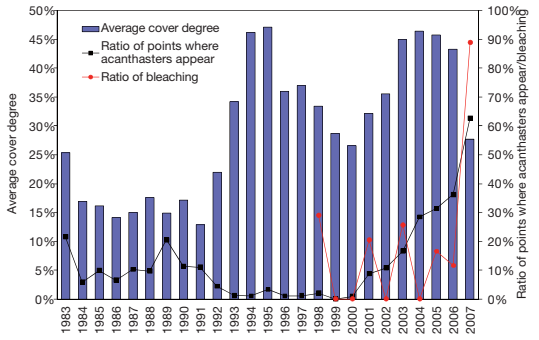


Figure: area of coral reef communities according to the cover degree in coral ponds (around 1990)

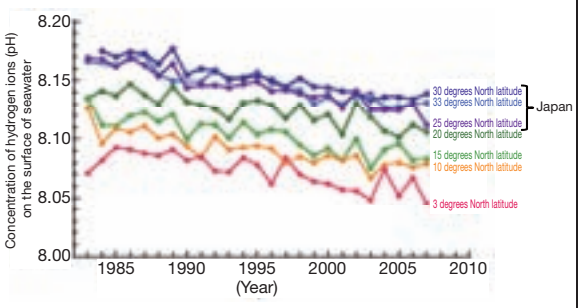
Figure: Transition of the area of coral reef communities according to the cover degree in coral ponds (around 1978 to around 1990)

The total area of existing coral reefs confirmed by the 4th Basic Research on Natural Environment Conservation (around 1990) was 96,497 ha. The area of coral reef communities in coral ponds was 34,642 ha. After the 2nd Basic Research on Natural Environment Conservation (conducted around 1978), 1,512 ha of coral reef were lost.
Note 1: The size of the pie chart indicates the area of coral reefs. The black portion indicates the coral reefs lost.
Note 2: The area around 1978 consists of the area around 1990 and the area of coral reefs lost around 1990.
Note 3: The year indicates the fiscal years when the survey was conducted, but does not strictly refer to conditions in a given year. For example, "around 1990" indicates survey data obtained from 1989 to 1992.

Data 27-⑨: Examples of changes in the coral cover degree in the Sekisei Lagoon

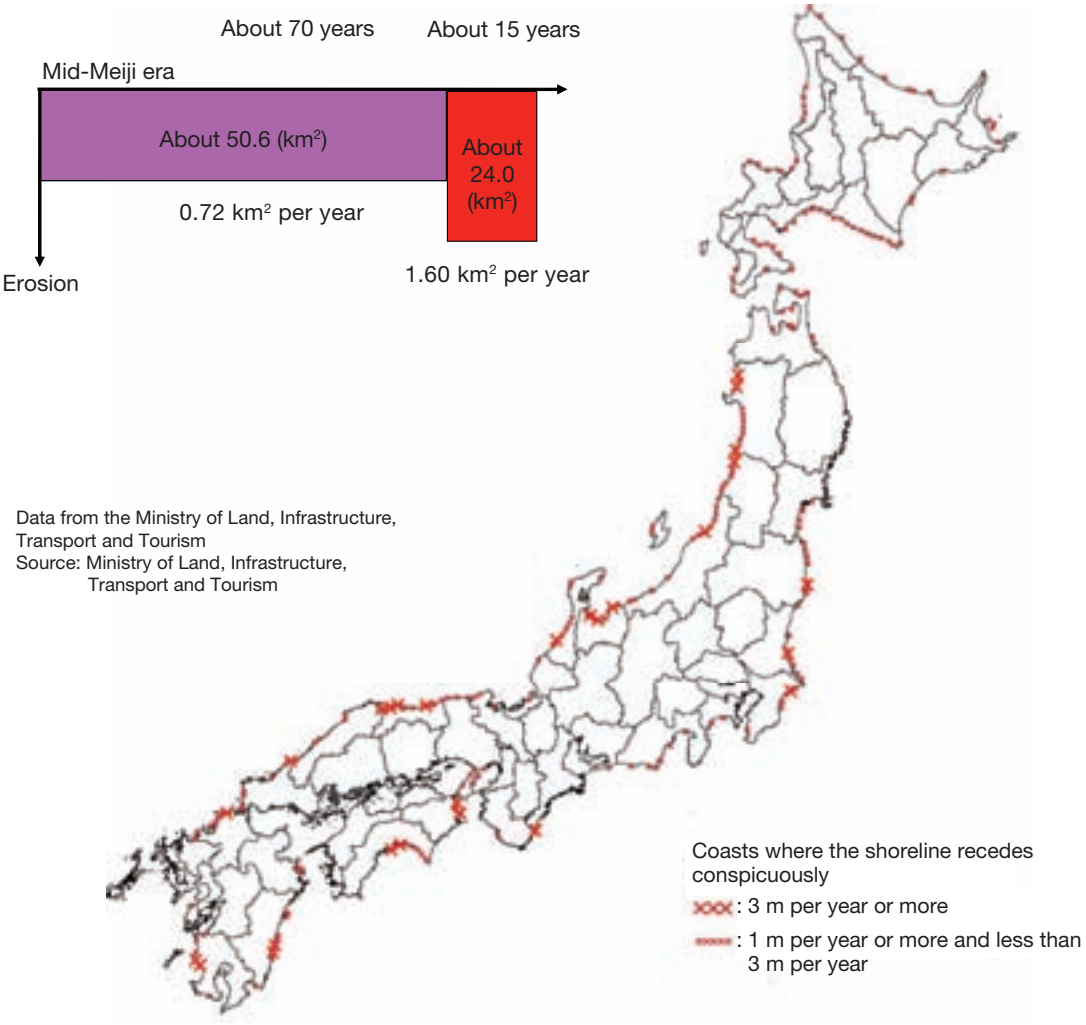


Data 27-⑩: Long-term changes in the concentration of hydrogen ions (pH) on the surface of seawater in winter at 137 degrees East longitude



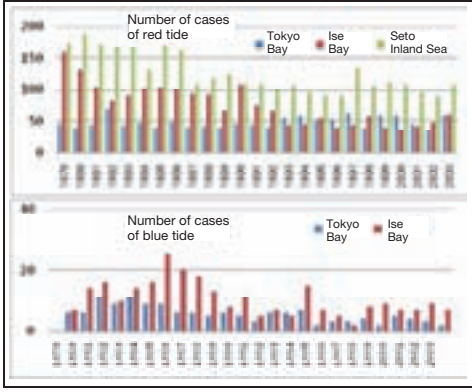
Concentration of hydrogen ions on the surface of seawater was calculated based on the concentration of carbon dioxide and total carbonic acid concentration according to the longitude zone.
Source: Ishii et al., 2008; 2nd International Symposium on the Ocean in a High-CO_2 World. Ministry of the Environment, Expense for comprehensive promotion of global environmental research (F-083), 2008 Report

Data 27-⑪: Changes in the speed of beach erosion

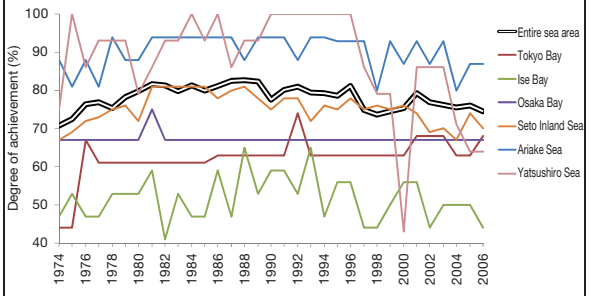


Data from the Ministry of Land, Infrastructure, Transport and Tourism
Source: Ministry of Land, Infrastructure, Transport and Tourism

Data 27-⑫: Incidence of red tide/blue tide in Tokyo Bay, Ise Bay and the Seto Inland Sea

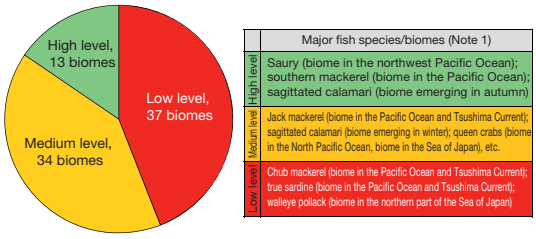


Data 27-⑬: Degree of achieving environmental standards (BOD or COD) in enclosed coastal seas



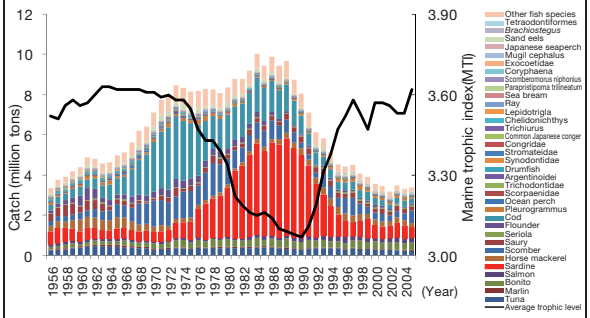
Note 1: Assessment of the status of achievement: As for BOD or COD, the environmental standard will be considered achieved in the designated water area category when 75% of the daily average value for the year satisfies the environmental standard at all environmental standard points stipulated as representing the water quality of the designated water area category.

Data 29-①: Assessment of fishery resources in the sea area surrounding Japan



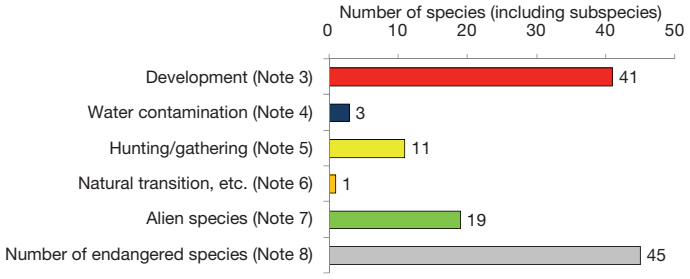
Note 1: In addition to the transition in the volume of resources (and fishing quantity) over the past 20 years and longer, in consideration of the indicator of maximum sustainable production volume, three levels—high, medium and low—have been set for assessment.
Note 2: A biome is a group whose life history (including spawning grounds, spawning seasons, and migration routes) is partially or totally distinguishable from that of others.

Data 29-②: Fishing quantity and Marine Trophic Index (MTI)



Note 1: The data are used as indicators of fishing in the North Atlantic Ocean where high-level predators in the food chain are mainly captured. As Japan has utilized fish species with low trophic levels, the indicators do not directly indicate sustainability.
Note 2: FISHBASE does not contain data regarding squid. Thus the data is not calculated into this assessment. Past data on fishing include fisheries in distant waters where the area differs from existing fishing zones. Therefore, comparisons should be limited to the fishing quantity within EEZ.

Data 30-③: Factors of decrease in endangered species on the Nansei islands



* As for endangered mammals, reptiles and amphibians (Note 2) living on the Nansei islands (Note 1), the factors of decrease are roughly categorized as “development,” ”water contamination (including agricultural chemicals),” ”hunting/gathering,” ”natural transition,” and ”alien species (invasive alien species).” The number of species (including subspecies) was counted. The newly added species at revision of the Red List among endangered species living on islands are not included in the data because the factors of their decrease are not clearly indicated.
Note 1: The Tokara Archipelago, Amami Islands, Okinawa Islands, Kerama Archipelago, Miyakojima Archipelago, Yaeyama Archipelago, Daito Islands, and Senkaku Islands are included.
Note 2: Species categorized as Extinct (EX), Extinct in the wild (EW), Critically endangered (CR), Endangered (EN), and Vulnerable (VU) are included.
Note 3: The newly added species at revision of the Red List among endangered species living on islands are not included in the data because the factors of their decrease are not clearly indicated.
Note 4: Logging, lake and river development, coastal and wetland development, grassland development, coal mining, golf courses, ski resorts, land development, and road and dam construction are included.
Note 5: Water contamination and agricultural chemical contamination are included.
Note 6: Collection for gardening, capture for ornamental use, collection for medicinal use, and other illegal collection activities are included.
Note 7: Abandonment of management, progression of transition, and changes in vegetation are included.
Note 8: The intrusion of predators, competition over domestication, cross-breeding and release are included.

Report of Comprehensive Assessment of Biodiversity in Japan

May 10, 2010

Japan Biodiversity Outlook Science Committee
The Ministry of the Environment

Issued by Global Biodiversity Strategy Office, Biodiversity Policy Division, Nature Conservation Bureau,
The Ministry of the Environment

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http://www.env.go.jp/

Individual Roles

Based on the findings of the Comprehensive Assessment of Biodiversity in Japan, we find it necessary for the entities below to take the following actions:

The national government	Place greater emphasis on studies and responses rooted in assessment findings, indicate nationwide targets, and provide stronger incentives for various parties to take actions to mitigate the loss of biodiversity.
Local governments	Assess biodiversity on regional scales and find ways to incorporate local issues into broader-reaching biodiversity strategies.
Researchers and NGO's	Use improved measurements of biodiversity and findings regarding ecosystem services to contribute to assessments.
Businesses	Understand the effects that the economic activities of one's own business have upon biodiversity, assess those effects, and strive to develop strategies to mitigate those effects.
Citizens	Consider seriously what can and should be done in one's community regarding biodiversity, and furthermore participate in the consensus-building processes at the national government, local government, business, and local movement levels.

Life in harmony, into the future
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For more information, please visit the Ministry of the Environment's official website.

http://www.biodic.go.jp/biodiversity/

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