5-2 Approaches for restoring coral reef ecosystems

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1 Introduction

Today, environmental deterioration is occurring in local regions and on a global scale. Coral reef ecosystems, along with tropical rainforests, harbor the highest biodiversity on Earth, but these ecosystems are currently in a critical situation, and action is necessary. This report introduces two coral reef ecosystem restoration projects conducted by the Japanese Ministry of the Environment. It also presents 'The New National Strategy on Biological Diversity', which triggered the promotion of nature restoration projects in Japan, and 'The Law for the Promotion of Nature Restoration', which stipulates the concept and framework of nature restoration projects in this country. The term 'coral reef ecosystem' in this report is used to indicate an ecosystem centered on hermatypic coral (hereafter coral) communities, including those in temperate zones.

2 The New National Biodiversity Strategy of Japan

'The New National Biodiversity Strategy of Japan' was formulated in March 2002 and was intended by the Japanese Government to plan and achieve a society that co-exists with nature. Together with the enhancement of conservation and sustainable use, nature restoration was specified as one of the three main pillars of this strategy, and the policy statement for nature restoration was as follows.

"Humankind has been overexploiting natural resources and destroying the natural environment beyond the level at which the environment can restore itself. Biodiversity, which is indispensable for human existence, has consequently been depleted. Under these circumstances, we have to change the way that we interact with nature: from a single-sided deprivation of natural resources and destruction of the environment, to contribution to the environment from the human side. These efforts should commence while sound ecosystems, which will serve as models and also as sources of species re-supply, still exist around us. The Japanese government has therefore begun positive restoration and rehabilitation projects aimed at enhancing the resilience of our natural environment. In this process, it is necessary that stakeholders share their information based on scientific knowledge and reach a consensus in terms of goal-setting in each project. Adaptive management practices should ensure that healthy ecosystems are not damaged in the process of restoration projects. Simultaneously, the projects themselves must be monitored properly, flexibly re-examined and conducted carefully over the long term. In this way, and by accumulating experiences and expertise, restoration and rehabilitation methods appropriate to the environments and regions of Japan will be established. Nature restoration projects will actualize consensus-based, comprehensive implementation of this policy on behalf of the Japanese Government and with the participation and cooperation of various actors such as citizens, researchers, and the private sector."

3 The Law for the Promotion of Nature Restoration

Following the above national strategy, 'The Law for the Promotion of Nature Restoration' came into force in 2003. This law defines nature restoration as a joint effort among various participants to implement conservation, restoration, creation, and management of natural environments including wetlands, tidal flats, seaweed beds, '*satoyama*' (coppice), '*satochi*'(rural landscapes), forests, and other environments that have been lost or degraded by human activities.

Specified in the law are five principles. Nature restoration should: 1) aim at realizing a society that can

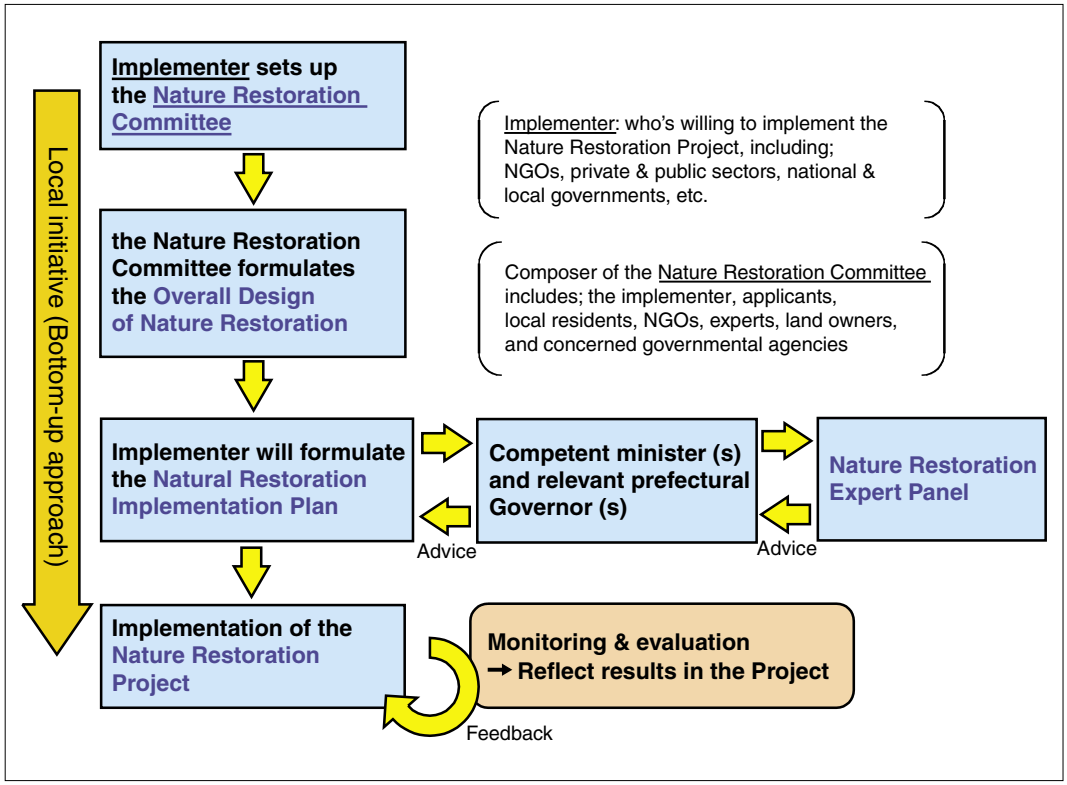

Fig. 1. Flow chart of planning and implementation for nature restoration projects, under the Law for the Promotion of Nature Restoration enacted in December 2002.

co-exist with nature through secure biodiversity; 2) be carried out in such a way that feedback from monitoring results is reflected in the project (adaptive management); 3) be carried out based on scientific knowledge; 4) be carried out in a flexible manner that adapts to the monitoring results; and 5) take opportunities to use projects for public environmental education.

Those wishing to implement nature restoration projects must organize a 'Nature Restoration Committee' that consists of stakeholders who are willing to participate in the project, such as local residents, nongovernmental organizations (NGOs), experts, land owners, and relevant government administrative bodies. Committee members must: 1) discuss and cooperate in the planning of an 'Overall Design of Nature Restoration' ; 2) act upon the drafted 'Nature Restoration Project Implementation Plan'; and 3) coordinate correspondence and consensus-building on relevant matters for project implementation. The overall design document serves to indicate the overall direction of the project and integrates the diverse stakeholders' wishes and efforts through the determination of the project goals, target area, roles of committee members, etc. Based on this design, an implementation plan must be formulated that specifies the target area, project description, advantageous outcomes, and significance of the project (Fig. 1).

4 Projects for restoring coral reef ecosystems

Nature restoration projects have been initiated by the Ministry of the Environment in line with the above-mentioned national strategy and law. As of December 2003, two projects and 15 preliminary studies are in operation (Fig. 2).

Two of these preliminary studies involve the restoration of coral reef ecosystems. The ultimate goal of this research is to enable the resumption of the sustainable use of coral reefs by local communities. These studies are being conducted in Sekisei Lagoon in Okinawa Prefecture, which is the largest coral reef in Japan, and in Tatsukushi Bay in Kochi Prefecture, which will serve as an example of a high-latitude coral community. In addition, the prefectural government

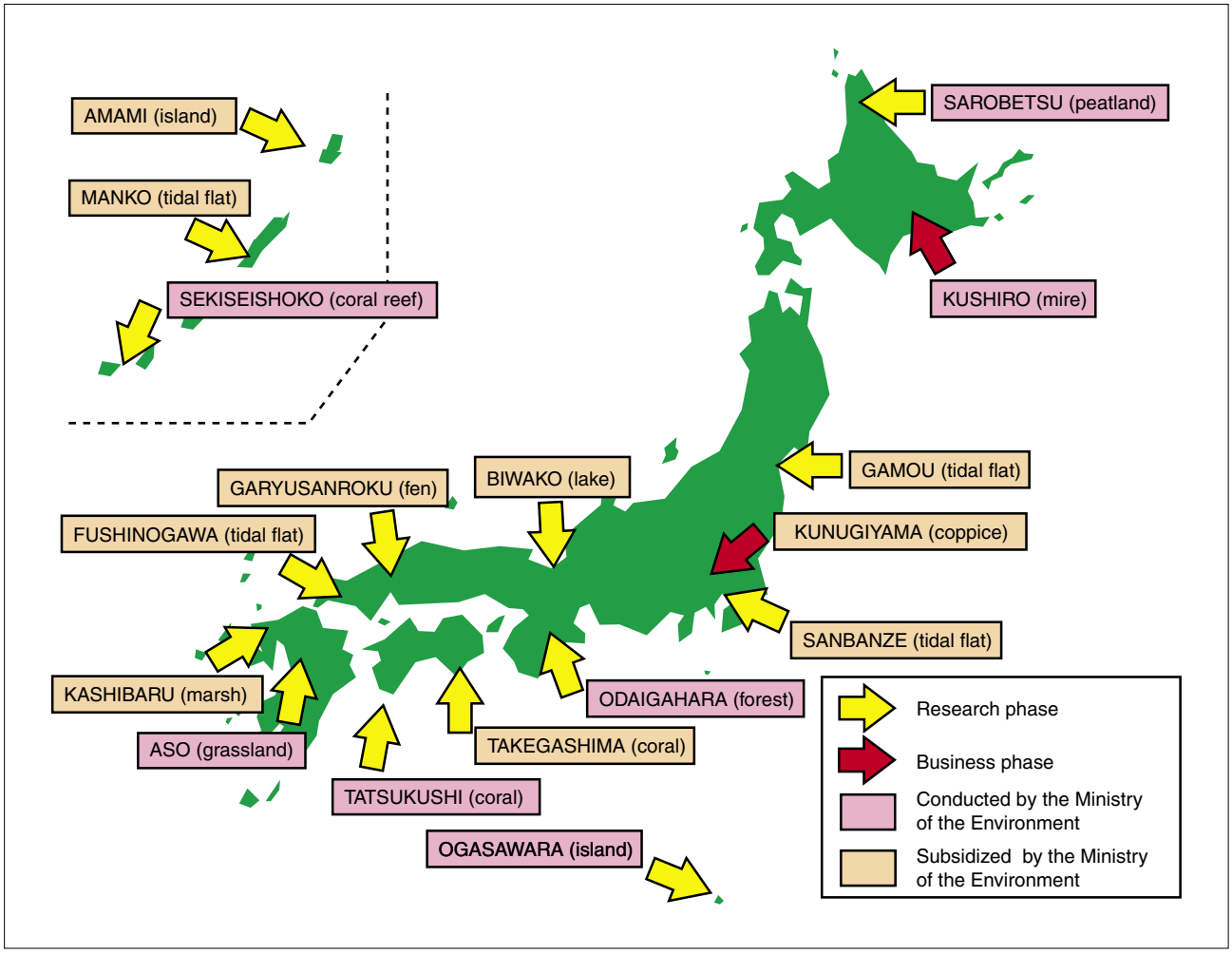

Fig. 2. Sites and targeted environments (in brackets) in the Japanese Nature Restoration Project, December 2003.

of Tokushima, subsidized by the Ministry of the Environment, is conducting research in coastal areas around Takegashima Island. Scientific committees, as well as consultative groups of local stakeholders such as fishermen, residents, and NGOs, are involved in the planning and conduct of these studies.

There are six stages in the performance of these projects: 1) preliminary research; 2) consideration and consultation; 3) planning; 4) project operation; 5) monitoring and evaluation; and 6) feedback and modification. The two preliminary studies mentioned above are now at stage two. At the first stage, the current status of each region's reef ecosystems must be understood and the causes of their degradation identified. Research parameters include surveys of coral distribution, sea currents, land use, terrestrial outflow of soils and pollutants, fisheries and tourism, and any other relevant factors. At the second stage, based on consideration of the above inputs and consultation, specific goals for each case, the critical area requiring protection, coastal management measures (including terrestrial areas), and appropriate protective measures are established. In the third stage, an execution plan is formulated that includes specific techniques for the restoration of regional coral communities, conservation and management of the sea area, management of terrestrial discharges, post-monitoring, and outreach programs to raise public awareness.

5 Sekisei Lagoon

Sekisei Lagoon lies between Ishigaki Island and Iriomote Island in the Yaeyama Archipelago. The reef measures approximately 20 km east-west and 15 km north-south, and more than 350 coral species have been recognized in this area (Nishihira and Veron 1995). For this reason,

Sekisei Lagoon, along with the virgin forest of Iriomote Island, has been designated as the Iriomote National Park. Within the park area, four Marine Protected Areas have been designated. The lagoon is important not only scientifically but also for local economies through fishing and tourism activities such as diving and glass-bottomed boat tours.

Despite this protection, there have been several severe disturbances to coral communities in Sekisei Lagoon, including the crown-of-thorns starfish (*Acanthaster planci*) outbreaks in the 1970s and 1980s, a mass coral bleaching event in 1998, and soil sedimentation caused by terrestrial erosion. Given these circumstances, in 2002 the Ministry of the Environment commissioned research in order to formulate a management and rehabilitation plan for the recovery of this sound and significant coral reef ecosystem. This plan is expected to cover a wide variety of issues such as conservation, management, appropriate use, a rehabilitation program, and environmental education.

Aerial and field surveys to identify the distribution of coral communities were conducted in 2002 and 2003. Comparisons of these results with those of surveys in 1980 and 1990, prior to the later *A. planci* outbreak and bleaching event, respectively, led to the identification of areas resilient to these negative impacts. In addition, the sources and transport routes of coral larvae have been identified through examination of regional sea-surface currents. Socio-economic surveys have identified areas important for fisheries and tourism.

Based on these scientific and socio-economic data, consensus-building meetings were held among participants, who included coral reef scientists, related national and local governments, and local stakeholders such as diving associations, fishery cooperatives, tourism agents, and local NGOs.

6 Tatsukushi Bay

Tatsukushi Bay, with an area of approximately 3.7 km^2, is located in the southwestern part of Shikoku. Coral species are relatively abundant, despite the high latitude, owing to the influence of the eastward-flowing Kuroshio Current. The bay is part of Ashizuri-Uwakai National Park, and contains four Marine Park Zones (Nos. 1 to 4). Huge, scientifically important colonies of *Pavona decussata* occur, especially in Zone 4. Many tourists visit this area and enjoy the underwater scenery by scuba diving, snorkeling, and glass-bottomed tour boats.

However, coral communities have deteriorated in recent years for several reasons. In Marine Park Zones 2 and 3, corals were damaged by the predation of coral-eating gastropods (such as *Drupella fragum*) and have not yet shown signs of recovery. Furthermore, a localized torrential downpour that hit this area in September 2001 caused severe soil erosion and outflow to the neighboring coasts, and corals were killed as a result of burial and sedimentation.

To counter these problems and to recover the healthy coral communities, the Ministry of the Environment began research in 2003 with the aim of restoring the coral reef ecosystem. Field surveys investigating the sea-bottom topography and coral community distribution were conducted. In addition, attempts have been made to follow the transport of soils into the ecosystem; regional sea-surface currents were examined, and the degree of sedimentation was recorded for different areas. Methods for the physical removal of accumulated sediments have been considered. As in the case of Sekisei Lagoon, diverse stakeholders were consulted during the planning and conduct of these studies.

These studies in Sekisei Lagoon and Tastukushi Bay provide us with scientific information about the status of coral communities and the influence of human activity on coral reef ecosystems, as well as socioeconomic information regarding the appropriate structuring of projects to allow each stakeholder to contribute initiatives and cooperate in problem-solving. We would like to share this information, and we believe that these projects could serve as useful models for coral reef restoration projects elsewhere.