



The Action Plan to Conserve Coral Reef Ecosystems in Japan 2016 – 2020

To protect Blessings from the Coral Sea





Coral reef ecosystems bring rich blessings such as fishing grounds and tourism resources to people, and are closely linked to community lives. But they are exposed to a lot of danger due to the runoff of red soil and coral predators such as crown-of-thorns starfish.



Fish and shellfish caught in the coral reefs are important foodstuffs that support people's livelihood in those regions [See Reference Material I-3-(1) at the end].



Sunflowers that spread over the field are called green manure as a part of measures against soil runoff. This measure is expected to increase cropping and conserve the coral reef ecosystems (Provided by Agricultural Support Division, Okinawa Prefecture) [See Reference Material I-1-(1) at the end].



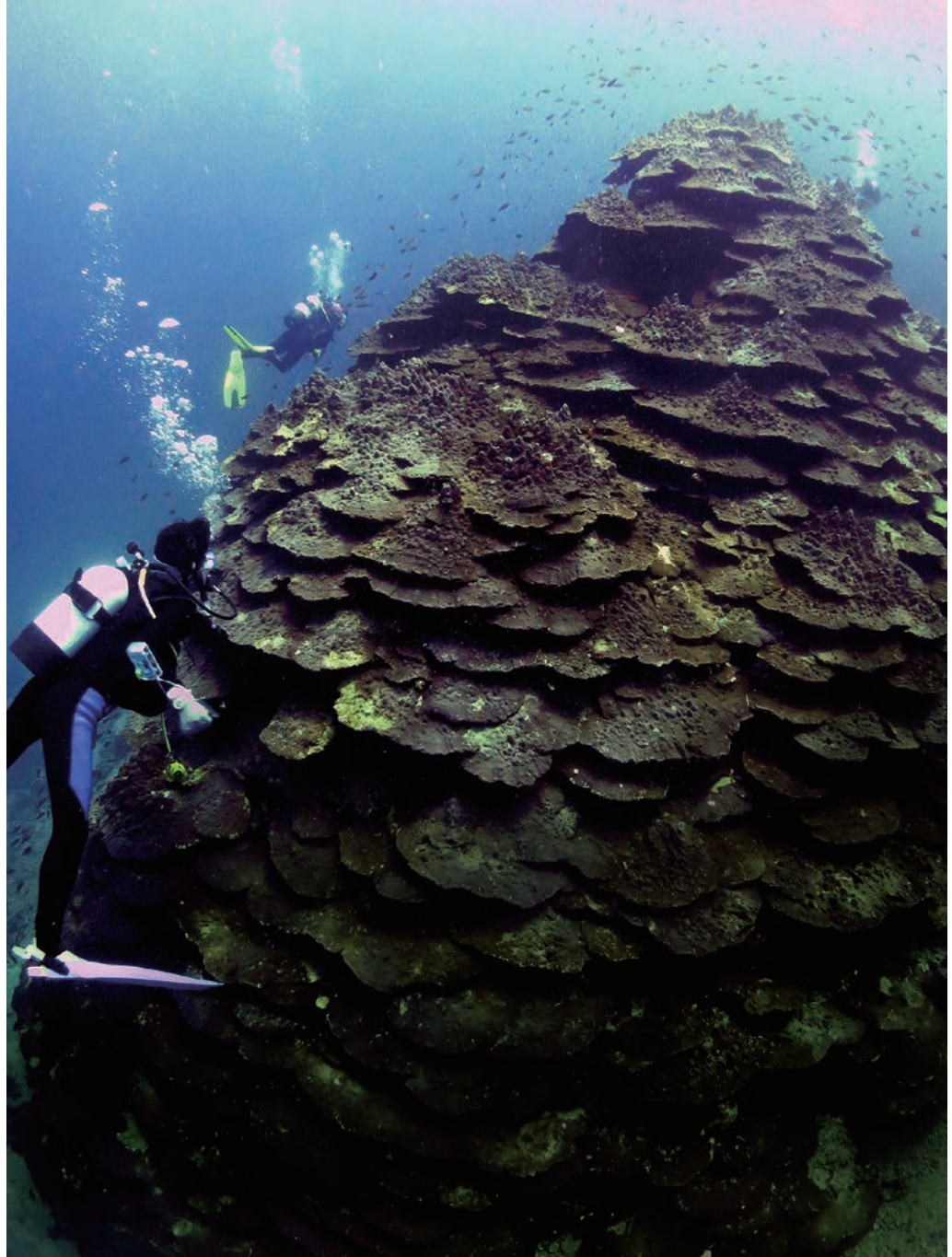
Staff of Ogimi Village are receiving an explanation from a staff member of Ishigaki City on planting of a green belt as a preventive measure for soil runoff. Such information sharing is expected to further facilitate the countermeasures against red soil runoff (provided by WWF Japan) [See Reference Material I-1-(2) at the end].



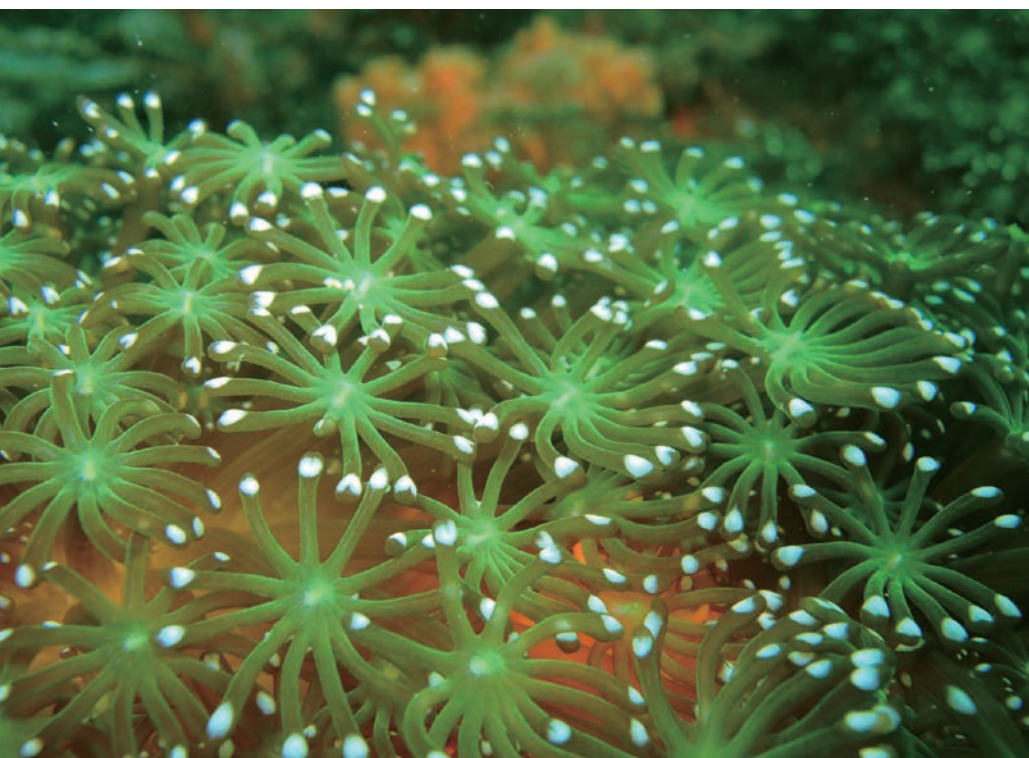
A signboard set up in the Iriomote-Ishigaki National Park appeals for cooperation to observe the rules of use of the coral sea [See Reference Material I-2-(1) at the end].



Students of Shiraho Junior High School, a local school in the area, participate in the Coral Watch Program. They experience nature of the sea and learn how to get involved in it, while also gaining an insight into the thoughts handed by people up to the present day (Provided by WWF Japan) [See Reference Material I-3-(1) at the end].



A gigantic coral colony of *Porites lutea* of the Mugi-Oshima, Tokushima Prefecture, called "Sennen Sango" (1000-year old coral) with affection from among people of the local community. The action to protect and succeed the abundance of nature symbolized by Sennen Sango has started. (Provided by NPO Kaifu Nature Network)
[See Reference Material I-3-(3) at the end].



Alveopora japonica of Suo-Oshima, Yamaguchi Prefecture. Some time ago, rich seagrass beds were formed in this place. In late years, the habitat of *Alveopora japonica* has expanded, and is beginning to establish new relationships between regional lives and coral communities. (Provided by Mr. Masaaki Fujimoto)
[See Reference Material I-3-(2) at the end]

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Terms marked with ※ are listed in II Glossary

Foreword

I found a monochrome picture.

The picture is covered with coral reefs in shallow waters.

An old woman who has caught a fish is smiling joyfully in the center of the picture.

Yet, such a landscape has increasingly been lost since then.

The sea seems to have become pretty poor-looking
as compared with those days when this photo was taken.

Nonetheless, the sea of coral reefs still brings plenty of blessings to us.

The world of coral reefs creating such rich blessings is really complex;
there are still an awful lot of mysteries unable to be solved.

The Action Plan to Conserve Coral Reef Ecosystems in Japan 2016-2020
introduces the coral reef ecosystems and various people's actions to conserve it.
The Action Plan describes what we should do at present up to Fiscal Year
2020 in order not to lose a lot of coral reef ecosystems in the near future.

We hope that this action plan will create an opportunity to generate measures for
conservation of the coral reef ecosystems and to connect them with each other.

If we can continue to achieve such approaches, we will be able to
specifically depict our future in which we continuously receive
services from coral reef ecosystems.



1 Formulation Development of the Action Plan to Conserve Coral Reef Ecosystems in Japan 2016 – 2020

Coral reef ecosystems, which are rich in biodiversity, have brought about a great deal of blessings, which can be called ecosystem services, based on biodiversity such as food supply, provision of tourism resources and recreation opportunities, etc. However, the deterioration of the coral reef ecosystem in recent years is serious, and moreover, difficulty in recovering from previous deterioration has become problematic.

In order to maintain such coral reef ecosystems in a favorable condition, the Action Plan to Conserve Coral Reef Ecosystems was formulated in 2010, as a five-year plan for conservation of the coral reef ecosystem, thanks to the cooperation of a large number of parties concerned (<http://www.env.go.jp/nature/biodic/coralreefs/project/index/html>). After the formulation, follow-up conferences to confirm its implemented situation have periodically been held, and an investigation to confirm the achievement rate of the items described in the action plan was also carried out in 2015. As a result of the survey, a fixed level of outcomes was produced in terms of designation and management of protected areas under the item of designation and management of significant areas, and in terms of removal of crown-of-thorns starfish and coral breeding under the item of action tackling different factors. On the other hand, the survey shows the number of efforts is small or the degree of achievement is low for the items of integrated watershed management connecting land and sea, promoting cooperation among organizations for a community living in harmony with the coral reef ecosystem, appropriate resource use for tourism, and outreach and capacity building. Moreover, in the follow-up conferences, in order to make the action plan more practical, the opinion was voiced that it would be necessary to set up priority fields to be tackled, and clarify the relationship with other similar strategies and goals.

In July 2015, the Ministry of the Environment revised the Action Plan to Conserve Coral Reef Ecosystems in Japan, and set up a revision review conference for the action plan to discuss its scheme in and after Fiscal Year 2016. At the first review meeting, consensus was reached that the target of the action plan should be continuously focused on the ecosystem conservation of coral reefs and coral communities. As policies in the occasion of the revision, the following three matters were decided based on reflections on the Action Plan to Conserve Coral Reef Ecosystems in Japan.

- Positioned it as an action plan to achieve the goals related to the conservation of coral reef ecosystems described in the National Biodiversity Strategy of Japan 2012-2020 (Cabinet decision on Sep.28, 2012) and the Basic Plan on Ocean Policy (Cabinet decision on April 26, 2013), contributing to achieving the Aichi Target.
- Select priority issues specifically regarding conservation for coral reef ecosystems by Fiscal Year 2020.
- On the occasion of implementing the plan, establish linkage among as many as organizations so that the follow-up conference will become a useful venue for information sharing and cooperation promotions.

The Action Plan to Conserve Coral Reef Ecosystems in Japan 2016-2020 (Draft), prepared based on this policy, was discussed in the second review meeting, and public comments were invited pertinent to a draft revision based on its result. The draft revised again based on the public comments, etc. was discussed in the third review meeting, in which the Action Plan to Conserve Coral Reef Ecosystems in Japan 2016-2020 was formulated.

The Action Plan to Conserve Coral Reef Ecosystems in Japan 2016-2020 was formulated with awareness to make the content more hands-on and practical, based on a hard look at what matters will be essential five years from 2016. This action plan is expected for a variety of organizations to promote an integrated implementation of initiatives toward conservation of coral reef ecosystems.

In this action plan, the description concerning the coral reef ecosystem (refer to page 3) shall, unless otherwise noted, apply to the ecosystem where a high-latitude coral community is dominant, which ranges along the Pacific coast from Kyushu to Tateyama, Chiba Prefecture and along the coast of the Japan Sea from Kyushu to offshore from Niigata Prefecture.



2 Current Status of Coral Reef Ecosystems in Japan

Currently, coral reef ecosystems all around the world have been negatively affected due to various causes and are left in very grave circumstances. Therefore, conservation activities for coral reef ecosystems are being carried out in everywhere in the world. Coral reef ecosystems in Japan are no exception, and various discussions have been held and conservation activities promoted.

Animals generally called "coral" can be classified into several groups, and the target of the said conservation activities is a group of reef-building coral which forms skeletons, where fine sea grasses called zooxanthella^{**1} live symbiotically. In order to proceed with conservation activities, it is essential to deepen understanding of the reef-building coral and coral reef ecosystems consisting of reef-building coral as essential elements.

In this part, in addition to the explanation of reef-building coral and coral reefs, the MOE will elucidate the blessings brought by coral reef ecosystems and the current status of coral reef ecosystem conservation and so forth.

Reef-building Coral and Coral Reefs

Coral reefs are defined as a terrain configuring a natural breakwater where accumulated (reef-building) animals such as coral insects form reef limestone which reaches almost up to the ocean surface. What bears very important roles for the formation of coral reefs is a creature called reef-building coral, belonging to the family of cnidaria, which includes sea anemone.

Eggs born from parent reef-building coral float in sea water, and in due course of time, they are fertilized to become planula larvae. (There also is a species whose fertilization completes inside the reef-building coral to release larvae.) In due course, planula larvae cling to the seabed base, subsequently repeat asexual reproduction^{**2} and continue to grow while forming solid skeletons (Fig.1). In this occasion, reef-building coral subsist on animal plankton as food. It is also known that they take in nutrients produced by co-existing zooxanthella (Photo 1) through photosynthesis. Nutrients due to only animal planktons may be insufficient for reef-building coral.

In the tropical/subtropical areas, coral communities where a variety of reef-building coral live have developed, and a massive amount of skeletons of reef-building coral are produced. Such skeletons with calcium carbonate created by calcareous algae^{**4} and foraminifer^{**5} are deposited to form lime rocks. When such lime rocks formed on the seabed grow upward to reach the sea surface or near the sea surface, the terrain of the rock reef is configured and called a coral reef.

The total area of such coral reefs is only around 0.1% of the earth surface. However, as many as 90,000 species live in the area of coral reefs. Further, there is a study reporting that coral reefs sustain the lives of 35% or more of species in shallow coastal waters. The sea of coral reefs is recognized to be one of the most crowded area with animals on the earth when comparing the number of species per unit area. With this regard, coral reefs where extremely many species live and which are superior in biodiversity are sometimes called "tropical forests in ocean."

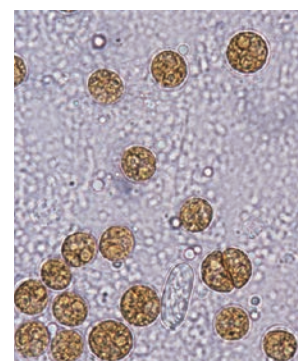
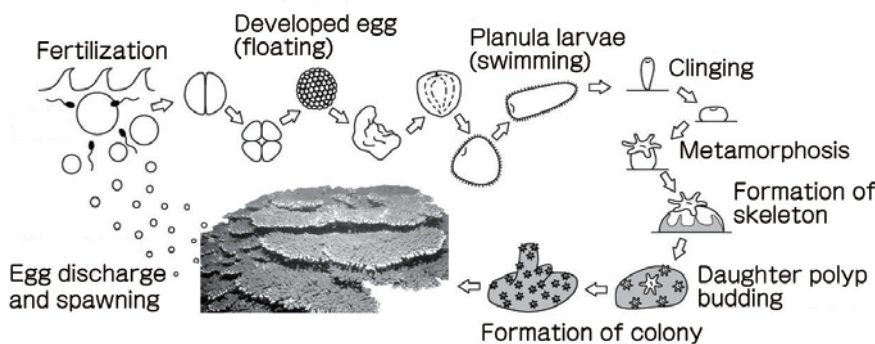


Photo 1 Zooxanthella (Provided by Mr. Yoshikatsu Nakano)

Figure 1. An example of a life cycle of reef-building coral

(Source: Iwase (2001): Introductory Study on Coral (3) Coral's Life Cycle: Current Vol. 2, No.2)

The deer's horn coral, one type of reef-building coral, is ambisexual. On early summer or mid-summer nights, they make a bundle of several oocytes and testicles and spawn eggs from their mouth. Bundles rise and are separated to eggs and sperm near the sea surface for mating with gamete of other colonies. Fertilized eggs continuously float near the surface to grow to be planula larvae within 3 to 4 days. They swim using cilia by turning over and cling to the seabed within 5 to 10 days. Planula larvae become polyps^{**3} having tentacles through metamorphosis. The formation of skeletons begins within 2 to 3 weeks after they cling to the seabed, and new polyps are generated (budded) around the polyp to start colony formation. In a few months up to about a year, polyps on branches and on their ends are formed, and mature in about 4 to 6 years to commence reproductive activities.

The Mysterious Sea of Coral Reefs

On the other hand, the marine waters with expanding coral reefs are generally recognized as being poor in nutrient salts^{**6}. The transparency of sea water in this area means that it contains few plankton. Nonetheless, why are there so many species in this area?

One of the reasons is related to an extremely important role of reef-building coral which plays the leading part of coral reef formation, to feed many living organisms with food resources. Organic substances fed in various forms by reef-building coral, including not only organic substances due to excretion from reef-building coral but also much of the amount of organic substances produced by zooxanthella co-existing with reef-building coral

through photosynthesis, are useful as food resources. It is said that, since such organic substances are consumed by many animals right away, sea water in the coral reef area is kept clean and beautiful and transparent water conditions are sustained. Keeping a balance between such supply and consumption is essential for the health of seawater.

Another important role of reef-building coral is to provide habitats for a variety of living things by creating a complex spatial structure.

The benefits of reef-building coral for cultivating biodiversity in the area of coral reefs are inestimable.

The Blessings Brought by Coral Reef Ecosystems (Ecosystems Services)

As described above, coral reefs have a significant function to enable a variety of organisms to co-exist. Also, abundant coral reef ecosystems structured mainly of reef-building coral bring the great benefits listed below for community life and the survival of humanity.

▶ Affluent fishing grounds

Coral reefs with extremely high productivity provide us with affluent fishing grounds. One of the results of estimation indicates that fish and shellfish unloaded from a coral reef of 1km² would support the livelihood of population of 300 or more.

▶ Decorations and souvenirs

Organisms living in coral reefs are frequently utilized as decorative things and also for ornamental purposes. In the Nansei Islands region, a variety of accessories using shells of shellfish such as great green turbans are manufactured and sold.

▶ Building materials

In Okinawa and peripheral islands, coral reefs have provided materials for buildings. For traditional buildings in this area, coral lime stone and the coral population itself are used in many parts of buildings (Photo 2). For stone

walls in the Gusuku Sites and Related Properties of the Kingdom of Ryukyu, registered as a world cultural heritage, lime stone is also used.

▶ Natural breakwaters

It is reported that the tsunami due to the Sumatra-Andaman earthquake, 2004 was attenuated by the coral reef. Like this, coral reefs can bear the role of a natural breakwater. The value of coral reefs in Okinawa Prefecture as natural breakwaters was calculated as a trial and the result reached up to 55.9 billion yen per a year.

▶ Formation of lands

Occasionally, an island is formed due to the elevation of a coral reef. Yoron Island and Kikaijima Island in the Amami Islands are good examples. Further, skeletons of coral and shells of foraminifer living in the coral reefs distribution zone are crushed to turn into sand and contribute to the formation of islands. In such a way, coral reefs have another function, to provide land.



Photo 2 Buildings and grout using reef-building coral

In the foundation under a pillar, skeletons of faviids and brain coral are used. Since the skeletons of coral are porous and well drained, they prevent corrosion of pillars. Coral is used for stone walls, a bed of sand in a garden and building materials such as cement plaster to fix roofing tiles.

▶ Ingredients for pharmaceuticals

In some cases, various substances produced by organisms living in a coral reef are useful as ingredients for pharmaceuticals. A coral reef area has potentialities due to its biodiversity to contribute to the development of new drugs in future.

▶ Culture formation - unique traditional events and festivals

Islands in an area where coral reefs are distributed have many cultural and traditional events derived from coral reefs. For example, in Okinawa, there is a custom to hang shells of spider conch, which is a shellfish living in a coral reef, from the eaves.

▶ Training grounds

Coral reefs provide a ground for nature education

activities in the region. They are functioning as training grounds and provide many types of teaching materials.

▶ Comforts and tourism resources

We can enjoy the great variety of scenery of colorful and beautiful coral reefs. Such a beautiful seascape of coral reefs has a great value as a tourism resource.

▶ Ornamental fish

Colorful fish living in a coral reef area are popular as ornamental fish. Many types of ornamental fish are traded these days.

(Note) Capture of ornamental fish may be regulated if they are living in marine park areas^{**7} prescribed in the Natural Parks Law or protective areas prescribed in the Prefectural Regulation of Fishery Adjustments made by prefectural governors in Japan. In some cases, such fish are not captured directly from coral reef ecosystems but cultivated in a nursery.

Coral Reefs in Japan

In Japan, coral reefs can be observed mainly in peripheral areas of the Ryukyu Islands and Ogasawara Islands. This is because of the necessity of warm seawater for development of a coral reef. The average water temperature must be 18°C or higher even in the coldest season. In the meantime, reef-building coral are distributed in the area covering from the Ryukyu Islands to Tateyama in Chiba Prefecture, which is along the Pacific coast, and from the islands to offshore of Niigata Prefecture, which is along the coast of the Japan Sea (Figure 2). From a global viewpoint, the above mentioned area is in the northern limit of distribution of reef-building coral. However, the northern limit has been moved northward in recent years due to the elevated seawater temperature, and moreover, the speed of development of reef-building coral has been raised in the northern limit area. As a fact, in the coastal area of Kochi Prefecture, it is confirmed that the sea trumpet dominated seaweed field was affected by seawater whose temperature was raised and disappeared to be replaced with table reef of deer's horn coral communities. In this area, occupations such as fisheries developed based on the sea in the region and the

culture may be greatly influenced by a significant change in member of species in the ecosystem. Furthermore, according to an evaluation using simplified indicators estimated from monthly average sea surface temperature, the possibility that the northern limit of the distribution range of reef-building coral will extend to the coasts of Aomori and Iwate Prefectures in the end of 21st century is indicated. Therefore, it may be increasingly necessary to deal with such changes, including rising seawater temperatures.

There are three types of the terrain called coral reef: fringing reefs, barrier reefs and atolls (Figure 3). Almost all those seen in Japan belong to the type of fringing reefs. This type of coral reef located near the land is an important component of the environment in people's lives, and coral reef ecosystems greatly impact regional livelihoods, culture and traditional events. At the same time, it can also be said that this type of coral reef ecosystem is susceptible to be damaged by such an impact because it may be directly damaged by nutrient salts, earth and sand flowing in from land areas.

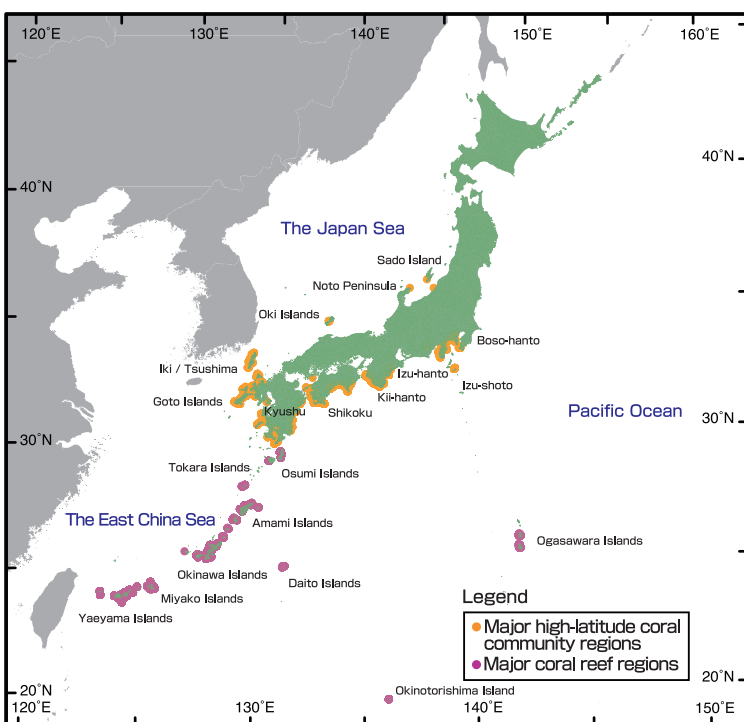


Figure 2. Distribution of coral reefs and coral communities in Japan

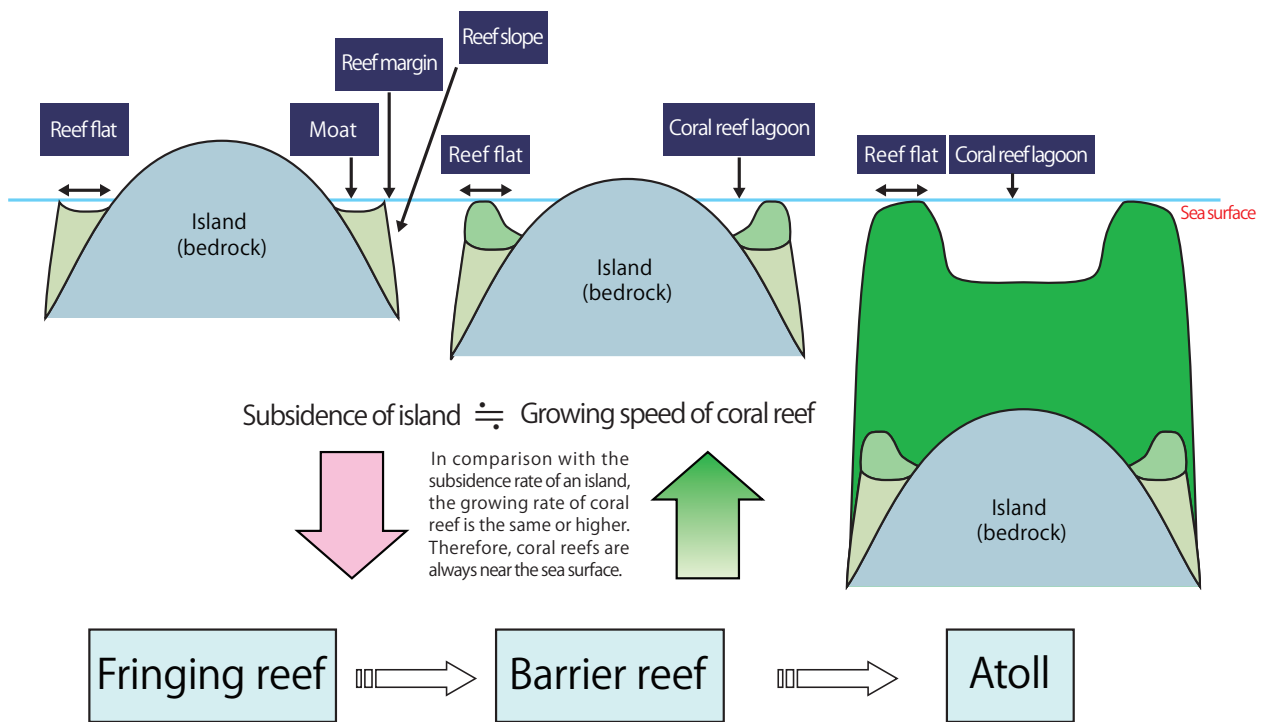


Figure 3. Fringing reefs, barrier reefs and atolls (three types of terrain formed from coral reefs)

As seen in the Ryukyu Islands and Ogasawara Islands, the terrain where a coral reef grows to encircle an island is called a fringing reef. When an island of fringing reef subsides due to crustal movement or elevation of the sea surface and the coral grows upward, a barrier reef is formed. This type of reef is separated by a coral reef lagoon from an island and structured to surround the island. When an island having the barrier reef subsides deeper and is located under the sea surface, the coral reef grows around the coral reef lagoon and forms an atoll shaped as a doughnut.

The Status of Coral Reef Ecosystems

The coral reef ecosystems, which increase affluent biodiversity and bring great benefits to us, are also known as being highly vulnerable.

What strongly impressed us as to the vulnerability of coral reefs is the global large scale coral bleaching⁸⁸ due to high water temperatures from 1997 to 1998. Seawater temperatures in warm water areas are close to the upper limit for reef-building coral. In such an area, if the maximum temperature stays at a level of 1°C higher than the average through the summer, the bleaching phenomenon of coral will begin. In the period from 1997 to 1998, as a result of the global spreading of high temperature seawater areas, about 16% of the reef-building coral in the world died, and this matter attracted attention as a global scale impact on coral.

Other than the above, coral reef ecosystems developing along coasts have various problems; destruction due to regional development, deterioration due to effluent substances from the land, and impacts due to large scale outbreaks of coral-eating gastropods such as the crown-of-thorns starfish.

From the above mentioned viewpoints, coral reef ecosystems are recognized internationally as requiring significant preservation measures. For example, one of the Aichi targets decided in the 10th Meeting of the Conference of the Parties to the Convention on Biological Diversity⁸⁹ was to minimize multiple anthropogenic pressures which degrade coral reefs and other vulnerable

ecosystems impacted by climate change or ocean acidification, so as to maintain their integrity and functionality. However, the achievement of this target is extremely difficult, and in the Global Biodiversity Outlook 4th edition (GBO4), the feasibility of this target is evaluated as being rather lowered. Furthermore, in the progress report on the protection and sustainable development of diversity of natural resources prepared preceding the Group of Seven (G7) Summit held in Germany in 2015, accelerated deterioration of coral reefs was described.

In the same manner, Japan's coral reef ecosystems have widely deteriorated due to the destruction of coral reefs caused by land development, negative impacts of substances such as red soil¹⁰ flowing from land areas, great damage to reef-building coral caused by the crown-of-thorns starfish which eats coral, destruction of reef-building coral by very large typhoons and an increase in seawater temperatures. It is pointed that the deteriorated coral reef ecosystems are in an irreparable condition. In addition, a rise in the sea level and seawater acidification induced by increase in CO₂ concentration in the air, which are negative impacts of global climate change, should be given attention.

Efforts for Conservation of Coral Reef Ecosystems

In order to conserve coral reef ecosystems, various efforts have been advanced in each region. For instance, regional fisheries cooperative associations and diving shops have carried out activities to remove* coral-eating gastropods aiming at conservation and regeneration of coral reef ecosystems (Photo 3). In each local governments, various efforts for ecosystem conservation have been tried. For example, in Okinawa prefecture, a study on designation of coral reef marine areas of significance^{**11} and regeneration of coral reefs, and support to coral reef conservation activities have been conducted, and moreover, ordinances and basic plans to prevent erosion of red soil^{**12}, etc. have been formulated as countermeasures against impacts caused by the land. Removal of coral-eating gastropods such as the crown-of-thorns starfish has been conducted widely in Okinawa,

Kagoshima and Miyazaki Prefectures. In Takegashima Island in Tokushima Prefecture, a coral community restoration project is underway for the purpose of the regeneration of environments in which *Acropora tumida* can live in a sound condition. Additionally actions are the formulation of the coral reef ecosystems conservation action plan, implementation of coral reef monitoring activities, and execution of restoration project of coral communities in Sekisei Lagoon (Okinawa Prefecture) and Tatsukushi (Kochi Prefecture). Internationally, the International Coral Reef Initiative (ICRI)^{**13} was launched in 1994 for sharing information on conservation and monitoring of coral reefs and conducting training for coastal area management.



Photo 3 Removal of coral-eating gastropods (crown-of-thorns starfish) by Onna-son fisheries cooperative association (data source: Onna-son fisheries cooperative association)

*Since prickles bristling on the surface of the crown-of-thorns starfish secrete venom, it is extremely dangerous to remove it casually. When trying to remove a crown-of-thorns starfish, please refer to the safety guidelines for removal of the crown-of-thorns starfish prepared by local bodies like NPOs.

The Actual Conditions of Achievement of the Coral Reef Ecosystems Conservation Action Plan in Japan

As seen above, a variety of efforts to conserve coral reef ecosystems have been carried out in various regions. However, how far has the conservation of coral reef ecosystems been accomplished? As one of ways to respond to this question, the Ministry of the Environment conducted research on the status of achievement of the Coral Reef Ecosystems Conservation Action Plan in FY2015, and compiled the status of implemented actions in the past concerning the items described in the Coral Reef Ecosystems Conservation Action Plan formulated in FY2010. Moreover, with regard to the status of achievement of each item, MOE conducted a questionnaire survey on 11 experts involved in the formulation of the action plan. As a result (Figure 4.), it was found that many of the items described in the action plan were accomplished, and measurable progress was confirmed in the achievement of purposes. For example, under the item of designation and management of significant areas -for establishing and managing marine park areas in national parks, the Kerama Shoto National Park was newly designated in 2014. Under the item of establishment of measures for each problem, a great deal of measures including removal of the crown-of-thorns starfish and sexual reproduction of coral were taken, and they were evaluated as being relatively well accomplished. On the other hand, although many groups have made efforts for the promotion of cooperation among organizations for a community living in harmony with coral reef ecosystems and

integrated watershed management connecting the land and sea, concerning the establishment of consultative meetings and social infrastructure improvement, the results were evaluated as being low in the rate of accomplishment. As for outreach and capacity building (including education on the natural environment, appropriate management and use of biological resources including popularization of Satoumi and proper control of marine resources and appropriate use of resources for tourism including eco-tourism promotion support), the number of groups involved in the action was fewer in spite of the higher level of accomplishment. For such an item, it was suggested that an effort to increase the number of groups working for the action would raise the effect of ecosystem conservation. Concerning the promotion of cooperation among organizations for a community living in harmony with coral reef ecosystems and integrated watershed management connecting the land and sea, some researchers pointed out that cooperation among various regional interested parties and comprehensive in-site initiatives have not progressed. With the aim of conservation of coral reef ecosystems, many relevant parties are required to implement integrated efforts for effective conservation and management of ecosystems through sharing information and purposes to deepen their cooperation.

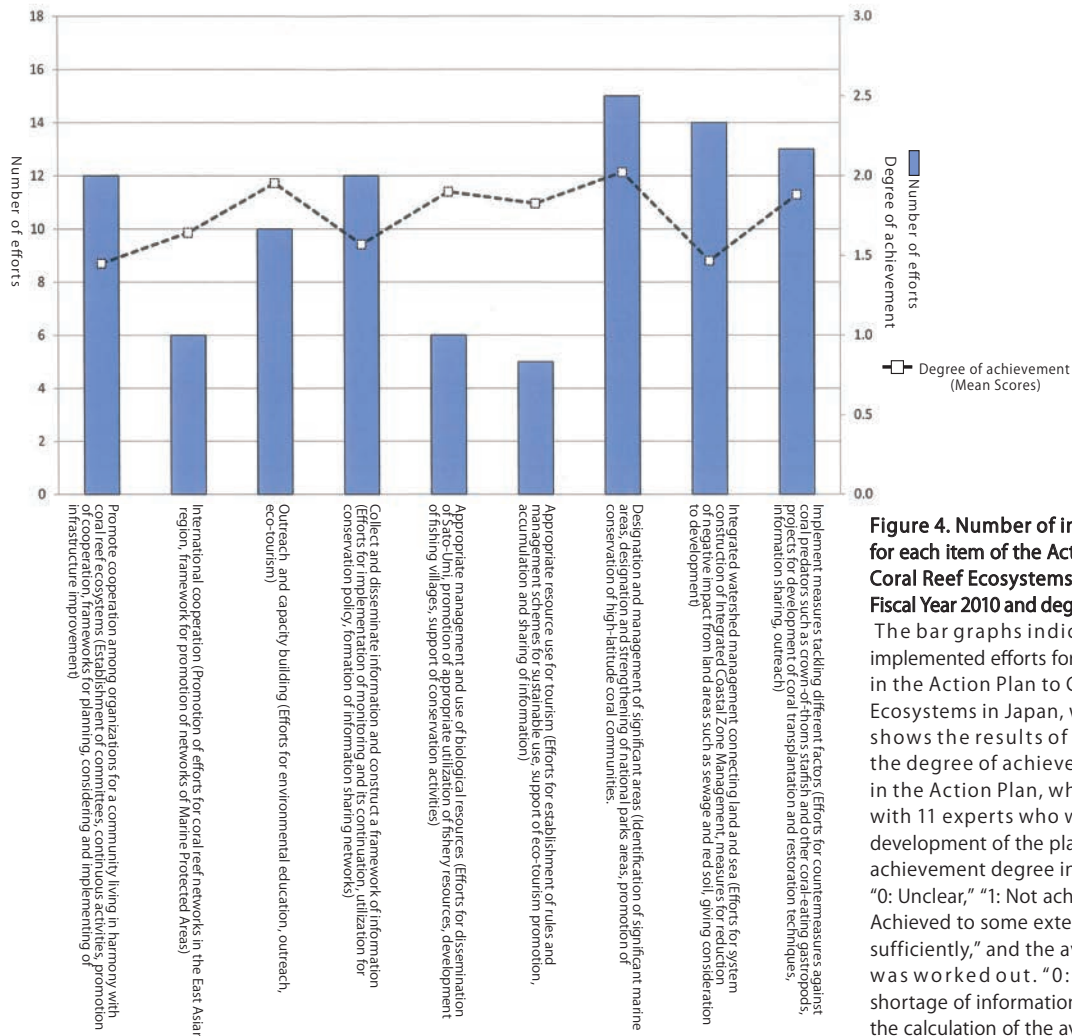


Figure 4. Number of implemented efforts for each item of the Action Plan to Conserve Coral Reef Ecosystems in Japan decided in Fiscal Year 2010 and degree of achievement.

The bar graphs indicate the number of implemented efforts for each item described in the Action Plan to Conserve Coral Reef Ecosystems in Japan, while the line graph shows the results of questionnaires on the degree of achievement for each item in the Action Plan, which was conducted with 11 experts who were involved in the development of the plan. They assessed the achievement degree in four grades such as “0: Unclear,” “1: Not achieved absolutely,” “2: Achieved to some extent,” and “3: Achieved sufficiently,” and the average for each item was worked out. “0: Unclear,” due to a shortage of information, was excluded from the calculation of the average score. (Source: Research Report of Achievement Degree of the 2015 Action Plan to Conserve Coral Reef Ecosystems in Japan, the Ministry of the Environment)

Column 1 Precious Coral

Reef-building coral inhabits bright and warm shallow coastal waters. In contrast, in the cold deep sea where light hardly ever reaches, are cold-water coral reefs. Well known ones of these are precious coral, namely jewelry coral such as red coral and *corallium elatius* (Figure 1). Different from reef-building coral, precious coral do not need light for growth since they do not coexist with zooxanthella. They catch plankton to obtain nutrition and are known to grow very slowly because of low water temperatures when compared to reef-building coral. Most reef-building coral belong to anthozoa hexacorallia, whereas jewelry coral belong to anthozoa octocorallia. The periphery of precisely calcareous axial skeleton used for jewelry is covered with thin coenosarc like scarfskin, and two types of polyps are scattered: one is an ordinary polyp having eight pinnate tentacle staghorns, the other is a polyp without them. Nobody knew jewelry coral could be produced in coastal areas of Japan until the end of the Edo Era (1586 – 1867) so coral products came from Mediterranean Sea up until then. After the Meiji Era (from 1868) Japan became the principal production area.

(Fumito Iwase, Shikoku Umi to Ikimono Kenkyushitsu: Research Laboratory of the Sea and Living Creatures of Shikoku)



Photo 1 Red coral, a species of jewelry coral (provided by Fumito Iwase)



Goal and Objectives of the Action Plan to Conserve Coral Reef Ecosystems in Japan 2016 - 2020

Framework for Conservation of Coral Reef Ecosystems

The Action Plan to Conserve Coral Reef Ecosystems in Japan 2016 – 2020 aims to translate into reality the achievements of the goals stated in the National Biodiversity Strategy of Japan 2012 – 2020 (Cabinet decision: September 28, 2012) and the Basic Plan on Ocean Policy (Cabinet decision: April 26, 2013).

The Basic Plan intends to facilitate conservation of the coral reef ecosystem efficiently and smoothly by identifying the problems to be addressed predominantly and taking measures in a focused manner to solve them on the basis of the current status of coral reefs and the social situation surrounding thereof. The goal is to construct the infrastructure for conservation of the coral reef ecosystem connected to local communities by the end of fiscal year 2020 through the framework for conservation.

Through the above efforts, the Basic Plan will contribute to the achievement of Aichi Target 10 decided at the 10th meeting of the Conference of the Parties of the Convention on Biological Diversity (CBD/COP10) that advocates the “the multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.”

Target Area

Formation of sufficiently developed coral reefs is found in the south of the Tanegashima and Yakushima Islands and the Ogasawara Islands in Japan and such areas are referred to as “coral reef regions” in the Action Plan. Japan is the northern limit of coral and coral reef distribution; other coral communities that can be found in higher latitudes than Kyushu area are collectively called “high-latitude coral community region” here, which are also part of the Action Plan. To promote the plan, taken into account in the coral reef ecosystems are the environment of associated sand beaches and seashore, adjacent seagrass beds, tidal flats, and mangroves in addition to coral reef communities.

However, it does not include cold-water coral and deep-sea coral, such as precious coral.

Targeted Period

The period for the plan is five years between fiscal years 2016 and 2020 basically while considering the amendment conditions of relevant plans.

Stakeholders to Promote the Action Plan

The Action Plan was developed by the Ministry of the Environment in the Review Meeting for Revision of the Action Plan to Conserve Coral Reef Ecosystems in Japan in cooperation with relevant national and local governments, and the Japanese Coral Reef Society. These organizations assume a role of promoting the plan from their own standpoint.

Furthermore, in order to promote the Action Plan, conserve the coral reef ecosystems and utilize thereof, it is extremely important for the residents in the local communities as well as various stakeholders to understand the plan and take appropriate actions. All participating organizations and individuals to promote the plan, for instance, need to pursue the raising of more awareness on the importance of coral reef ecosystems and of the close relationship between people's daily life and coral reef ecosystems, to behave with consideration to the conservation of the ecosystem and promote the framework in concert with other bodies on the basis of the Action Plan. These stakeholders include those engaged in local economic activities such as agriculture, forestry, fisheries, tourism, and other relevant private companies; committees and economic groups in the region; schools and public community centers; researchers and academic societies, NGOs, media, and visitors. Moreover, another important aspect is to create the framework for conservation and restoration of coral reefs in local areas in free thinking ways after appreciating the importance of them in the communities.

Reference 1 Superordinate Plan and Objectives of the Action Plan to Conserve Coral Reef Ecosystems in Japan 2016 - 2020

● Aichi Targets

The Strategic Plan for Biodiversity 2011 – 2020 adopted in the 10th meeting of the Conference of the Parties of the Convention on Biological Diversity sets a goal of “Living in harmony with nature” by 2050,” and “take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020.” Specific individual objectives to achieve the above goals are the Aichi Targets. Those especially deeply involved with The Action Plan to Conserve Coral Reef Ecosystems in Japan 2016-2020 are the following three matters:

Target 8 Pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem functions and biodiversity..

Target 10 The multiple anthropogenic pressures on coral reefs, and other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, so as to maintain their integrity and functioning.

Target 18 The traditional knowledge, innovations and practices of indigenous and local communities relevant for the conservation and sustainable use of biodiversity, and their customary use of biological resources, are respected, subject to national legislation and relevant international obligations, and fully integrated and reflected in the implementation of the Convention..

(<https://www.cbd.int/sp/targets/>)

● National Biodiversity Strategy of Japan 2012-2020

The National Biodiversity Strategy of Japan is a basic plan regarding conservation of biodiversity and its sustainable use, set by the Japanese Government on the basis of the Basic Act on Biodiversity. The National Biodiversity Strategy of Japan 2012– 2020 illustrates Japan's roadmap to achieve the Aichi Targets and at the same time indicates what the ideal symbiotic society should be when considering the Great East Japan Earthquake. In addition, it involves as many as 700 specific policies as the government's five-year action plan to put the roadmap into reality. Revisions of this action plan are also included herewith.

(http://www.biodic.go.jp/biodiversity/about/library/files/nbsap2012-2020/nbsap2012-2020_cop11ver_EN.pdf)

● Basic Plan on Ocean Policy

In order to proceed with policies on oceans comprehensively and systematically under the Basic Act on Ocean Policy, the Japanese government developed this plan, which states the basic policies on the ocean, set down every five years. Incorporated in the basic plan are promotion of the management of coastal areas connecting the land and sea, reducing the impact of pollution flowing in from the land, promotion of ecotourism, establishment of rules to regulate utilization of the ocean surface, and support of efforts by local fishermen and residents for maintenance management of coral reefs, which have drastically decreased since the period of rapid economic growth.

(http://www.kantei.go.jp/jp/singi/kaiyou/kihonkeikaku/130426kihonkeikaku_e.pdf)



4 Selection of Priority Issues to Be Addressed by Fiscal Year 2020

The Action Plan to Conserve Coral Reef Ecosystems in Japan 2016 – 2020 has been designed to assure the effectiveness of the plan through selecting priority issues intensively in particular for conservation of the coral reef ecosystem by fiscal year 2020, based on reflection of the Action Plan to Conserve Coral Reef Ecosystems in Japan. Specifically, the following three items have been set as priority issues by the fiscal year 2020 for conservation of coral reef ecosystems grounded in the current status surrounding the coral reef ecosystem in Japan and the status of achievement of the Action Plan to Conserve Coral Reef Ecosystems in Japan (See page 7).

The policies which are thought to be effectively promoted by being grasped in a wide sphere such as enhancement of Marine Protected Areas^{**1} and, progress of scientific information and knowledge through survey and monitoring, will be based on the Marine Biodiversity Conservation Strategy^{**2} (MOE, March 2011). They will be utilized also in the measures for solving the priority issues.

- Promotion of measures against red soil sediments and nutrient salts from the land
- Promotion of sustainable tourism in coral reef ecosystems
- Establishment of relationship between community life and coral reef ecosystems

The reasons why each priority issue was selected are as follows.

Promotion of Measures against Red Soil Sediments and Nutrient Salts from the Land

Excessive runoff of red soil sediment and nutrient salts from the land area are thought to be the main factor in the loss and degradation of coral reef ecosystems, of which fringing reefs accounts for most of the coral reefs in Japan, so control of them is absolutely imperative. Moreover, amid an increase in risks to coral reef ecosystems due to the rise of sea water temperatures, it will become important to raise the integrity of reef-building coral in normal periods and enhance their resilience so that they are able to overcome the rising of sea temperatures to some

degree. In this regard, reduction of excessive runoff of red soil sediment and nutrient salts from the land areas will become increasingly necessary to conserve and restore coral reef ecosystems.

In addition, it is also important to consider measures tackling runoff of red soil sediments and nutrient salts from the land, while taking account of regional social situations such as demographic composition by age and the condition of infrastructure improvement.

Promotion of Sustainable Tourism in Coral Reef Ecosystems

Tourism including scuba diving and snorkeling in the sea of coral reefs is very popular, and is now an industry which produces the greatest economic value in the coral reef areas as well. Furthermore, it is likely that the number of tourists will increase even further in the future due to an increased economic strength in the Asian area and

activation of low cost carriers (LCC).

For this reason, searching for and promotion of sustainable tourism in the coral reef ecosystems corresponding to such changes, and enriching people's understanding of coral reef ecosystems and conservation thereof will become essential for conservation of coral reef ecosystems.

Establishment of Relationship between Community Life and Coral Reef Ecosystems

The coral reef ecosystems provide food such as fish and shellfish and attractive tourism resources, or serve as natural breakwaters; thus such very important ecosystems bring a variety of bounties to the coastal residents and are associated with festivities or traditions, culture, and customs in various forms.

However, the relationship between community life and coral reef ecosystems has become weak in recent years because of changes in industrial structures and distribution. Furthermore, the passing on of knowledge, experiences and techniques for harmonious coexistence with coral reef ecosystems is likely to become difficult under the current situation in Japan, with its aging society and low birthrate. In the areas where coral communities have moved toward the north and new distribution has been recognized due

to increasing sea temperatures, coral communities have become something of value as a new tourism resource. In this way, there are some cases where the relationship between coral communities and the ecosystem surrounding them are seen in a new form.

For this reason, it is an urgent necessity to construct relationships that enable conservation of coral reef ecosystems while utilizing them, by deepening understanding of the blessings brought about by coral reef ecosystems, collecting knowledge and experiences concerning the sustainable use of coral reef ecosystems that have been inherited thus far, and reassessing the relationship between community life and coral reef ecosystems through sharing knowledge and experiences among communities.



5 Current Status of Each Priority Issue

This section explains the current status and countermeasures of the three selected issues: Promotion of Measures against Red Soil Sediments and Nutrient Salts from the Land, Promotion of Sustainable Tourism in Coral Reef Ecosystems, and Construction of Relationships between Community Life and Coral Reef Ecosystems.

5-1 Current Status of Red Soil Sediments and Nutrient Salts from the Land

Although an appropriate amount of nutrient salts from the land is essential for the growth of coral reefs, excessive runoff may break down the balance of coral reef ecosystems. Thus inflow of substances from the land affects the ecosystem in various ways. To uncover the whole picture of such functions is difficult, so knowledge is restricted in the present circumstances. In the future, it is necessary to proceed with investigation and research so as to elucidate the full-length picture of how the substances running off from the land where people live affect coral reefs.

Under these conditions, the negative impacts of excessive runoff of red soil sediments and nutrient salts on the coral reef ecosystem have become relatively clear.

Current Status of Red Soil Runoff

In a forest, a black soil stratum containing plenty of organic substances called a humus horizon is on the surface of soil. The humus horizon has a function like glue, preventing soil from coming apart. However since the degradation rates of organic substances are accelerated, the humus horizon becomes thin in the areas of high temperature throughout the year where coral reefs are distributed. Therefore when development activities are conducted, the fractional humus horizon is easily lost. Moreover, in the areas of the Ryukyu and Amami Islands, fragile and easy-to-crumble red soil is widely distributed. When the humus horizon is lost, the bare red soil (Photo 4) easily flows out by rainfall.

At the same time, the rivers in the islands are short and rainfall like a squall that causes high precipitation at a short time in localized areas frequently occurs. These conditions result in massive runoff of bare red soil, which makes rivers, marine areas, and groundwater systems muddy, and by extension, brings about a serious problem, that is, a red soil pollution issue that wreaks tremendous damage to coral reef ecosystems, tourism and fisheries industry (Photo 5) (Photo 6).

The survey for Fiscal Year 2011 made by Okinawa Prefecture shows that the runoff quantity of red soil was 298,000 tons in total, of which 255,000 tons, or 86%, was from the agricultural land. Accordingly the measures against runoff of red soil from the farmland has become a momentous subject (Photo 7). Meanwhile, the Amami Islands have neither regulated the development activities by an ordinance nor grasped the runoff quantity yet.

Such an outflow of cultivated soil from the upland field has become a big loss for farming households. The Ministry of the Environment conducted a survey by questionnaire on the measures against the burden of inflow from the land that was subjected to Okinawa Prefecture and municipalities of the Amami and Ogasawara Islands in 2015. The survey results disclosed that necessary measures for preventing outflow of cultivated soil have not caught up with the current situation because of typhoons or record-breaking heavy rains in recent years.



Photo 4. Red soil is exposed due to development activities (Amami Oshima)



Photo 5. Reddish river colored with red soil
(Provided by Okinawa Prefectural Institute of Health and Environment)



Photo 6. Reef-building coral covered with red soil
(Provided by Environment Protection Section, Environment Department, Okinawa Prefecture)

Further, although measures for greenbelt planting and for improvement of farming techniques in terms of the intangible aspects exhibit high effects, it seems to be hard for the people to take further actions due to labor shortages resulting from the aging of agriculture workers and an increase in part-timer farmers.

Meanwhile, according to replies to the survey, there are many areas whose farmers are apathetic about the issue of red soil runoff or solutions have not been sufficiently disseminated. It shows how the raising of public awareness among the farmers is important in promoting the measures.

The result also made clear that it was necessary for local governments involved in vast farmlands to grasp the agricultural lands for which measures against red soil runoff need to be implemented, and measures for gradient modification and construction of drained canals and sediment ponds should be taken from the standpoint of both tangible and intangible aspects. At the same time, there are opinions that establishment of a council that will be a core of the efforts and of a department that specializes in the issue will be effective to continue these measures.



Photo 7. Runoff of red soil from the farmland due to rainfall (Provided by Okinawa Prefectural Institute of Health and Environment)

Current Status of Runoff of Nutrient Salts

Since reef-building coral ordinarily adapts to oligotrophic seawater, an excessive increase in nutrient salts concentration inhibits their growth. In addition to this knowledge, there is such a point of view that an extreme inflow of nutrient salts accelerates the increase in phytoplankton and becomes one of the factors in the mass generation of crown-of-thorns starfish, coral-eating gastropods which feed on the plankton in their larval stage.

In recent years, the growth environment of reef-building coral has deteriorated because of elevated seawater temperatures. In addition to this, there is an issue of runoff of nutrient salts from the land, such as chemical fertilizers from the farmland and excrement of livestock. Therefore it is thought that the degree of the negative impact on the coral reef ecosystem may have been enhanced.

The dissemination rate of domestic wastewater treatment systems^{**1} (Fig.5) across the country as of the end of Fiscal Year 2014 reached 90% (sewage system: 78%, agricultural drainage systems^{**2}: about 3%, Johkaso (decentralized wastewater treatment systems)^{**3}: approx. 9%) (Reference: Okinawa Prefecture 84.7%, Kagoshima Prefecture 76.4%, Ogasawara Village 99.8%). In areas accounting for 10% of the entire area, where wastewater

treatment systems have not been disseminated yet, there is concern over the impact of effluence of pollutants due to discharge of domestic effluent from kitchens and bathrooms.

Regarding livestock manure, the Act on the Appropriate Treatment and Promotion of Utilization of Livestock Manure^{**4} (Act on Livestock Manure) strictly regulates open-air storage by simply piling up livestock manure and excavation without timbering by storing it in a pit dug in the ground. In addition, for wastewater treatment, construction of decentralized wastewater treatment systems with independent functions such as sewerage, agricultural drainage systems and Johkaso in light of regional characteristics has been promoted. Drainage from livestock production facilities is controlled pursuant to the Water Pollution Control Act^{**5}. Although the relationship between the above matters and coral reef ecosystems is unclear, the burden of rising sea temperatures on reef-building coral is increasing. It has become essential to create environments where reef-building coral can exercise restoration strength by itself, therefore, concerned parties should join together as one to continue to tackle the problem toward realization of appropriate treatment of discharged water as well in the future.

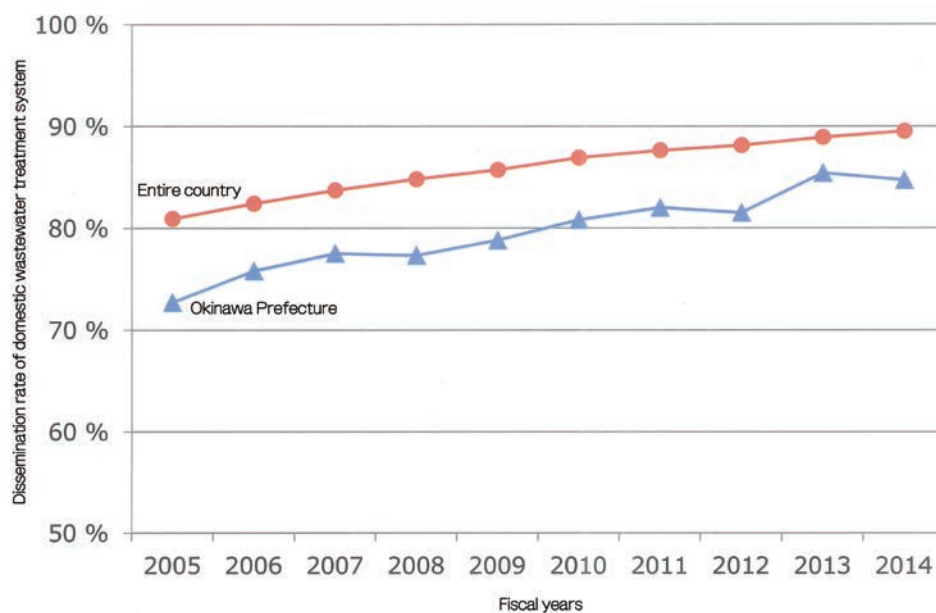


Figure 5. Transition of dissemination rate (%) of domestic wastewater treatment systems in whole country and Okinawa Prefecture. (Prepared based on the Dissemination Rate of Domestic Wastewater Treatment System posted on the Johkaso Site of MOE)

5-2 Current Status of Tourism in Coral Reef Ecosystems

Recently people increasingly desire to enjoy nature year by year so nature experience-type tourism activities based on marine leisure, including scuba diving and snorkeling, are thriving. A survey conducted by Okinawa Prefecture shows that inbound tourists aiming to enjoy marine leisure such as sea bathing account for as high as 26.6% in Fiscal Year 2014, and 7.8% for scuba diving. According to a survey on tourists conducted by the Amami and Ogasawara Islands, about 27% visited the former for scuba diving, while about 55% visited the latter for marine-based ecotourism. Accordingly it will be vital to think about conservation of shallow coastal waters in view of the tourism industry in these areas. Conservation of the coral reef ecosystem enhances its value as a tourism resource, so it will become more and more important in terms of the development of the tourism industry in the region.

While marine experience-type tourism based on marine leisure is drawing attention, the adverse impact on coral reef ecosystems by excessive and inappropriate utilization of marine areas is a matter of concern. It is not rare that more than 1,500 scuba divers, more than 2,000 snorkelers, and more than 120 boats visit a marine area in a day where marine leisure is active in Okinawa Prefecture (Photo 8). For instance, there is concern over the negative impact on coral communities by treading on or contacting them in the intensively utilized marine area,

in particular, diving points with capability of beach entry. Actually in such areas, the pointed end of the population of deer's horn coral was broken so that the growth was stunted. As a result, a lot of populations whose entire shape has become rounded have been observed (Photo 9). In a shallow coastal waters which are concentratedly utilized for snorkeling and swimming, adverse impact on coral communities due to treading on and contacting is concerned (Photo 10).

According to the Basic Survey of Impact of Diving Tourism on Coral Reef Ecosystem for Fiscal Year 2015 by the Ministry of the Environment, in the area between the diving points whose utilization rate varies in the marine area surrounding the headland of Maeda of Okinawa Prefecture, the average density of a small population of deer's horn coral (about 1 – 3 years old after participation) which dominates coral communities in the marine area and coral coverage (percentage of coral on the seabed) were investigated. A significant difference was not found in the average density of a compact colony, while coverage decreased in the places where utilization for diving is concentrated. The growth of deer's horn coral may be hindered (Figure 6).

Research on whether prior briefing for reducing the contact with reef-building coral is effective revealed that briefing for divers who can maintain neutral buoyancy^{**6} has a certain effect.

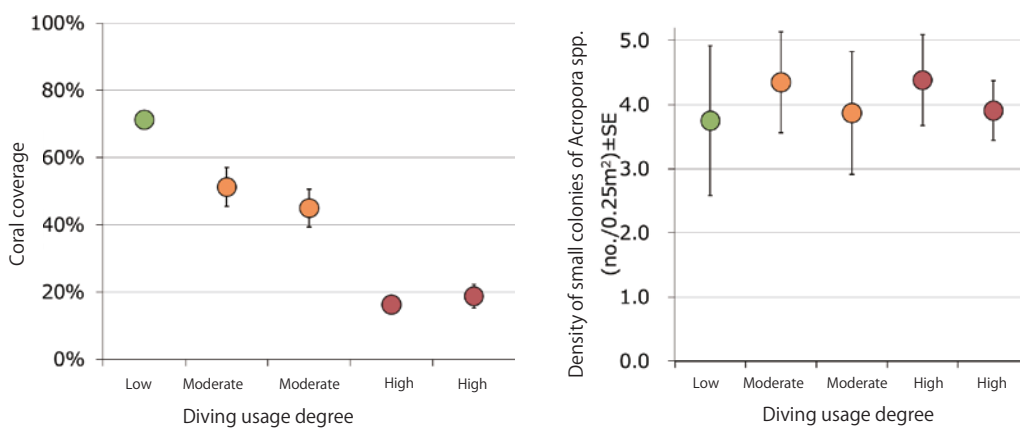


Figure 6. Average coral coverage (%) (left) and average density of small colonies of *Acropora* spp. (colony/0.25m²) (right) in each spot with different degrees of diving usage around Cape Maeda in Onna-son (Source: The Basic Survey of Impact of Diving Tourism on Coral Reef Ecosystem for Fiscal Year 2015, the Ministry of the Environment.)

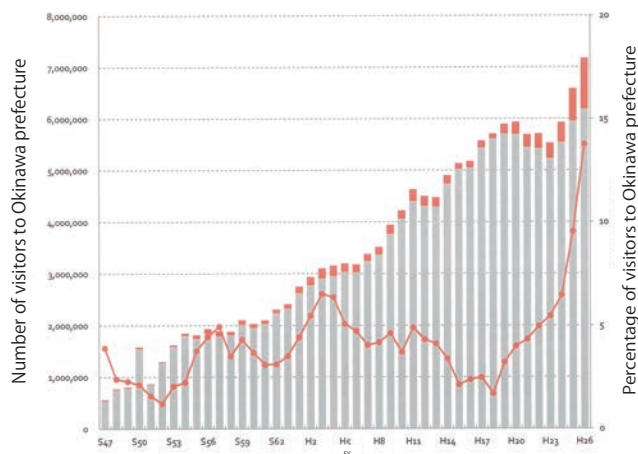


Figure 7. □ Number of Japanese tourists, □ number of foreign tourists and □ percentage of foreign tourists to Okinawa prefecture since 1972 (Prepared based on the Tourism Directory in 2014, Okinawa Prefecture.)

This shows that public awareness by tour conductors is effective depending on the situation, but on the other hand, briefings for divers who cannot maintain neutral buoyancy does not have enough effects. The result suggests that a combination of briefings with technical training to maintain neutral buoyancy will increase the effect.

Hitherto some ways and means have been adopted to reduce the negative impact of utilization of marine areas for diving. To take measures for marine leisure tourists who do not have enough chances to get a prior briefing is an issue to be solved in the future.

An aggressive enticement policy for foreign tourists to visit Japan is currently being implemented. As a result

of this enticement policy, the number of foreign tourists visiting Japan in 2014 was 13.41 million, reaching the record high for two consecutive years, and foreign visitors to Okinawa Prefecture accounts for 13.8% (Figure 7.). A further increase in the number of tourists and globalization are also expected due to enhancement of economic power in Asia and an increase in airlines by employing LCCs. The results of surveys made by Okinawa Prefecture in Fiscal Year 2015 indicate that 20.1% of foreign tourists to Okinawa Prefecture experienced marine leisure such as scuba diving. Therefore there are possibilities that utilization of the coral reef ecosystems for tourism will be further enhanced and tourism modalities based on the coral reef ecosystem will change in the future.



Photo 8. The atmosphere of marine areas used for tourism most actively in Okinawa Prefecture. Users visit the area on boats or from the land for scuba diving, snorkeling, or swimming.



Photo 9. In shallow coastal waters where many divers gather at the start or at the end of diving, they tread on or contact coral communities, so the pointed end of coral populations such as deer's horn coral was broken. As a result, the growth was stunted and the entire shape became rounded.



Photo 10. Coral communities near the coast are adversely affected by trampling and contact in marine areas where snorkeling and swimming are concentrated.

5-3 Current Status of Relationship between Community Life and Coral Reef Ecosystems

As described in “2 Current Status of Coral Reef Ecosystems” (P3), coral reef ecosystems have provided various benefits to people living in a coral reef region and have been closely connected with regional folk customs, culture and traditions.

However, due to significant changes in regional societies induced by changes in industrial structures, changes in occupation and lifestyle influenced by urbanization, depopulation and the aging society or the like, the relationship between community life and coral reef ecosystems is weakening at a rapid pace. In such a situation, it is difficult to carry on the regional traditions and culture created and preserved against the background of the relationship with coral reef ecosystems to the next generation.

Fishery, an occupation closely connected with coral reef ecosystems has also shown a weakened connection with coral reefs, recently. For instance, catches of each of top ten species of coastal fish in Yaeyama district, Okinawa Prefecture greatly decreased in these 15 years (Figure 8). Possible reasons for such a phenomenon include the decrease in fishery resources in coral reef ecosystems and changes in distribution systems of fishery products. When considering the fishing industry in Okinawa Prefecture, the overall aging of fishermen and difficulty in capacity building of successors are important issues. According to results of the statistical survey on the age structure of fishery operators in 2013, male operators over 60 years of age accounted for 36.6% of all.

In the coastal areas of Ryukyu Islands and Amami Islands, fishing activities have been carried out not only by fishery operators but also by other residents. There are customs of catching or collecting fish/shellfish or seagrasses/seaweeds in shallow waters (site coral reefs) in front of villages, to serve them as daily dishes (Photo 11). Traditionally, such site coral reefs have been considered as “commons (common property)” which supply people with rich products of the sea. Although it has been very familiar to both of fishermen and residents of villages, this concept of commons has passed into history in some places in the Ryukyu Islands and Amami Islands.

In villages in the coastal area, a sand beach of coral reefs is an important space as a public square. In Yamato-son

in Amami Islands, there is a sand beach given the popular name of Shikushibama, which means “a beach where the girls’ festival is performed” and is associated with the event of Hamauri³⁷ performed on March 3 in the old calendar. On that day, the people of Yamato-son wet their feet with sea water and pray for their health during the year. Also in the Shiraho Village in Ishigaki City, Okinawa Prefecture, there was a custom of holding a Hamakudari event where a woman cleanses herself with sea water and lays coral stones to build a fence like a territory for gathering of her family (Figure 9), on March 3 in old calendar. At present, the Hamakudari in Shiraho Village is continued in a different style without constructing a fence.

In such a way, relationship between community life and coral reef ecosystems has been weakened. On the other hand, there is a tendency to retrieve the relationship. In Shiraho Village, led by the Shiraho Conservation Council for Bountiful Seas³⁸, attempts are being made by residents, including children, to restore the traditional fixed fishing gear called ishihimi (inkachi or kachi) utilizing sheltered lagoons* (ino), which were extensively used in the community. This is an ongoing initiative to pass on community lives with the sea of coral reefs to the next generation (P36). In Tokunoshima in the Amami Islands, the Ilsen town office purchased a fishing net to conduct experiential learning of tuck-net fishing in sheltered lagoons (ino), targeting children. In such a way, the town office has promoted industrialization of experiential learning of coral reef ecosystems rich in nature. Efforts including the above efforts for reviewing the life style with coral reef ecosystems from the standpoint of people living in modern society may be extremely important for conservation of coral reef ecosystems, which should be carried out mainly by regional residents. By implementing these efforts, residents’ pride will be restored.

As described on page x, the distribution of reef-building coral has actually changed according to the rising of seawater temperatures. Based on the current situation and expectations for the future, a local society should consider how to take measures against changes in ecosystems due to the increase of coral communities in high-latitude coral community regions.

*Sheltered lagoons are called inoh in the Ryukyu Islands and ino in the Amami Islands.

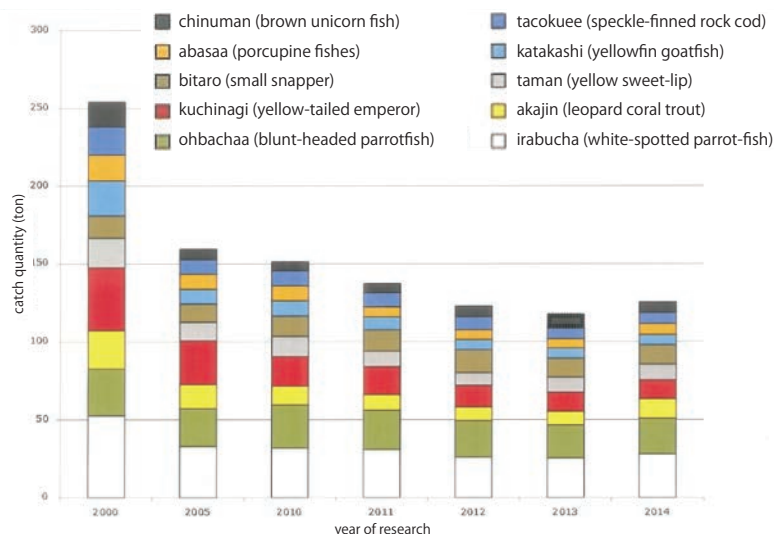


Figure 8. Changes in catches (tons) of each of the top ten species of coastal fish in Yaeyama district (Source: Okinawa Prefectural Fisheries Research and Extension Center, “Osakana no Hanashi (Story of Fish) 2015.12.1)



Photo 11 Most of the fish and shellfish in a market are blessings from the sea of coral reefs.



Figure 9. Hamakudari event: laying coral stones to build a fence for gathering of a family
(Source: Ishigaki Island Coastal Leisure Safety Council: Annadatta-yo Ishigaki Islands, 2015; drawn by: Rika Kasahara)

Column 2

Relationship between Geomorphological Names of Coral Reef and Fishing Activities in Yamato-son, Amami Oshima

Fishing activities mean operations to capture marine organisms. In the sea area of coral reefs, fishermen have targeted the bottom community, including bottom fishes and snails, which are closely related to the terrain of the coral reef area. This is a reason why fishermen have classified terrains into various groups and described them with unique names.

Figure 1, a schematic sketch of the terrain of a coral reef area during low tide in the spring tide shows the popular names of groups of terrains formed from coral reefs, given by fishermen in Yamato-son, Amami Oshima. Coral reef terrain in the Amami/Okinawa Islands can be roughly classified into three groups: moat, reef crests and reef outer slopes. In Yamato-son, the moat and reef crests are called ino and quisi, respectively. The outer surface of a reef crest is formed of a reef front gentle slope called nadara and a steep reef slope called suniutoushi.

Quisi (reef crest) dries up during low tide in the spring tide, and ino (moat) in quisi becomes shallow enough to enable people to capture marine organisms without a fishing boat. Ino is a place for shell gathering at low tide in the daytime in the period from early summer to early autumn, where women gather snails including spring top-shells and capture octopus ornatus (Photo 1). In winter, people bring lights for gathering shells in the nighttime. This type of fishing is called Yuuisho (described as “seashore pleasure” in Amami Seikatsu-shi (Lifestyle Magazine in Amami), Yoshimori Ebara, 1973) and is still being continued even now, being performed by women in seaside communities. At a beach called a pija, with large scattered rocks scattered, snails lurking in the rocks, including sheep’s ear shell (a species of abalone), are targeted by shell-gatherers (Photo 2). A notch between quisi (reef crests) is called kuchi, and important as a gateway for fishing boats.

In the area outside quisi, affluent with marine resources like big-sized snails including trochus shell, green turban, etc. and

fishes including white-spotted parrot-fish, sea bass, damsel fish, golden-banded fusilier, etc., is a fishing ground mainly managed by male fishers. Spring lobsters inhabit a sandy couloir called wari or muzuu, and fishers catch them with a net after the opening of the fishing season (usually at the end of August). On the bottom of a bag-shaped basin called katama configured on a reef front slope, flat rocks are aligned side by side. Due to fishes like yellow-tailed emperor and octopus cyanae feeding on crustacean living under the rocks, katama is an important fishing ground in spite of being empty of corals.

Figure 1 shows terrain names (common nouns) and place names (proper nouns). Place names such as matsu / gatama, fuu / guchi, and naga / hija are given by fishermen to indicate each fishing ground by using its terrain name as a word base. These place names, which were used as the knowledge of a fishing ground (comprising a part of coral reef fishing culture), have become less popular these days due to the weakened relationship between coral reefs and residents in the coral reef sea area. Meanwhile, an attempt to record and pass down place names peculiar to the district has been advanced by people who regret the disappearance of these names. For example, an NPO in Yamato-son, which has made efforts to conserve a diversified natural environment and traditional culture in the Amami Oshima, records regional terrain names and place names related to fishing grounds, as well as knowledge on fishes and fishing operations, and uses them for execution of its business. Moreover, terrain names and place names related to coral reefs and the coral reef sea are described in local community magazines including town and areal journals, not only in Yamato-son but also in the Amami Islands.

(Ken Toguchi, Faculty of Law and Letters, University of the Ryukyus)

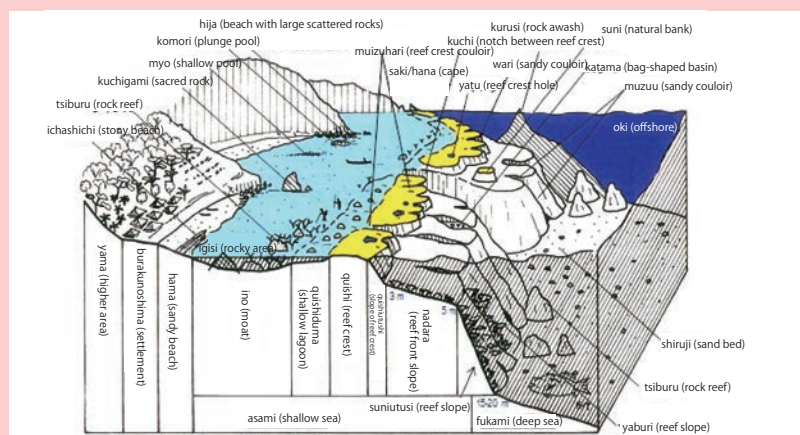


Figure 1. Terrain of coral reef area and place names in Yamato-son, Amami Oshima (drawn by Toguchi, 2001)



Photo 1 Woman capturing octopus (Yamato-son, Amami Oshima)



Photo 2 Sheep's ear shell and Japanese grata limpet gathered in the seaside area (Yamato-son, Amami Oshima)



6 Ideal Visions to Be Realized in Fiscal Year 2020

The Action Plan to Conserve Coral Reef Ecosystems 2016-2020 lays out a goal to establish the basis for the conservation of coral reef ecosystems connected to local communities by the end of Fiscal Year 2020. Toward the realization of this goal, the following situations are targeted in each priority issue.

Promotion of Measures against Runoff of Red Soil Sediments and Nutrient Salts from the land

Measures to reduce the impact from the land will be implemented on a trial basis in several regions through cooperation and collaboration of bodies concerned, and lessons from the measures will be compiled and provided to other areas so that they can put it to practical use.

Promotion of Sustainable Tourism in Coral Reef Ecosystems

Model cases of sustainable tourism in coral reef ecosystems will be created and a framework to share the knowhow pertinent to appropriate utilization methods and conservation of coral reef ecosystems will be established on the basis of such model cases. At the same time, a multilingual tool effective for raising public awareness of foreign tourists to deepen their understanding of conservation will be developed and provided to them with an eye on a future increase of tourists from abroad.

Establishment of Relationships between Community Life and Coral Reef Ecosystems

When ecosystem services from coral reef are organized by each region, understood by local people and appropriately utilized, conservation of coral reef ecosystems will be promoted by local communities.

With regard to the high-latitude coral communities, sharing of information on utilization methods of ecosystem services will be promoted.

For the purpose of achieving the goal, it is important that actions corresponding to the three priority issues which are correlated with each other on a reciprocal basis be integrally implemented in each region while conforming to the actual circumstances thereof (Fig 10).

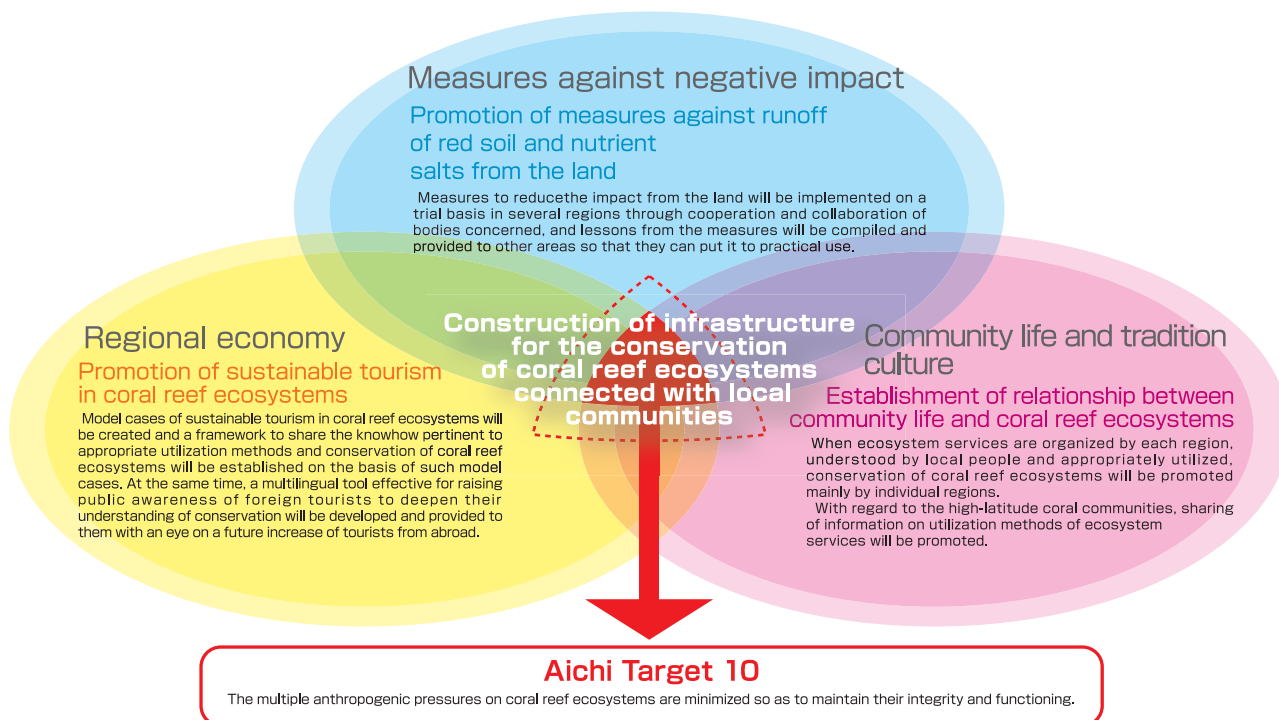


Figure 10. Ideal visions to be realized in Fiscal Year 2020
Construction of the infrastructure for conservation of the coral reef ecosystem connected to local communities, advocated as the objective of this Action Plan, will be realized through integrative implementation of frameworks corresponding to the three priority issues which are correlated with each other on a reciprocal basis. By extension, this will contribute to achievement of Aichi Target 10.

Column 3

Taketomi-cho Basic Plan on Ocean Policy

Taketomi-cho, Okinawa Prefecture is an archipelagic autonomous body composed of 16 islands; nine inhabited islands and seven uninhabited islands. As it is composed of multiple islands, its culture and nature are rich in diversity. For instance, in terms of a cultural aspect, a variety of festivals designated as important intangible folk cultural assets have been performed in islands. Further, rich and diverse nature areas such as Sekisei Lagoon (Photo 1), which is the largest coral marine area in Japan, and mangrove forest (Photo 2), and a subtropical forest ecosystem where Iriomote wild cats inhabit is designated as a special natural monument, have been formed.

Thus, while there is diverse and rich nature, there also exist regional issues in Taketomi-cho. For example, it is hard to improve transportation networks and medical environments and it takes relatively high physical distribution costs due to the location characteristics of this archipelagic region. In addition, since coral reefs, mangrove forest, and subtropical forest ecosystems are susceptible to manmade impacts, it can be said that conservation is particularly significant.

With such a background, the Taketomi-cho Basic Plan on Ocean Policy was formulated by a local government for the first time in Japan in March 2011 with the aim of building a safe and secure local community that can coexist with oceans and contributing to forming a marine nation in a positive manner.

The Basic Plan specifies 23 items of measures and policies to be executed for achieving the goal of protection of nature and culture supported by the marine environment, and the creation of safe and secure local communities. In addition, the Plan defines measures and systems to be created and executed by the local communities and the residents by themselves, and requirements to the government and Okinawa Prefecture to realize the items.

The specific items mentioned above include such measures as rulemaking for ecotourism such as restrictions on the number of visitors to the inside of region and the routes they may use, and construction of a recycling system of methane gas generated when composting livestock excrement. Proposals and requirements to the government and Okinawa Prefecture incorporated in it are as follows: (i) improvement of marine-environment considering the type of seashore protection facilities, (ii) establishment of marine protective zones acceptable to Taketomi-cho which limit conduct and utilization that may invite destruction of the natural environment, though a certain utilization inevitable for residents may be permitted, and (iii) measures against runoff of the land soil involving the construction of windbreak forest and scenery green belt zones and construction of sediment ponds.

(Planning & Financial Division, Taketomi-cho)

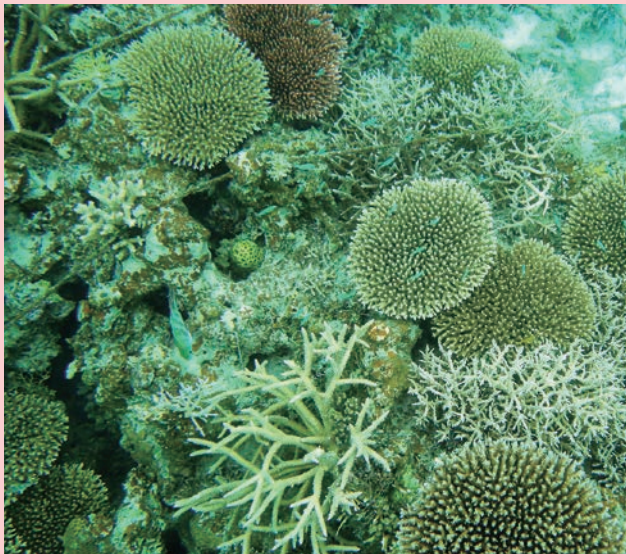


Photo 1: Coral reef in Sekisei Lagoon



Photo 2: Mangrove forest along the Urauchi River, Iriomote Island, Taketomi-cho (Provided by Planning & Financial Division, Taketomi-cho)



Matters to Be Implemented by Stakeholders Aiming at Realization of Ideal Visions

Concerning three priority issues, stakeholders proposed the following actions which they consider feasible at the present time. It is expected that measures to address the main challenges are promoted under the actions proposed by stakeholders in cooperation among people engaged in the local economic activities, including agriculture, forestry, fisheries, tourism and other relevant businesses of private companies, and members of committees, industry groups, schools and public community centers, research groups and academic societies, NGOs and media groups, as well as local residents and tourists.

7-1 Action to Promote Measures against Runoff of Red Soil and Nutrient Salts from the Land

Basic Actions

Promotion of sharing of information relating to measures

- ▶ MOE will hold a workshop once a year in principle, in an area having coral communities, in cooperation with related prefectural governments. This workshop will be held aiming at sharing of information on successful case studies and issues among related ministries and government offices, and local governments. (MOE)
- ▶ MOE will implement model projects for configuration of a promotion system of conservation of coral reef ecosystems, issues which should be addressed mainly by local communities for being used as reference when promoting measures in each region, in one or more places. (MOE)

Outreach and awareness-raising program

- ▶ The Japanese Coral Reef Society will hold a symposium on prevention measures against impacts from the land for contributing to conservation of coral reef ecosystems, publish books and academic journals, and operate websites, aiming at outreach and awareness raising of coral reef conservation. (The Japanese Coral Reef Society)

Capacity building program

- ▶ The Japanese Coral Reef Society will promote human resource development for contributing to reduction of impacts from the land on coral reef ecosystems, through a series of lectures given by researchers belonging to the Japanese Coral Reef Society, who explain details of current status and issues, and giving of awards for coral reef conservation activities (The Japanese Coral Reef Society)

Actions for prevention of soil runoff

Comprehensive measures

Nature restoration project

- ▶ For implementing nature restoration project in areas in Okinawa, Kochi and Tokushima Prefectures where coral reefs and coral communities are distributed, information on measures against impacts on coral reefs and communities due to the land, including measures against red soil runoff and those against point sources that contribute to sediment runoff, will be shared, and cooperation among stakeholders will be strengthened. (MOE)

The Basic Plan for Prevention of Red Soil Runoff in Okinawa Prefecture

- ▶ In the Basic Plan for Prevention of Red Soil Erosion in Okinawa Prefecture formulated in September 2013, the aim is that the amount of sediment of red soil in the targeted marine area will be reduced to 55% by Fiscal Year 2021 compared with 2011. To achieve this aim, the Okinawa Prefectural Government will take comprehensive measures. (Okinawa Prefectural Government)

Marine area monitoring project for prevention of red soil runoff

- ▶ To verify whether measures implemented for achieving environmental conservation goals formulated in the Basic Plan for Prevention of Red Soil Runoff in Okinawa Prefecture^{※1} have had an effect on a decrease in amount of sediment of red soil in the targeted marine area, the Okinawa Prefectural Government will determine the status of sediment through monitoring it throughout the year, for collecting data. (Okinawa Prefectural Government)

Red soil runoff prevention activities support project

- ▶ For achieving the goal established in the Basic Plan for Prevention of Red Soil Erosion in Okinawa Prefecture, the prefectural government will subsidize bodies taking part in activities thereof, and will make efforts to educate residents in the region where the red soil erosion prevention measures are taken, about environmental preservation. (Okinawa Prefectural Government)

Measures against red soil runoff caused by land development

Prevention measures of red soil runoff from the site of land development

- ▶ According to How to Take Measures for Prevention Red Soil Runoff^{※2} (Preventive Measures for Red Soil Runoff and Implementation Procedures by the Oshima Branch Office), the Kagoshima Prefectural Government will promote measures to prevent red soil runoff from the site of land development, including construction of temporary sediment ponds (using sandbags), fences for prevention of water pollution, bamboo fences and others in development sites executed by development business operators. (Kagoshima Prefectural Government)

Prevention measures of red soil runoff caused by land development

- ▶ To promote prevention measures against red soil runoff caused by land development, the Okinawa Prefectural Government will confirm the notification on development activities based on the Red Soil Erosion Prevention Ordinance by Okinawa Prefecture, and will execute monitoring/supervising of sites of land development. Also, it will conduct dissemination and awareness-raising activities for development business operators. (Okinawa Prefectural Government)

Measures against red soil runoff from agricultural land

Water quality conservation project

Water quality conservation project

▶ Aiming at purifying of water discharged from agricultural land and contributing to conservation for water resources such as the sea, MAFF will subsidize to take measures for utilization of natural cleansing capabilities of agricultural land (fallow fields) and water creatures, and construct water purifying waterways including contact oxidation channels³³ and aeration facilities³⁴. (MAFF)

Construction of prevention facilities of runoff of cultivated soil

▶ In Okinawa Prefecture and the Amami Islands, having widely distributed erodible soil, MAFF will subsidize to construct curtain drains³⁵ and sediment ponds³⁶, and carry out gradient control, slope protection, soil layer improvement, construction of underdrainage³⁷ and slight changes of existing facilities. (MAFF, Kagoshima Prefectural Government and Okinawa Prefectural Government)

Multifunctional payment (payment for activities to enhance multi-functionality)

▶ MAFF and Okinawa Prefectural Government will support community joint activities aiming at favorable conservation of rural environments and qualitative improvement of local resources including slight repair of water channels and agricultural roads and preservation of natural scenic beauty by raising of trees and plants conducted by organizations sustained by local residents, and activities for life elongation of facilities. Especially, for prevention of runoff of cultivated soil, they will construct greenbelts. (MAFF and Okinawa Prefecture)

Agriculture activation support project considering conservation of the natural environment of Okinawa

▶ Aiming at independent and sustainable promotion of measures for prevention of red soil runoff in each region, the Okinawa Prefectural Government will make efforts for development of agricultural environmental coordinators who are in charge of outreach of prevention measures of red soil runoff, structuring of support organizations and establishment of techniques for securing funds and manpower required for implementing the prevention measures. (Okinawa Prefectural Government)

Others

Vegetation restoration project in the Muko-jima Group and the Chichi Islands in Ogasawara National Park

▶ Tokyo Prefectural Government will implement sediment runoff minimization measures in Nakodo-jima Island, where feral goats have been completely removed, to control red soil runoff from upland areas, where feral goats have excessively grazed, to marine area, using subsidies for the Ogasawara Islands Promotion and Development Plan³⁸. Also, it will promote removal of feral goats from Chichi-jima Island, which is only island where feral goats are still living. (Tokyo Prefectural Government)

Actions for prevention of nutrient salts runoff

Measures based on regulation of effluent discharged from factories or workplaces

Conservation of environmental water quality

▶ Each prefectural government will designate important areas for domestic wastewater measures as required among those neighboring urban areas and densely populated areas having difficulty in meeting the environmental standards, and will enhance cities, towns and villages nearby the designated water areas to implement domestic wastewater measures, for conserving water quality in public water areas. (Prefectural Governments)

Monitoring and guidance of factories or workplaces concerned with water quality

▶ Each prefectural government will execute on-site inspections in specified workplaces based on the Water Pollution Control Act and give guidance so that standards on effluent discharged from workplaces to public water areas are satisfied. In such a way, the government will make efforts to achieve environmental standards in public water areas. (Prefectural Governments)

Regulation of effluent based on the Water Pollution Control Act

Regulation of effluent containing nitrogen and phosphorus

▶ MOE regulates the total nitrogen and total phosphorus contained in effluent flowing into eighty-eight enclosed coastal sea areas in Japan including the marine areas of Kinwan in Ryukyu Islands and Yakiuchi-wan in Amami Oshima, which are major coral reef regions with high possibility of eutrophication due to their closed nature. (MOE)

Review of tentative standards of effluent flowing into enclosed coastal sea areas

▶ Targeting specified business types including those of livestock farming which have had difficulty in achieving general effluent standards, five-year tentative standards were established on effluent flowing into enclosed coastal sea areas in Japan. At present, such tentative standards for nitrogen content are intended for five business types and standards for phosphorus content for one workplace. MOE will review the tentative standards which will expire in 2018. (MOE)

Effluent measures for livestock farming

Okinawa model project of effluent measures for livestock farming

▶ To promote livestock farming sustainably and meet the enforced standard of effluent due to livestock farming, the Okinawa Prefectural Government has examined technology of effluent treatment and those for utilization of liquid fertilizer, for formulating guidelines for effluent measures for livestock farming and preparing technical manuals of effluent treatment. The government will structure the leadership system corresponding to the enforced standard of effluent, to train, use and manage professional engineers utilizing the above mentioned guidelines and technical manuals. (Okinawa Prefectural Government)

Pilot project for production of sawdust for livestock farming utilizing unused resources

▶ In Okinawa Prefecture, hog raising using sawdust as bedding has been promoted. Sawdust is effective for reducing environmental impacts due to livestock farming because it absorbs odor and livestock excreta and controls discharge of effluent, but the problem of unstable supply remains. Thus, Okinawa Prefectural Government will try to utilize unused wood-based resources such as pruned branches expected as materials for production of sawdust. (Okinawa Prefectural Government)

Reference 2 Projects to Support Measures against Red Soil Runoff from Agricultural Land

● Agriculture activation support project considering conservation of natural environment of Okinawa

(The Japanese Government offers Okinawa Prefecture a subsidy of 80% or less of expenses of work subject to subsidies using a special subsidy for promotion of Okinawa.)

In order to conserve the water environment by reducing runoff of red soil, the Okinawa Prefectural Government aims to promote independent and sustainable measures for prevention of red soil runoff in each region. The government makes efforts for development of agricultural environmental coordinators who are in charge of outreach of prevention measures of red soil runoff, structuring of support organizations and establishment of techniques for securing funds and manpower required for implementing the prevention measures.

Contact: Agricultural Support Division, Department of Agriculture, Forestry and Fisheries, Okinawa Prefectural Government

● Red soil runoff prevention activities support project

(The Japanese Government offers Okinawa Prefecture a subsidy of 80% or less of expenses of work subject to subsidies using a special subsidy for promotion of Okinawa.)

The Okinawa Prefectural Government aims to foster an awareness of the problem of red soil runoff and promote independent and sustainable measures for prevention of red soil runoff in each region. The government will support private bodies for their activities including raising trees/plants in greenbelts and dredging of sediment ponds for prevention of red soil runoff. Environmental education related to this problem has been already provided by holding visiting lectures and outreach/awareness events.

Contact: Environmental Preservation Division, Department of Environmental Affairs, Okinawa Prefectural Government

● Multifunctional payment (payment for activities to enhance multi-functionality)

(The Japanese Government offers acting bodies through prefectural governments and municipalities a subsidy for a part of expenses used for the work subject to subsidies. The subsidy rate and its unit cost depend on the type of the program and details of activities.)

MAFF and the Okinawa Prefectural Government intend to maintain and demonstrate the multiple functions of agriculture and rural areas including conservation of natural environment, and aim to support community joint activities for promotion of appropriate management of local resources. Under this project, two types of subsidies, the Farmland maintenance payment and the Resource improvement payment are offered. The former supports community joint activities for maintaining the multiple functions of agriculture, including management activities of water channels and agricultural roads which are apt to be a burden on farmers. The latter supports joint activities for qualitative improvement of local resources, including preservation activities of natural scenic beauty and biotope by slightly repairing water channels, agricultural roads and reservoirs, and raising trees and plants.

Contact: An agricultural sector in the municipality in your area

● Water quality conservation project

(Construction of prevention facilities of runoff of cultivated soil) (The Japanese Government offers a subsidy for a part of expenses used for the work subject to subsidies. The subsidy rate: 3/4 for Okinawa Prefecture, 2/3 for the Amami Islands)

MAFF aims to prevent environmental damages including loss of cultivated soil and marine pollution in Okinawa Prefecture and the Amami Islands, by controlling red soil runoff from agricultural land and its peripheral area. Specifically, it has implemented construction work on curtain drains leading water from agricultural land or its hinterland, drainage facilities and sediment ponds, and conducted prevention work on sediment runoff from the land by protecting slopes, raising trees and plants, and modifying gradients.

● Project concerning improvement of measures for vitalization of rural areas

(The Japanese Government offers a subsidy for a part of expenses used for the work subject to subsidies. The subsidy rate and its unit cost depend on the type of the program and details of activities.)

The aim is to offer support for construction or improvement of facilities required to realize the vitalization program formulated based on the Act on Promotion of Settlement and Interregional Exchange for Vitalizing Rural Areas (Act No.48 of 2007). This vitalization program is mapped out with consideration to the situation of each municipality, through consensus building among residents. Matters to be executed are improvement of infrastructure, including construction of agricultural drainage systems and land replotting, improvement of production facilities like raising seedling facilities and machinery for transportation of agricultural, forest and fishery products, improvement of living environmental facilities including provision of simple water feed/drainage systems and disaster prevention and safety securing systems, and development of bases for inter-area exchange including construction of comprehensive inter-area exchange promotion facilities for urban areas and rural areas.

Treatment of domestic effluent

Rural sewerage treatment project

▶ In correspondence with the deterioration of the growing environment of aquatic animals and plants due to domestic effluent, MAFF will make efforts to reduce the water pollution impact from the land, by improving sewerage water treatment system in rural area. (MAFF)

Improvement of dissemination rate of domestic wastewater treatment system

▶ The Wakayama Prefectural Government will enhance development of sewage systems and johkaso by implementing the subsidy systems for municipalities (for promoting conversion of lavatories into flush toilets, and for promoting or developing sewerage projects) and executing the johkaso installation and improvement project. (Wakayama Prefectural Government)

Chura water plan through waste water recycling in Okinawa^{**9}

▶ The Okinawa Prefectural Government will promote development of sewage systems, johkaso and agricultural drainage systems aiming at maintenance/improvement of residents' living environment and water quality conservation of public water areas, based on the Chura water plan, which was formulated as a guideline to carry out the improvement of various wastewater treatment facilities systematically and effectively through cooperation between the Okinawa Prefectural Government and municipalities in the prefecture. To formulate the plan, the target area for wastewater treatment, improvement methods and schedule for the improvement were discussed among them. (Okinawa Prefectural Government)

Improvement of combined sewage system

▶ MLIT will promote implementation of systematic and effective improvement measures for combined sewage systems^{**10}. (Ministry of Land, Infrastructure, Transportation and Tourism (MLIT))

Implementation of various wastewater treatment measures including those for night soil and domestic effluent based on the sewage system

▶ To promote development of the wastewater treatment system effectively, based on changing social circumstances including population decline, MLIT will develop the sewage systems required in each region, consisting of sewers, agricultural drainage facilities and johkaso for appropriate sharing of the role of wastewater treatment, considering characteristics of each region. (MLIT)

Johkaso improvement project

▶ Based on the Waste Treatment Facility Development Plan^{**11} (May 31, 2013, Cabinet Decision) provided in the Waste Management and Public Cleansing Act, MOE will enhance appropriate treatment of night soil and domestic effluent using johkaso by providing grants for establishing a sound material-cycle society, aiming to obtain a specific ratio (12%) in the dissemination rate of domestic wastewater treatment systems (the rate of people covered with the johkaso treatment system to the total population) by Fiscal Year 2017. (MOE)

7-2 Action to Promote Sustainable Tourism in Coral Reef Ecosystems

Promotion of sharing of information relating to measures

▶ MOE will hold a workshop once a year in principle, in an area having coral communities, in cooperation with related prefectural governments. This workshop will be held aiming at sharing of information on successful case studies and issues among related ministries and government offices, and local government offices. (MOE)
▶ MOE will implement model projects for configuration of a promotion system of conservation of coral reef ecosystems, issues which should be addressed mainly by local communities, for being used as reference when promoting measures in each region, in one or more places. (MOE)

Outreach and awareness program

▶ The Japanese Coral Reef Society will hold a symposium on sustainable use of coral reef ecosystems for tourism, publish books and academic journals, and operate websites, aiming at outreach and awareness raising of coral reef conservation. (The Japanese Coral Reef Society)
▶ The Wakayama Prefectural Government will make efforts to give people lessons on coral reef ecosystems in Kushimoto Marine Part Area in Yoshino-Kumano National Park, a wetland registered under the Ramsar Convention^{**12}, to raise their awareness and deepen understanding on conservation of natural environments. Specifically, a snorkeling course will be established for giving them such lessons. (Wakayama Prefectural Government)

Capacity building program

▶ The Japanese Coral Reef Society will promote human resource development in the tourism industry for contributing to conservation of coral reef ecosystems, through a series of lectures given by researchers belonging to The Japanese Coral Reef Society, who will explain details of the current status and challenges, and giving of awards for coral reef conservation activities. (The Japanese Coral Reef Society)

Promotion of tourism contributing to conservation of coral reef ecosystems

▶ The Okinawa Prefectural Government will enhance efforts for outreach and awareness raising of conservation of coral reef ecosystems through a tourism and leisure program purposing conservation of coral reef ecosystems, targeting tourism and leisure enterprises and various groups including local residents, which are expected to be closely involved in conservation of coral reef ecosystems. (Okinawa Prefectural Government)

Promotion of environmental conservation type of nature experience activities

▶ The Okinawa Prefectural Government will enhance efforts for conclusion of the Agreement of Conservation and Utilization (rules voluntarily implemented and concluded by stakeholders engaged in environmental conservation type of nature experience activities in order to conserve the locations where such activities are carried out). (Okinawa Prefectural Government)

Promotion of ecotourism in coral reef ecosystems

▶ MOE will support activities of the regional ecotourism in national parks including Kerama Shoto National Park, through development of attractive eco tour programs and capacity building of guides for eco tour, for the purpose of promotion of regional vitalization using natural resources for tourism. (MOE)

Column 4

Use of Recycled Water as Agricultural Water for Contributing to Environmental Conservation of Coral Reef Islands

In Japan, almost all wastewater is discharged after being treated in a wastewater treatment plant so that organic substances contained in the wastewater are removed to some extent. From a global viewpoint, however, there are many regions with serious worries about water shortages, like Singapore. In such regions, highly advanced water treatment technology applying the membrane process for water filtration is used, for raising the purity of treated water and reusing it as drinking water. This advanced technology has been applied in the International Space Station.

Water resources are also scarce in Okinawa Prefecture, which consists of coral reef islands. On the main island of Okinawa, dams were constructed in the northern wooded district for maintaining people's lives. In the southern district, resources of agricultural water depend on underground dams where groundwater shielding walls are constructed in the earth. The situation of water supply is the same in the isolated islands of Okinawa, and the problem of water shortages in those islands will become more serious according to the growth of the tourism industry in the future. On the other hand, excessive construction of dams causing damage to natural resources, which are precious for growth of the tourism industry as a key industry in Okinawa, must be avoided.

Discharged wastewater contains nutrient salts even after treatment, and induces eutrophication in the coastal sea areas. Its impact on coral reef ecosystems is so significant that it cannot be ignored. In this viewpoint, use of treated water as recycled water will greatly contribute to conservation of coral reef islands and local vitalization, because it may minimize the need for water resource development.

In Okinawa Prefecture, a pilot plant (Photo 1) was introduced in the Itoman City Sewage Treatment Center by a joint research system organized mainly by Kyoto University. At present, the Nanbu Agricultural Civil Engineering Office in Okinawa Prefectural Government is examining use of recycled water for agriculture for applying an Okinawa type water circulation system (Figure 1). In this system, recycled water is sterilized in

the water treatment plant, but nutrient salts are not removed from the water. Therefore, nutrient salts contained in the treated water may be effective as fertilizer when the water is used for agriculture, and moreover, the amount of fertilizer purchased from outside areas of Okinawa may be reduced. This system, involving complex recycling technology enabling high order use of both of water and nutrient salts, may become an internationally advanced example of agriculture of the environmental conservation type.

Even though utilization of recycled water has been established from the technical viewpoint, a problem of cost required for construction and operation of the system remains when realizing it. It will be indispensable for promotion of this system to recognize the possibility that use of recycled water for agriculture contributes to conservation of coral reefs and increase of brand power in each industry in Okinawa Prefecture. (Yoshikatsu Nakano, Tropical Biosphere Research Center, University of Ryukyus)



Photo 1 Pilot plant introduced in Itoman City Sewage Treatment Center (Photo credit: Yoshikatsu Nakano)

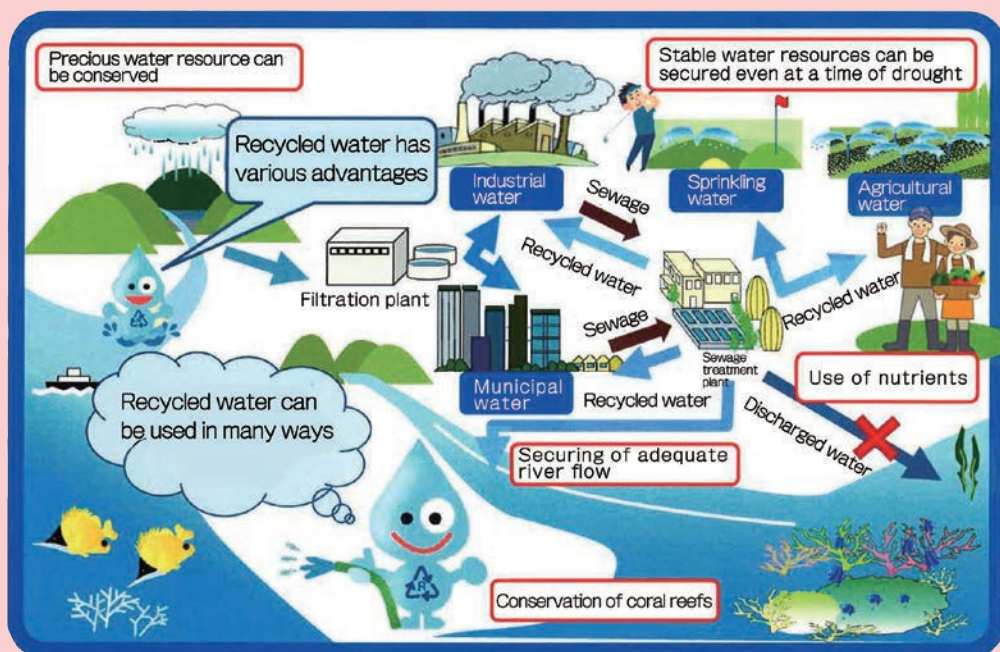


Figure 1. Recycled water: for realizing Okinawa type water circulation system (Illustration by Nanbu Agricultural Civil Engineering Office in Okinawa Prefectural Government)

7-3 Action to Establish Relationship between Community Life and Coral Reef Ecosystems

Basic actions

Promotion of sharing of information relating to measures

- ▶ MOE will hold a workshop once a year in principle, in an area having coral communities, in cooperation with related prefectural governments. This workshop will be held aiming at sharing of information on successful case studies and issues among related ministries and government offices, and local governments. (MOE)
- ▶ MOE will implement model projects for configuration of a promotion system of conservation of coral reef ecosystems, issues which should be addressed mainly by local communities, for being used as reference when promoting measures in each region, in one or more places. (MOE)

Outreach and awareness-raising program

- ▶ The Japanese Coral Reef Society will hold symposiums for discussing the importance of conservation of coral reef ecosystems from the viewpoints of the regional community and economy, publish books and academic journals, and operate websites, aiming at outreach and awareness raising for coral reef conservation. (The Japanese Coral Reef Society)

Capacity building program

- ▶ The Japanese Coral Reef Society will promote human resource development for contributing to the establishment of relationships between regional livelihood and coral reef ecosystems, through a series of lectures given by researchers belonging to the Japanese Coral Reef Society, who explain details of current status and challenges, and the giving of awards for coral reef conservation activities. (The Japanese Coral Reef Society)

Actions for establishment of relationship

Sustainable use of ecosystem services

Promotion project for integrated use of the service in the Okinawa coastal zone

- ▶ The Okinawa Prefectural Government intends to recover and sustainably use coastal aquatic resources which have significantly decreased. The government will collect and analyze data on actual conditions of fish catches, trends of resources/ecosystems and environments of coastal zones and land areas, for examining methods of integrated management and utilization of marine products and environments of the coastal zone. (Okinawa Prefectural Government)

Basic plan for conservation of the coastal zone in the Ryukyu Islands

- ▶ In the coastal zone in the Ryukyu Islands, a religious event named Hamakudari has been held, and octopus/cuttlefish hunting named Izari has been performed as recreational fishing, for a very long time. In such a zone, however, structures including an upright breakwater may reduce accessibility to the coast. Therefore, the Okinawa Prefectural Government will promote improvement of coastal conservation facilities in consideration of convenience for local residents and visitors. (Okinawa Prefectural Government)

Basic plan for conservation of the coastal zone in the Satsunan Islands

- ▶ The Kagoshima Prefectural Government will enhance measures for promotion of appropriate use of the coastal zone for the public benefit, taking existing projects into consideration. Projects have been implemented for enabling people to obtain pleasure from the coral reef sea in the nature-rich Amami Gunto Quasi-National Park and hand local marine history down to posterity. (Kagoshima Prefectural Government)

Promotion of satoumi creation

- ▶ To support creation of satoumi, where various fish/shellfish live and people can enjoy significant benefits from them now and future, MOE will provide a guidebook for satoumi creation prepared in Fiscal Year 2010, and data on cases where satoumi were created in Japan, via the Satoumi-net^{※13}. At the same time, MOE will collect and compile data on nationwide activities of satoumi creation, especially those related to seagrass beds, tidal flats and coral reefs attracting attention from the viewpoint of "the rich sea." Information on roles of such activities will also be provided. (MOE)

Coral communities conservation activities support project

- ▶ The council for conservation of coral communities in Nichinan Kaigan has undertaken outreach activities, including holding of events for awareness raising of prefectural residents on the importance of conservation of coral reefs and biological diversity, and provision of environmental education for local residents. The Miyazaki Prefectural Government will support the council to implement such activities. (Miyazaki Prefectural Government)

Actions for succession of relationship

Project for child-nature friendship in Iriomote-Ishigaki National Park

- ▶ MOE will implement environmental conservation programs including child-nature friendship activities for urging children who are attending elementary schools located in Iriomote-Ishigaki National Park to learn about coral reefs. MOE aims to enhance children's understanding of rich natural environments and raise their awareness on conservation of coral reef ecosystems, through these programs. In such a way, MOE will support development of the future generations of children who are expected to make efforts actively to conserve the natural environment of the national park. (MOE)

Support for coral reef conservation measures taken mainly by each community

Project for demonstration of the multi-functions of the fishing industry and fishing communities^{※14}

- ▶ MAFF will support regional activities including those for conservation of coral reefs, that contribute to demonstrate the multiple functions of fisheries and fishing villages. (MAFF)

Coral reef conservation activities support project

- ▶ The Okinawa Prefectural Government will support organizations which implement monitoring to verify the actual situation of coral reefs, spread coral reef conservation activities among residents in Okinawa Prefecture and raise their awareness on the activity, and take practical measures for conservation of marine areas including removal of coral-eating gastropods. (Okinawa Prefectural Government)

Frameworks other than the above, which are expected to contribute to conservation and sustainable use of coral reef ecosystems implemented in consideration of relationship among ecosystems, will be required. For example, those for appropriate management of ecosystems in upstream areas should be promoted. Moreover, it is hoped that people in each community deeply understand the actual conditions of coral reefs and make efforts for conservation and restoration of them based on the free thinking of individuals.



8 Follow-up and Review

It is important to periodically execute follow-up after the plan is carried out. In the Action Plan to Conserve Coral Reef Ecosystems in Japan 2016-2020, follow-ups of each framework made on each scene will be carried out centering on three priority issues (Efforts for Promotion of Measures against Runoff of Red Soil and Nutrient Salts from the Land, Promotion of Sustainable Tourism in Coral Reef Ecosystems, and Construction of Relationships between Community Life and Coral Reef Ecosystem).

Specifically, a workshop to share information on the implementation status of this Action Plan will be, in principle, held once a year, with the cooperation of related prefectures. Further, a venue for this workshop will be decided after consultation with prefectures concerned. At the same time, symposia for the general public in line

with actual conditions and needs of each region will be made public as far as possible (cohosted by the Ministry of the Environment and the prefectures concerned) to raise awareness and reinforce information sharing even further in each region.

Moreover, regarding the achievement situation of this action plan, the interim evaluation and final evaluation will be carried out around Fiscal Year 2018 and by Fiscal Year 2020, respectively.

Furthermore, this action plan will be reviewed by Fiscal Year 2020 on the basis of the above evaluations. In this occasion, we will strive to perform operations efficiently and effectively based on the trends of the related plans such as the National Biodiversity Strategy of Japan and the Basic Plan on Ocean Policy, and the situation surrounding coral reef ecosystems.

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I Case Studies of Efforts for Conservation of Coral Reef Ecosystems

I-1 Case Studies of Measures against Runoff of Red Soil Sediments and Nutrient Salts from the Land

(1) Efforts of Agricultural Environmental Coordinators in Okinawa Prefecture

Since the majority of the runoff of red soil in Okinawa Prefecture derives from farmland, The Support Program for the Motivation of the Agricultural Industry Considering the Conservation of the Natural Environment of Okinawa (hereinafter referred to as the "Support Program") has been conducted using the Subsidy for Special Promotion of Okinawa^{*1} from Fiscal Year 2012. This is to support the implementation of the sustainable prevention of red soil runoff and the development of a promotion structure in coordination with the farming activities in the region.

Based on this Support Program, agricultural environmental coordinators (hereinafter referred to as "coordinators") who advise, instruct and give demonstrations on the prevention of red soil runoff to be tackled by each region have been fostered, and assigned to Regional Committee for Prevention of Red Soil Runoff^{*2} in six municipalities of Okinawa (Ogimi-, Higashi-, Ginoza Villages, Itoman City, Kumejima-cho, Ishigaki City). The Coordinators are promoting the measures for the source such as, installing greenbelts^{*3} (Photo 1) and prevention boards, seeding green manure, mulching^{*4} vegetables grown outdoor and pine fields, and building the structure to carry out the measures through one-to-one consultations with the farmers in the region, and coordinating with NPOs and farmers, mainly for the focused monitoring

regions^{*5} that were instituted in the Basic Plan for Prevention of Red Soil Erosion in Okinawa Prefecture established in FY2013.

In order to promote these efforts, the coordinators are implementing detailed actions that are in line with the actual state of affairs of each farmland, such as building a system for planting greenbelts that is a relatively easy and effective way, and furthermore for sugar cane fields that have a high area of red soil runoff, focused measures were implemented such as subsoil breaking^{*6} and cultivation of cover crop (green manure)^{*7} (Photo 2).

Moreover, raising awareness in the region is also promoted through courses on preventive measures for red soil runoff held at the National Liaison Council of Rural Youth Club (Photo 3), and planting greenbelts in the form of a participatory event on Soil Conservation Days^{*8} as a community event.

Through various actions such as these, we aim to realize environment conservation-oriented agriculture in Okinawa Prefecture while supporting the people in the agricultural industry and those who live in the community, so that the coral and the beautiful sea that the coral live in may be passed on to subsequent generations.

(Agricultural Support Division, Department of Agriculture, Forestry and Fisheries, Okinawa Prefecture)



Photo 1. Greenbelt planting activity
(Provided by Agricultural Support Division, Okinawa Prefecture)



Photo 2. Cultivation of cover crops (crotalaria, sunflower)
(Provided by Agricultural Support Division, Okinawa Prefecture)



Photo 3. Courses on preventive measures for red soil runoff held at the National Liaison Council of Rural Youth Club
(Provided by Agricultural Support Division, Okinawa Prefecture)



Photo 4. Planting greenbelts in the form of a participatory event
(Provided by Agricultural Support Division, Okinawa Prefecture)

(2) Measures against Runoff of Red Soil through Regional Exchanges in the Nansei Islands

There are various measures against runoff of red soil peculiarly seen in Okinawa Prefecture and the Amami Islands according to the crops grown in each island or region, farmland and landscape. On the other hand, the Nansei Islands all produce the same types of crops, ie. sugarcane, and their climate and soil are alike. Hence, the regions can share amongst one another countermeasures to tackle the runoff of red soil.

WWF Japan has been working on the Nansei Islands Project for the purpose of the conservation of coral reef ecosystems. As part of this project, we have planned an opportunity for regional exchange between Ogimi Village and Ishigaki City. These two regions share similar issues regarding the runoff of red soil.

Agricultural environmental coordinators, farmers and government officials from Ogimi Village participated in the project and visited Ishigaki City. The group listened to talks concerning efforts for coral reef conservation such as greenbelts planting by the WWF Japan Coral Reef Conservation and Reserch Center (Shiraho Coral Village)^{※9} and the people in Shiraho region, and the red soil research and tourism promotion activities for the marine area by the local NPO Natsupana (Photo 5). Furthermore, they actually visited

the farmlands and were shown examples of the greenbelt planting using Japanese musa liukiensis and shell ginger by the Chairman of Natsupana (Photo 6), were shown an embankment that was made utilizing sugarcane leaves (Photo 7), and measures to enhance the permeability of rain water in agricultural fields.

On Ishigaki Island, measures against runoff of red soil are combined with the revitalization of the regional economy such as the commercialization of shell ginger that was used as greenbelt planting (photo 8). Moreover, in Ogimi Village, outreach building and environmental education using illustrated books for farmers are active. By thus sharing details of their activities, both sides were able to gain new knowledge.

In the future, we plan to promote not only exchanges between local municipalities within Okinawa Prefecture, but connections among the Nansei Islands, including the Amami Islands. By the mutual cooperation between the conservation efforts in each region, and widespread collaboration, will lead to further promotion of the conservation of coral reef ecosystems.

(WWF Japan Nature Conservation Office)



Photo 5. Exchanges between persons concerned in Ishigaki City and Ogimi Village (Provided by WWF Japan)



Photo 6. Greenbelt planted with musa liukiensis and shell ginger (Provided by WWF Japan)



Photo 7. Embankment using sugarcane leaves (Provided by WWF Japan)



Photo 8. A room deodorant made from distilled shell ginger (Provided by WWF Japan)

(3) Watershed Partnership Initiative in U.S.A.

1998 was the International Year of the Ocean designated by the United Nations General Assembly. In addition, the United States Coral Reef Task Force was also set up the same year as a new initiative for marine environments. Initially this Task Force was comprised of 11 federal agencies. However, through the acknowledgement that it was imperative to work harmoniously with the states for the conservation of coral reefs, it now includes leaders of 12 federal agencies, seven U.S. states, territories and commonwealths (dominions). In 2009, the establishment of the Watershed Partnership Initiative was adopted in order to promote urgent preventive measures against the influx of contaminants from the land, which has become an issue in all of America, as well as issues that arise due to land improvement and coast development. For the initiative, human resources and capital were invested by federal agencies involved in the Task Force. The initiative stipulates that water catchment areas with the highest priority needs for conservation should be specified, and intensive provision of measures on targeted areas should be made. Guanica in Puerto Rico (2009), West Maui in Hawaii (2011) and Faga'al in American Samoa have so far been selected as priority sites by the initiative.

Out of these, research and analysis was carried out in the Wahikuli and Honokōwai Watersheds in the West Maui, with an emphasis on identifying the state of the use of land, and sediment and pollutant sources and types by 2012. As a result, various types of discharge from the land have been evaluated as issues which should be most

urgently addressed in this region. These include the large outflow of rain water caused by the inhibition of rain water permeation triggered by urban development (Photo 9), wastewater overflowing from malfunctioning Johkaso, and runoff of sediment and nutrient salts from agricultural land. Moreover, points and facilities were identified as the main deliverers of pollutants.

Based on this report, a regional council was set up to address these issues. Reclaimed water usage and water quality enhancement projects through collaboration between the hotel industry and the government, the prevention of sediment runoff project through the planting of native vegetation (Photo 10), and the Rain Garden Project that utilizes slopes and planting which can be implemented in households (Figure 1), were set up by the regional council. Initiatives that involve the whole community were promoted through collaboration between the regional council and the Watershed Partnership Initiative. Hereafter, how much of a difference these measures have made to the restoration of the ecosystem is expected to be verified.

Watershed Partnership Initiative are also accumulating data regarding such community initiatives and are also actively promoting data sharing.



Photo 9. When it rains, sediments and nutrient salts run off through road. (Provided by West Maui R2R)



Photo 10. In Wahikuli, West Maui in Hawaii, members of the regional council and volunteers are planting through united efforts an endemic species on the slope as a measure for preventing sediment runoff. (Provided by West Maui R2R)



Hawai'i Residential Rain Garden Manual

Figure 1. A rain garden with a structure of impounding drained rain water on a temporary basis by using the land shapes such as slopes or concave ground. (Provided by Hui o Ko'olaupoko)

I-2 Case Studies of Promotion of Sustainable Tourism

(1) Efforts regarding Tourism in Okinawa Prefecture

Since tourism is Okinawa's main industry, it is highly important to promote sustainable tourism^{※10} which maintains and improves the tourism opportunities for future generations without constituting too much of a burden to the tourism resources (Coral Reef Ecosystems) in scuba diving or snorkeling tourism.

In Okinawa Prefecture, organizations such as Onnason Coastal Total Management Council, Ecotourism Promoting Council Zamamison, Ecotourism Promoting Council Tokashikison, Miyakojima Churaumi Liaison Council, and Sekisei Lagoon Nature Restoration Committee have been established. They are creating and putting into execution usage rules (Guidelines) of Coral Reefs and Coral Reef Conservation Plans and disseminating this information (Figure 2). Individual councils are made up of members of various organizations such as government offices, commerce and industry associations, fishery cooperatives, boards of education, neighborhood community associations, diving associations, and maritime research institutes and tourism promotion associations, and are instrumental in discussing and coordinating several issues that are related to the region.

The members of the councils shared their concerns and issues and as a result, through the cooperation between the diving associations and the fishery cooperatives in the marine waters in the Kerama Islands (Zamamison and Tokashikison), Onnason and Miyakojima City) that are heavily used for diving, anchor buoys were installed. The aim is to prevent the anchoring effect from destroying the coral communities and coral reefs by the diving vessels using these buoys when anchoring in the ocean. In the marine waters of Zamamison and Tokashikison, buoys have been installed in 20 locations. In the marine areas around Maedamisaki (Onnason), which has the highest concentration of diving vessels alone, there are more than 20 buoys installed (Photo 11, Figure 3). Moreover, by limiting the number of vessels that can be simultaneously attached to the buoys, the number of diving vessels and

divers can be controlled, and can sometimes lead to reducing the adverse effect caused by the high number of users.

In contrast, the fishery cooperative and the diving association conducted a trial to prohibit in principle the usage of the marine waters of Nishibama of Akajima, Amurojima Higashi and Agenashiku-jima Nishi in Zamamison for tourism and fisheries for three years. This trial resulted in the increase in the coral coverage areas and therefore there are moves now to limit the number of people entering certain locations in the marine waters through ordinances.

There are also examples of fishery cooperative associations and diving associations allowing a diverse range of people to take part in the removal of crown-of-thorns starfish and the transplanting of coral as a part of the activities to raise public awareness apart from the direct activities for coral conservation, and posters being put up and brochures being distributed on ferries and high speed boats to disseminate manners and prohibited points regarding the usage of coral reef ecosystems before the tourists arrive on the island (Photo 12).

Moreover, the Ecotourism Promoting Council Okinawa is promoting a form of tourism with less impact on the environment by introducing tour companies that have signed the Agreement of Conservation and Utilization^{※11} with the Ecotourism Promoting Council Okinawa and their programs on the council Okinawa website.

We believe it is possible for tourism to develop as a sustainable regional industry if sustainable tourism is promoted from various perspectives as above. (Incorporated Foundation Okinawa Prefecture Environment Science Center)

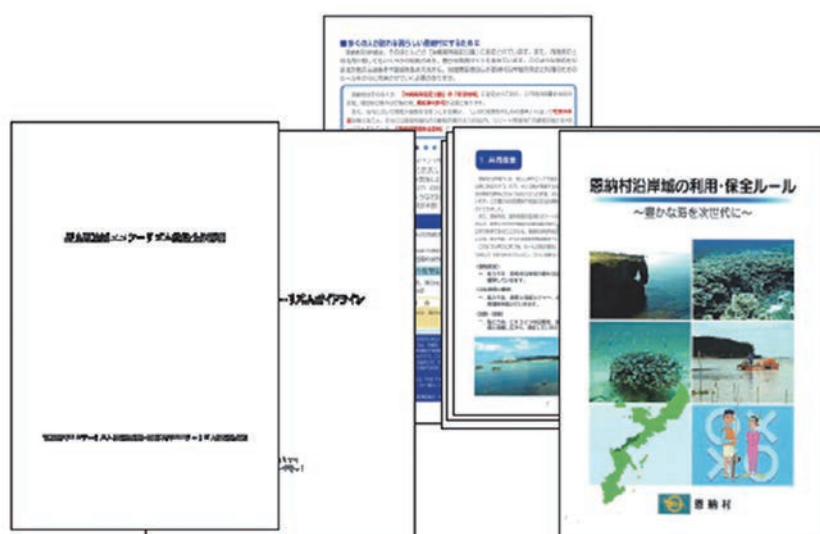


Figure 2. Zamamison and Tokashikison have created the Entire Framework for Promoting Ecotourism in the Kerama Area and the Ecotourism Guideline for the Kerama Region on the basis thereof for sustainable use of coral reefs in the Kerama Islands. Onnason developed the Rules for the Use and Conservation of the Onnason Coastal Areas.

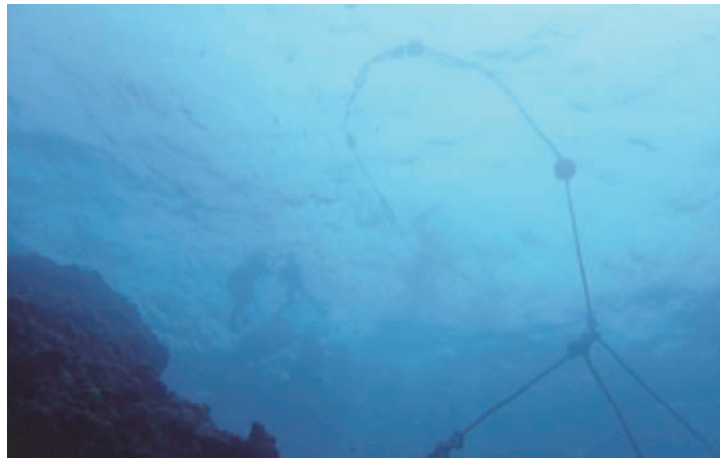


Photo 11. An Anchor buoy set up in the marine areas in Maedamisaki (Onnason)

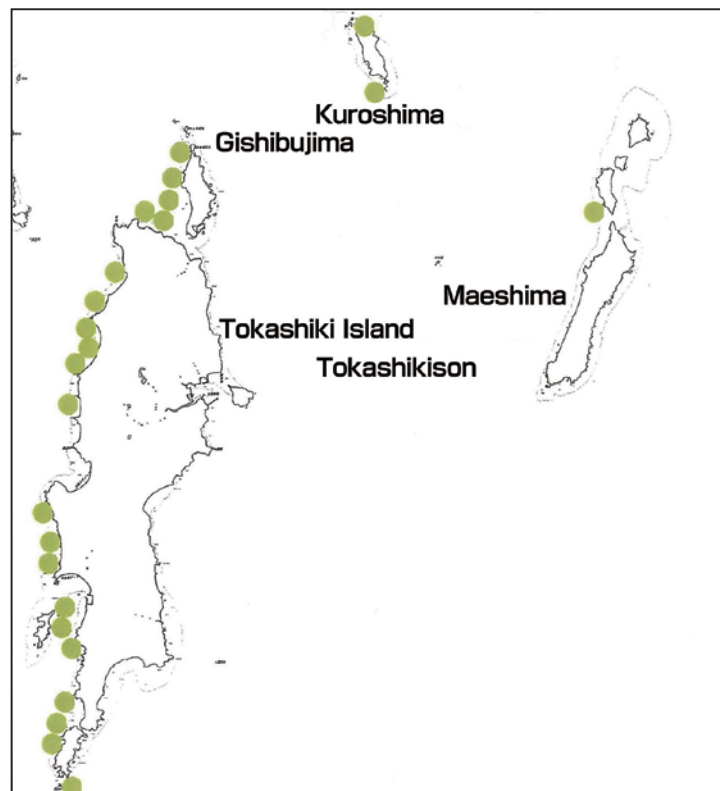


Figure 3. Installation site of an anchor buoy in marine areas around the Tokashiki Island.(Provided by Tokashiki Fisheries Cooperative Association)



Photo 12. Posters put up in a high speed boat on the Kerama Islands

(2) Overseas Efforts regarding Tourism (Green Fins)

The color and high level of biological diversity of the coral ocean is a captivating sight for people from all over the world. For this reason, the coral reefs attract many tourists each year. However, the impact on the coral reef ecosystem due to scuba diving and snorkeling is at such a high level that it cannot be ignored when considering what ideal tourism is. Therefore, efforts need to be made to develop the tourist industry in a sustainable way.

Under these circumstances, an initiative for environmental conservation called Green Fins, which can be promoted together with diving and snorkeling operators, is becoming more widespread in Southeast Asia, which is frequented by many diving tourists.

Green Fins is a network that was established in 2004 as an initiative by the United Nations Environment Programme (UNEP)^{※12} in collaboration with a British charity group called the Reef World Foundation^{※13}. The goal of the initiative is to realize sustainable tourism in coral reef zones, such as diving and snorkeling that do not damage the coral reefs, in collaboration with diving operators and divers. The operators who participate in Green Fins have to first train with Green Fins based on the Code of Conduct of Green Fins, which consists of 15 points (Photo 13). Thereafter they will be assessed once a year by a Green Fins staff as to how well they are following the Code of Conduct. After being assessed for the first time they will be certified as a Green Fins member. However, after two years if they have not improved their status in following the Code of Conduct, then their certification may be revoked. Since there is a follow up after the certification, in order to continue being certified it is essential to unceasingly improve one's adherence. Hence a system is in place so the operators can maintain and improve their motivation to participate in Green Fins. Another incentive is that the operator can

openly advertise that their center is an "environmentally friendly shop," and that the top 10 operators are publicly announced.

In order to examine the effect of the Green Fins initiative, the dive operators in Puerto Galera and Moalboal Implementation Activities, which are tourist resorts in the Philippines, had their adherence status to the Code of Conduct compared. Comparisons were made of their status at the beginning when they first joined Green Fins and the status a year after. Comparisons were assessed as one of the following 3 levels: "high-level adherence", "improvements have been made in terms of adherence but there is room for even more" and "no improvements have been made in terms of adherence, and there is a severe violation that will have a negative effect on the environment." Greater adherence means lower points. Upon assessing the operators using this scoring method and then averaging the scores of the operators out, it was found that the scores were significantly getting lower (Figure 4), which showed that Green Fins' efforts have been instrumental in reducing the burden on the environment.

The Green Fins Initiative that started in Thailand and the Philippines has spread to Indonesia, Malaysia, Maldives, and Vietnam, and the number of participants has reached over 400. If this network further spreads in the future and leads to the dissemination of initiatives and raising awareness of not only the dive operators but tourists visiting coral areas, the network is expected to contribute to the development and stabilization of the industry as a sustainable use model for coral reefs.



Photo 13. Lecture class for the Green Fins (Provided by the Reef-World Foundation)

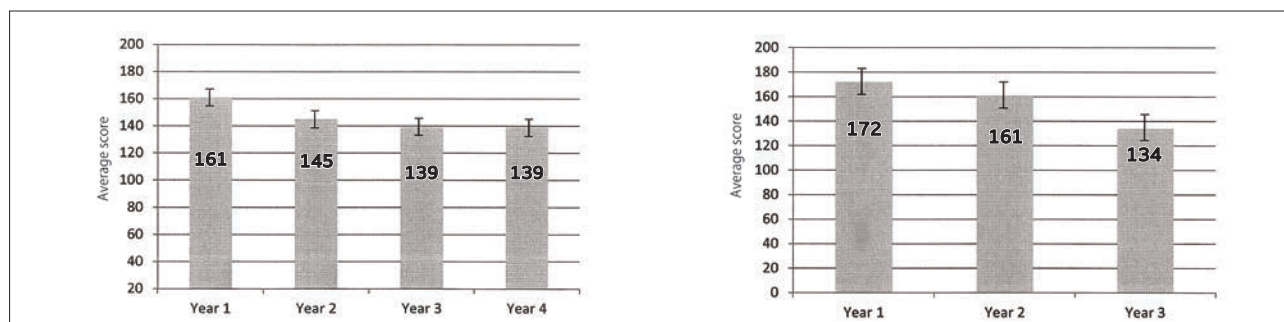


Figure 4. Adherence status to the Code of Conduct
Average scores of quantified adherence of all dive operators in Puerto Galera (left) and Moalboal (right) Implementation Activities in Philippines

I-3 Case Studies of Relationship between Community Life and Coral Reef Ecosystems

(1) Efforts of Shiraho Village

The relationship between coral and life in Shiraho Village

Although Shiraho Village on Ishigaki Island is a farming region, at low tide the people have been collecting the fruit of the sea, such as seaweed, sea shells, octopus and shrimps, in order to earn a living. (Photos 14, 15)

Even when there is a crop failure due to the effect of the climate such as drought, or during the war when working in the fields was not possible, it was possible to catch something to eat in the sea. The elderly women in Shiraho place an importance on the sea and call it the “sea

of treasure” and “the sea of life.” The love and ownership toward coral reefs has been fostered in this way, and passed down for generations within the community.

Based on such sentiments, the right of use of the sea at coral reef sites centering on moats (ino) of the community belongs to the village, so persons from other areas had to pay a fishing fee. The moat (ino) was once the sea owned collectively by the village

The coral reef sea that brings diversified products

The blessings brought about by coral reefs are not only fish and shell fish. When you walk around Shiraho Village, you can also see stonework made of coral (Photo 16). In the gardens the ground is covered with shards of coral. Coral is also used for the foundation of the pillars and the stepping stones, and the red tiles of the roofs are held together with plaster made by burning coral. Also, since the farmland soils are composed of decayed coral, agricultural crops grown there can also be classified as the product of the coral.

During the Harvest Festival (Photo 17), which is the largest Shinto festivity in the village, people dance to the music about the treasures from the coral-rich sea. So there is a strong link between the coral of the sea, the festivals and the Shinto festivities. This type of lifestyle is called the “Coral Reef Culture.”

Such a lifestyle that had close relationships with coral reefs

has been greatly affected by post-war modernization and the changes in the livelihood and lifestyles brought on by penetration of the monetary economy and the market economy. The proof of this is the disappearance of the inkachi, a traditional fixed-type of fishing tool. Inkachi is a primitive fishing tool that catches fish along with states of the tide by building square or semi-circular stone walls in the shallows of the sea. In the past, there were 16 inkachis installed in the Shiraho Village. These were fishing tools to help the people in the farming industry catch fish. However, since others who moved to the island from elsewhere began to carry out fishing as a principal occupation, and due to the increase of part time farmers and the sharp drop in the self-sufficient half-agricultural and half-fishing lifestyle, people stopped using the tool in the 1960s.

Coral Reef Conservation as a Community Building

The Shiraho Conservation Council for Bountiful Seas was set up in 2005. The aim of this council is the conservation of the natural environment and living environment, and the sustainable development of communities through collaboration among the people of the community, such as the director of the community center, the senior's club, the women's association, young men's association, the stockbreeders' association, farmers, guest house managers, tour operators that hold eco tours such as snorkeling, and fishermen. The council has restored the inkachi (Photo 18) with a view to rebuilding the disappearing relationship between the community people and the sea, in particular the relationship between the farm houses and the sea, and gives experiential learning for elementary and junior high school children. Moreover, the Shiraho Children's Club was set up as a place where the adults can give nature experience activities to local elementary and junior high school children (Photo 19) so that they can take over the involvement in nature and thoughts about nature that have been passed down in the region.

Furthermore, the Shiraho Village Yuratiku Charter^{*14} was established in 2006. The charter consists of the goal for community building and the seven articles of village building. This was due to the increasing sense of danger over the rapid change as a result of the construction of the New Ishigaki Airport and the influx of people moving in to the

area. All the residents had various feelings towards the issue, but the Shiraho Community Center acted as a hub, and the village elders were interviewed, questionnaire surveys were conducted with the residents, and round table discussions were held so that the conservation of regional resources and transmission policies that are to be passed down to the next generation can be shared. The Charter stipulates not only the conservation of coral reefs but also the development of an industry that is harmonious with the environment with coral reefs as one of the objectives.

In addition, while establishing the Charter, the Shiraho Conservation Council for Bountiful Seas has also gained recognition in the region as the bearer of coral reef conservation. At the same time, preventive measures against the runoff of red soil have been accelerated owing to the involvement of various people such as farmers in the region.

Also in Shiraho, NPO Natsupana was set up as the organization involved in the continuous efforts of community building. The NPO is promoting tourism that utilizes the various resources and human resources of Shiraho, such as the observation of coral reef ecosystems while snorkeling, experience of farming and farmhouse vacation rentals, with a view to hand on the coral reef conservation and coral reef culture.

(WWF Coral Reef Conservation and Research Center)



Photo 14. Hamauri, an event to gather the bounty of the ocean such as seashells and seaweed (Provided by WWF Japan)



Photo 15. Capturing octopus at low tide (Provided by WWF Japan)



Photo 16. Stonework made of Ryukyu limestone and coral seen in Shiraho Village (Provided by WWF Japan)



Photo 17. Harvest Festival held in a village (Provided by WWF Japan)



Photo 18. Restored inkachi (Provided by WWF Japan)



Photo 19. Activity of the Shiraho Children's Club (Provided by WWF Japan)

(2) High-latitude Coral Communities and Community Life (a) - Alveopora Japonica in Suo-Oshima -

“Coral reef in the Seto Inland Sea? The largest in Japan?”

This is what a lot of people say when they first heard about the existence of *Alveopora Japonica* in Suo-Oshima, Yamaguchi Prefecture.

Since there is a need to protect the precious ocean scenery like the largest *Alveopora Japonica* in Japan (Photo 20), the marine area off the southeast coast of Suo-Oshima was designated as the first Marine Park Zone in the Seto Inland Sea National Park with the understanding and cooperation of the fisheries in the region in February 2013. Locally, the Suo-Oshima Nihon Awasango Council was set up as a public-private partnership, with a view to conserve and maintain the rich sea and environment that is the home to *Alveopora Japonica* and to revitalize the community, and various initiatives have been implemented such as creating rules for conservation of the marine area, and planning of eco-tours that involve coral viewing (Photo 21).

However, seagrass beds richer than they are now were formed in the marine area of the past, and were full of fish. It is speculated that as a result of diminished seagrass beds and a rise in the sea temperatures, *Alveopora Japonica* has rapidly expanded its habitat. Naturally, many people say the sea should be returned to its original state that abounded with seagrass beds. However it is impossible to return the environment to its original state quickly, therefore

we believe it is essential to protect the sea inhabited by *Alveopora Japonica* and maintain it for regional promotion for the future through the use of the sea in various ways.

Three years have passed since the marine area was designated as a Marine Park Zone. Thought is now starting to be given to the designation of the land area to the rear of the Zone as a protective zone, a pending matter. The natural environment of the marine area has been negatively affected in various ways by the runoff of sediments and nutrient salts from the land. Mountains and villages should be in healthy conditions in order to conserve the marine area in a healthy state.

If we continuously monitor and watch out for the changes to the environment and living organisms in this marine area, and pass on the accumulated data to the regional schools, residents and tourists, this will enhance the region's attractiveness and contribute to the development of the region. We believe this to be our mission as an organization that is devoted to the research, conservation, use and application of the *Alveopora Japonica* of Suo-Oshima which is located in the temperate zone.

(NPO Nature & Fishing Network (NFN), stationed in Suo-Oshima, Yanai Prefectural Citizen Affairs Bureau, Yamaguchi Prefecture)



Photo 20. Japan's largest *Alveopora japonica*
(Provided by Mr. Masaaki Fujimoto)



Photo 21. Tourists of an eco tour
appreciating *Alveopora japonica* by
snorkeling
(Provided by Mr. Masaaki Fujimoto)

(3) High-latitude Coral Communities and Community Life (b) - Sennen Sango in Mugi-Oshima -

The inner bay of Mugi-Oshima, which is richly endowed in nature and is a part of the Muroto-Anan Kaigan Quasi-National Park, is home to a gigantic coral colony of *Porites lutea* which has existed from over 1000 years ago. The coral has been lovingly nicknamed the Sennen Sango (1000-year coral) (Photo 22) by the local residents. The Sennen Sango, one of the largest in the world, spreads its roots on the sea bed at a depth of 23m, with the height of about 9m, and an outer perimeter of about 30m. The exterior resembles a Christmas tree, and is considered very rare. It is a miraculous piece of natural heritage that was borne out of several coinciding favorable conditions, such as the warmer ocean temperatures being carried in by the Kuroshio Current, the low environmental destruction due to the island not undergoing development, and due to its location in an inland bay that was protected from the heavy seas.

Using this Sennen Sango as a symbol, efforts have been made to revitalize the town from 2008, spearheaded by the local citizens' group called Mugi Sennen Sango no Hakkutsutai (discovery group) (hereinafter referred to as Hakkutsutai). However, just at that point it was discovered that there have been outbreaks of crown-of-thorns starfish and coral-eating gastropods such as sea snails that feed on living coral near the Sennen Sango.

These outbreaks have had a major impact on coral reefs in the areas surrounding Mugi-Oshima, and there were fears that the coral communities including the Sennen Sango would be destroyed. Amidst these worries the Hakkutsutai embarked on the removal of coral predators, including the crown-of-thorns starfish and sea snails, from March 2009. Furthermore, in 2011, with newly selected members, the Council of Town Development

with Sennen Sango (hereinafter referred to as the Council) was established for the purpose of community revitalization utilizing the natural area surrounding the Mugi-Oshima area and of the development of successors who are responsible for the next generation.

The Council has established a supporter system to procure funds for activities, and set up a system for receiving volunteer divers from inside and outside the prefecture to remove the crown-of-thorns starfish and sea snails, and are continuously promoting conservation activities (Photo 23).

These conservation activities have steadily produced results, and the annual catch level of the crown-of-thorns starfish in Fiscal Year 2014 was 7, which was a considerable reduction from the annual catch of 1,187 when the efforts first started.

In conjunction with these activities, research was initiated on the status of the inhabitation of coral. In the area of affected coral communities, numerous young coral reefs were detected and a new sign of life was confirmed. The development of such young coral is a source of great hope in line with the conservation of the existing Sennen Sango.

Hereafter, the Council will focus on disseminating the necessity of the conservation activities of coral, conduct activities that permit people to experience the wonder of an ocean filled with coral, to inherit a rich natural environment using the Sennen Sango as a symbol, and nurture the next generation of leaders who will promote the conservation activities.

(NPO Kaifu Nature Network, Health and Welfare Department, South District Administration Bureau, Tokushima Prefectural Government)



Photo 22. Sennen Sango (1000-year coral)
(Provided by NPO Kaifu Nature Network)



Photo 23. Volunteers who are accepted by the Council of Town Development with Sennen Sango removed crown-of-thorns starfish.
(Provided by NPO Kaifu Nature Network)

II Glossary

2 Current Status of Coral Reef Ecosystems

※1 Zooxanthella

A species of dinoflagellate cohabiting with coral. Supply nutrient salts to coral by photosynthesis.

※2 Asexual Reproduction

General term for reproductive mode without relation of gamete. In asexual reproduction of coral, a polyp germinates one after another or divides to produce new polyps, and soon forms colonies in a great number of species.

※3 Polyp

Polyp is one of the basic forms of a system for cnidaria such as coral and is a morphology for an epiphytic way of life. Also a basic unit to organize coral, it is basically composed of a cylindrical body with a mouse-like form on the upper surface, and multiple tentacles surrounding thereof. There are many variations.

※4 Calcareous Algae

General term for algae whose body surface is deposited with calcium carbonate. The coralline algae found in large numbers from the Temperate Zone to the Torrid Zone sometimes become engaged in the formation of coral reefs.

※5 Foraminifer

A protist having shells with various morphologies and pseudopolium. Inhabits every marine environment from blackish water to the deep sea floor, and from the polar areas to the tropics.

※6 Nutrient Salts

Salts containing elements such as nitrogen, phosphorus, etc. necessary for plants to keep normal functions. Excess nutrient salts runoff causes eutrophication of water quality, negatively affecting ecosystems. (⇒5-1 Current status of red soil sediment and nutrient salts from the land.)

※7 Marine Park Areas

One of the type of land classifications for the national and quasi-national parks which are designated in accordance with the Natural Park Law (Old Act No. 161, June 1, 1957) to protect natural scenic beauty and biological resources. Since the amendment of the Natural Parks Law in 2010, the designation subject has been expanded from underwater views consisting of coral reefs and marine algae up to marine areas ranging from the ocean's surface to undersea areas that include tidal flats and rock reefs which seabirds inhabit. (⇒ (Reference Materials) 2-(1) Efforts regarding Tourism in Okinawa Prefecture)

※8 Coral Bleaching

A phenomenon where white coral skeletons are seen through transparent tissues. This is due to removal of zooxanthellae from living creatures which have zooxanthellae cohabiting with them, caused by stress from high water temperatures or low salinity, or pigment degradation or degeneration of zooxanthellae.

※9 Convention on Biological Diversity

While bringing various benefits to people, biodiversity faces increasingly serious aspects such as extinction of species (of organisms) and disruption of ecosystems. The Convention was adopted in 1992 to tackle this issue on a global basis.

※10 Red Soil

Reddish brown or red-yellow soil with fine particles having a wide distribution to the Nansei Islands including the Ryukyu and Amami Islands. It contains plenty of iron and shows an acid reaction, so is suitable for cultivation of crop plants that grow in acid soil like pineapples. (⇒5-1 Current status of red soil sediments and nutrients salts from the land)

※11 Designation of Coral Reef Marine Areas of Significance

Coral reef marine areas to be conserved as selected by Okinawa Prefecture in fiscal 2005. The areas are specified to satisfy the requirements for the quality of coral and capability of continued conservation activities. As a result of a survey of coral coverage and a hearing survey, 50 spots of coral reef regions in the prefecture were selected.

※12 Ordinances to Prevent Erosion of Red Soil

The Red Soil Erosion Prevention Ordinance enforced by Okinawa Prefecture (Ordinance No. 36, October 20, 1994). In order to prevent erosion of red soil accompanied by coastal development, which causes pollution of marine areas and rivers in Okinawa, the Ordinance prescribes that necessary measures be taken and to give notice to the prefecture on the occasion of land reform construction.

※13 International Coral Reef Initiative (ICRI)

International Partnership which permits interested parties relevant to sustainable use and conservation of coral reefs to discuss the conservation of coral reef ecosystems under the equal cooperative relationship. Established in 1994 and currently has 37 member countries and 33 agencies and bodies.

4 Selection of Priority Issues to Be Addressed by Fiscal Year 2020

※1 Marine Protected Areas

Marine areas designated and managed by laws or other effective means in consideration of use modalities, aimed at the conservation of marine biodiversity supporting the sound structure and functions of the marine ecosystems and ensuring sustainable use of marine ecosystem services.

※2 Marine Biodiversity Conservation Strategy

Compiled by MOE in 2011 with regard to the basic attitude, philosophy and policies to conserve the marine ecosystem and carry out sustainable use of marine blessings.

5-1 Current Status of Red Soil Sediments and Nutrient Salts from the Land Areas

※1 Dissemination rate of domestic wastewater treatment system

Percentage of permanent population in the region who use the facilities for treating various domestic effluent, such as sewage systems, agricultural drainage systems, johkaso and community wastewater treatment plants, out of the total population of each municipality.

※2 Agricultural Drainage Systems

A small-scale integrated sewage system to treat sewage water such as night soil and domestic effluent in agricultural villages. The systems are designed to contributing to a healthy water cycle and enhance the basic life circumstances by preventing pollution of water quality by agricultural drainage, reuse of treated water for agriculture, and returning treated sludge to farmland.

※3 Johkaso (decentralized wastewater treatment systems)

Facilities installed at every house to treat both night soil and domestic effluent from kitchens and bathrooms. Since such a tank can be installed in a short period at a comparatively low cost, employment of it is an efficient means for treatment of domestic effluent in a region where residential houses are scattered. In contrast, an individual treatment johkaso only for treatment of night soil is removed from the definition of "Johkaso" based on the amendment of the Purification Tank Act and restriction is put on cases where such are newly installed because they apply an enormous environmental load on public waters.

※4 Act on the Appropriate Treatment and Promotion of Utilization of Livestock Manure

The Act on the Appropriate Treatment and Promotion of Utilization of Livestock Manure (Act on Livestock Manure) (Act No. 112, July 28, 1999) was enacted in 1999 for the purpose of the healthy development of the livestock industry by eliminating open-air storage and excavation without timbering to normalize management of livestock manure and promoting the utilization thereof.

※5 Water Pollution Control Act

The Water Pollution Control Act (Act No. 138, December 25, 1970) was enacted in 1970 for the purpose of controlling the pollution of the quality of public water and underground water by regulating water discharge from factories and business facilities to the public waters or infiltration thereof into the underground, and by promoting measures for domestic effluent.

5-2 Current Status of Tourism in Coral Reef Ecosystems

※6 Neutral Buoyancy

Neutral state in which buoyancy force and gravity force are in balance during scuba diving so that divers do not float up nor sink to the bottom.

5-3 Current Status of Relationship between Community Life and Coral Reef Ecosystems

※7 Hamauri

A seasonal event in the Okinawa and Amami regions. Residents go to the seashore with fancy meals on March 3 in the lunar calendar, when the tidal range is the biggest in the year, and gather shellfish and seaweed. There is also a custom that women and children soak their hands and legs in the sea to purify themselves and pray for good health.

※8 Shiraho Conservation Council for Bountiful Seas

A Council established mainly by residents aiming at the activation of the Shiraho area by coral reef conservation and its sustainable use. Residents acting as central figures make efforts to grapple with various projects for restoration of Nagaki (fishing fences), a traditional type of fixed fishing gear, and green belt planting to prevent topsoil outflow.

7-1 Action to Promote Measures against Run off of Red Soil and Nutrient Salts from the Land

※1 Environmental Conservation Goal Formulated in the Basic Plan for Prevention of red Soil Runoff in Okinawa Prefecture

A goal established as an environmental guiding principle regarding sedimentation of red soil, aiming at restoration of the coastal areas in Okinawa Prefecture to a favorable condition.

※2 How to Take Measures for Prevention of Red Soil Runoff (Preventive Measures for Red Soil Runoff and Implementation Procedures by Oshima Branch Office)

Measures and implementation procedures for prevention of red soil runoff compiled by Oshima Branch Office in Kagoshima Prefecture in 2012, as reference material for persons in charge of implementing measures to prevent red soil runoff in the Amami area and office staff responsible for executing various projects. A variety of measures including Procedures of Preventive Measures, Implementation Procedures of Preventive Measures, and a Promotion System have been developed.

※3 Contact Oxidation Channels

A channel with a function to purify water utilizing microorganisms adhering to the surface of gravel. When filthy water flows into a channel which has a gravel-covered bottom, pollutants are deposited between the pieces of gravel, and as a result microorganisms resolve and absorb organic substances and then purify water.

※4 Aeration Facilities

Facilities to increase dissolved oxygen in water by sending air into the water.

※5 Curtain Drain

A channel provided in the boundary to the hinterland to block water flowing in from the hinterland and drain away without inflow to the area.

※6 Sediment Ponds

Facilities to deposit and remove sediments and gravel that flow with running water at the time of water intake or drainage.

※7 Underdrainage

Drainage facilities composed of drainpipes and pipes made of rice hulls buried in the ground.

※8 Subsidies for Ogasawara Islands Promotion and Development Plan

Government subsidies granted for improvement of industrial infrastructure and local infrastructure implemented by the Tokyo Metropolitan Government and Ogasawara Village based on the Act on Special Measures for the Ogasawara Islands Development (Act No. 79, December 8, 1969) in order to realize autonomous development of regions, stabilization of the lifestyles of residents on the island, and improvement of their welfare.

※9 Chura Water Plan through Waste Water Recycling in Okinawa

Framework formulated by Okinawa Prefecture in 2011 designed for the maintenance and enhancement of the living environment and the conservation of water quality. The framework indicates a guideline to carry out the improvement of various waste water treatment facilities systematically and effectively through cooperation between the prefecture and municipalities.

※10 Combined Sewage System

A sewage system to drain waste water and rain water simultaneously through the same conduit to the sewage plant. This system has the merit of reduced maintenance cost, whereas untreated waste water sluices to public water areas from a pumping station or storm outfall when precipitation increases, resulting in the water environment being worsened.

※11 Waste Treatment Facility Development Plan

The plan is formulated every five years to systematically implement the waste management facilities construction project in accordance with Article 503 of the Waste Management and Public Cleansing Act (Act No. 137, December 25, 1960).

7-2 Action to Promote Sustainable Tourism in Coral Reef Ecosystems

※12 Wetlands Registered under the Ramsar Convention

Wetlands of international importance registered in accordance with the Ramsar Convention and international standards aiming at the Conservation and Wise Use of wetlands. Fifty Japanese wetlands, including the Kushimoto coastal waters and the Kerama Islands coastal waters, have been registered.

7-3 Action to Establish Relationship between Community Life and Coral Reef Ecosystems

※13 Satoumi-net

The website of the Ministry of Environment introduces efforts to maintain and pass on satoumi to the following generations. Satoumi means a coastal area whose biological productivity and diversity have been enhanced through human interaction, and which has supported culture and cultural exchange through fisheries and distribution for a long time

※14 Project for Demonstration of Multi-functions of Fishing Industry and Fishing Communities

A Project implemented since 2013. It aims at restoration of the commercial fishing industry and revitalization of fishing villages by supporting the regional activities that contribute to demonstrating the multiple functions of fisheries and fishing villages.

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I-1-(1) Efforts of Agricultural Environmental Coordinators in Okinawa Prefecture

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※2 Regional Committee for Prevention of Red Soil Runoff

The committee is a central agency where involved parties take the action of working together as a single body through public-private partnership in preventing red soil runoff in Okinawa Prefecture.

※3 Greenbelts

Vegetation zones such as bare areas and field peripheries planted with trees and vegetation, which intercept soil particles to prevent erosion of red soil. If these areas become greenbelts by appropriate afforestation, runoff of cultivated soil will be reduced to approx. 60%.

※4 Mulching

This means the covering of the ground surface of the plant foot of crops with wooden chips or grass mulch such as straw. This plays the role of keeping the farm land warm and suppressing weed, and at the same time is said to have the effect of controlling runoff of soil and fertilizer due to rainfall; therefore this technique has been employed as a preventive measure for red soil runoff.

※5 Focused Monitoring Regions

Twenty-two regions designated based on the fact that the coastal waters are remarkable in terms of red soil sedimentation, coral coverage, and their utilization situation, in accordance with the Basic Plan for Prevention of Red Soil Erosion in Okinawa Prefecture.

※6 Subsoil Breaking

One of preventive measures for red soil erosion. It involves cracking the soil layer, which has been hardened due to repeated agricultural practice, to improve water drainage. This as a result allows rainfall to easily penetrate into the earth.

※7 Cover Crop (Green manure)

Crops designed to be planted in the farmland where agricultural crops have not been planted yet, to control the surface soil runoff or overgrowth of weed. Typical ones include crotalaria and sunflowers. This method controls about 60% of the amount of red soil erosion, and at the same time the cover crops become manure after plow-in. A yield increase of the subsequent crops is also expected.

※8 Soil Conservation Days

In Okinawa Prefecture, the 30 days from the third Monday of May are declared to be the Soil Conservation Month, and the days on which events are held in various regions are called Soil Conservation Days.

I-1-(2) Measures against Runoff of Red Soil through Regional Exchanges in the Nansei Islands

※9 WWF Japan Coral Reef Conservation and Research Center (Shiraho Coral Village)

The WWF Japan established this in 2000 to conserve the rich coral reef in the Shiraho area of the Ishigaki Islands. The center has made efforts to carry out coral reef conservation activities and to proceed with sustainable use of marine resources in cooperation with the local residents.

I-2-(1) Efforts regarding Tourism in Okinawa Prefecture

※10 Sustainable Tourism

A concept and practice of tourism development to avoid degradation of the natural environment and culture and excessive commercialization which often occur as a result of mass tourism. The first principle of sustainability is involved in the aspect of the natural environment, economic aspects and sociocultural aspects of tourism development. To ensure the long-term sustainability of tourism, sustainability in each of these three aspects needs to be well balanced.

※11 Agreement of Conservation and Utilization

Rules voluntarily implemented and concluded by stakeholders engaged in environmental conservation-type of nature experience activities in order to conserve the locations where such activities are carried out in Okinawa Prefecture.

I -2-(2) Overseas Efforts regarding Tourism (Green Fins)

※ 12 United Nations Environment Programme (UNEP)

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A United Nations organization established in accordance with the resolution of the UN General Assembly in 1972. The organization aims at putting into the practice the Declaration of the United Nations Conference on the Human Environment and the Stockholm Action Plan adopted at the United Nations Conference on the Human Environment in the same year

※ 13 The Reef World Foundation

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A charitable institution established in the U.K. to support a regional framework for conservation of coral reef ecosystems and sustainable development. It undertakes monitoring of coral reefs and the guidance of diving tours.

I -3-(1) Efforts of Shiraho Village

※ 14 Shiraho Village Yuratiku Charter

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This Charter has seven articles stipulating a vision of construction to activate the regions utilizing regional resources with the participation of and under agreement of residents in the Shiraho area.

III Literature*

* Only those which are available in English version

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— Review Meeting for Revision of the Action Plan to Conserve Coral Reef Ecosystems —

The Review Meeting for Revision of the Action Plan to Conserve Coral Reef Ecosystems consisting of experts and members of national and local government agencies was set up to discuss revision of the Action Plan to Conserve Coral Reef Ecosystems in order to develop 2016 – 2020 version.

■ Committees (Names in order of Japanese Alphabet, ○ mark: chairperson)

Fumito Iwase (Shikoku Umi to Ikimono Kenkyushitsu: Resarch Laboratory of the Sea and Living Creatures of Shikoku)

Masahito Kamimura (Director, WFF Japan Coral Reef Conservation and Research Center)

Koichi Kinjo

(Environment Sciences Group, Okinawa Prefectural Institute of Health and Environment, Okinawa Prefectural Government)

○ Makoto Tsuchiya (Professor Emeritus, University of the Ryukyus)

Tatsuo Terasaki (Manager, Tourism Cultural Research Division, Director of Japan Travel Bureau Foundation)

Ken Toguchi

(Associate Professor, Majors: History, Human Geography and Ethnology, Human Sciences, Faculty of Law and Letters, University of the Ryukyus)

Satoshi Osada

(Nature Environment, Environment Sciences Division, Incorporated Foundation Okinawa Prefecture Environment Science Center)

Yoshikatsu Nakano (Technical Assistance, Sesoko Station, Tropical Biosphere Research Center, University of the Ryukyus)

Kazuo Nadaoka

(Professor, Major: Department of Computer Science, Graduate School of Information Science and Engineering, Tokyo Institute of Technology)

Keita Furukawa (Director, Ocean Research Division, Ocean Policy Research Institute, Sasagawa Peace Foundation)

Hiroya Yamano (Director, Center for Environmental Biology and Ecosystem Studies, National Institute of Environmental Studies)

■ Local Governments

Okinawa, Kagoshima, Kumamoto, Miyagi, Nagasaki, Kochi, Ehime, Tokushima, Wakayama, Tokyo

■ Agencies

Ministry of the Environment; Ministry of Agriculture, Forestry, Fisheries; Ministry of Land, Infrastructure, Transport and Tourism; Ministry of Education, Culture, Sports, Science and Technology.

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<http://www.env.go.jp/en/index.html>

