

Chapter

4 Sustainable use and conservation of coral reefs

Coral reefs have been providing us with many blessings such as fishery products and tourist resources. This is highly dependant on its high diversity where innumerable organisms inhabits in the complex ecosystem, and thus, on the other hand, is susceptible to disturbances. Once it is utilized inappropriately, coral reefs can be degraded easily, but takes considerable period, or never, to be recovered to original state. Therefore, for continuous and sustainable use of coral reefs, a strict conservational management is necessary, including environment education for enlightenment of its importance, and constitution of related legal systems that can act to restrict the degradation. This chapter introduces the current status of usage and conservational activities on coral reefs in Japan.

4-1 Coral reef conservation and management in Japan

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1 Resource use

Sustainable use is the goal of the modern conservation movement. Without regulation of resource use, natural ecosystems and the services and resources that they provide to humanity deteriorate. Resource use here refers to the use of all natural resources, including land, water, biological resources, and minerals. Modern societies have been utilizing natural resources well beyond what is sustainable. The following management foundations are necessary to achieve the sustainable use of natural resources.

- a) Establish baselines defining ecosystems, and monitor the condition of these systems.
- b) Understand and recognize the adverse effects of excessive, irreversible, and destructive use.
- c) Limit uses defined as excessive, irreversible, or destructive.
- d) Assist recovery of deteriorated ecosystems.
- e) Develop techniques and systems that enable the sustainable use of natural resources.
- f) Through socializing the above elements, build a conservation ethic that is backed up by law.

The goal of management is not to manage nature, which is an impossible task, but rather to manage the human use of natural resources. It is necessary to think about management on a global scale, but its foundation, as outlined above, should be achieved on a local scale. Cooperation between and among regions and nations, however, is indispensable.

These tenets apply to coral reef management; in this respect, a variety of attempts have been made toward the sustainable use of reefs in various regions of the world. This chapter focuses on coral reef conservation in Japan in relation to the above-outlined management goals. More details pertaining to each goal can be found throughout this book [e.g., a) Chapters 1, 3, and 6; b) and c) Chapters 2 and 6; d) Chapter 5; and e) and f) this chapter].

2 Negative anthropogenic impacts

1. Fisheries

Fishing has been an important part of Japanese culture since ancient times. Japanese fisheries, however, have declined owing to overfishing in neighboring waters, and fisheries management in Japan is an important issue, as it is in other regions of the world (see 4-2). Fortunately, Japan developed laws at an early stage against directly destructive fishing techniques, such as the collection of corals and the use of dynamite and hydrocyanic acid. However, these practices constitute important on-going problems for Southeast Asia and other regions.

2. Coastal development

Civil engineering projects in Japan have had irreversible, destructive impacts on coral reefs. 'Reclamation' projects have been conducted in many areas to create land for urban districts, sightseeing facilities, and for public facilities such as airports. The accompanying dredging works have created harbors and sea routes. In addition, breakwaters have been built along coastlines in many locations (see 2-4). An example of what ensues from this kind of development can be seen in Okinawa Island, where only 57.3% of the entire coast is natural shoreline, with no human alteration (Nature Conservation Bureau, Environment Agency 1998). Moreover, development such as farming, deforestation, road building, and military exercises, together with modification of the drainage systems of rivers, have caused accelerated runoff of red clay, which has negatively affected many Okinawan reefs (see 2-5). The background for these problems lies in geography, history, and in social values. Geographically, Japan's reefs often form small islands and fringing reefs, adjacent to coastal urban areas and farmland. Japan is densely populated, and possesses highly advanced, large-scale engineering technology that is at the center of well-funded regional promotion plans. These factors are especially important in Okinawa Prefecture, which was governed by the U.S.A. for 27 years after World War II. Since its han-

dover to Japan, Okinawa has sought to catch up with the more advanced economy of mainland Japan. Unfortunately, little consideration has been given to conserving the coral reefs and the natural environment during this period.

3. Tourism

The aforementioned engineering projects were undertaken, in the main, for the construction of facilities relating to tourism and recreation. Intensive use of coastal areas by large numbers of people constitutes a serious problem in Japan (see 4-5). An important issue that has recently arisen is the growth of diving tours for the purpose of coral transplantation. While the aim behind these efforts to contribute to coral reef recovery may be laudable, the collection of coral fragments from reefs for transplantation negatively impacts healthy coral communities, and potentially destroys genetic structure by mixing different regional coral populations. At present, most of such projects have been initiated on a commercial basis, without the support or cooperation of appropriately qualified scientists.

It is necessary to recognize that Japanese tourism and recreational activities affect coral reefs in other countries, as well as in Japan. Many Japanese tourists and divers visit coral reefs throughout the Pacific Ocean and Southeast Asia. Direct impacts to reefs from this kind of tourism include the trampling of coral by divers; there are also indirect impacts, for example, with respect to water quality, which is affected by the effluent from accommodations, the construction of sightseeing facilities, and other forms of coastal development. The growing home aquarium industry in Japan should also be recognized as a significant threat to reefs. Although the collection of corals is limited in Japan, many reef organisms from elsewhere in the world are sold in Japanese pet shops. Such practices continue because irresponsible individuals, who profit from coral reefs, take advantage of opportunities to achieve personal gain at the cost of the natural environment; the negative attitude of related industries toward coral reef conservation is also a factor in the continuation of these detrimental activities. It is time to promote a deeper understanding of coral reefs, and to investigate industrial activities that are compatible with reef conservation.

3 Current issues in Japanese coral reef management

1. Historical background

As noted above, conservation was given a very low priority in Japan during the period of post-war economic expansion. What attention that was given to conservation by researchers, institutions, and the public, was focused, mainly, on terrestrial systems, such as forests. Following environmental pollution problems, including the very serious problem of Minamata disease in the 1970s, marine pollution that directly influenced human health came under close scrutiny, and a variety of legal systems and measures were established to deal with such matters. The general deterioration of marine ecosystems, however, was not considered. Similarly, concerns about reclamation works around Tokyo and Osaka were limited to their effects on fisheries only, with no regard for the ecosystem as a whole.

The situation was similar for coral reefs. The corallivorous crown-of-thorns starfish (*Acanthaster planci*) increased explosively in the Ryukyu Islands in the 1970s, causing widespread damage to reefs. Although the impacts of this event were widely reported, the causal relationship between the *A. planci* outbreak and human activities was not clarified, and mitigation measures were limited to management of the *Acanthaster* population. When a project for the construction of an airport on the coral reefs of Shiraho, Ishigaki Island, Okinawa Prefecture, became controversial in the late 1980s and early 1990s, opinions such as 'coral conservation is unrelated to human life' and 'how can you make a living with corals?' were commonly expressed. The airport project was publicized in Okinawa and throughout Japan by the IUCN (International Union for Conservation of Nature and Natural Resources), and by national and local conservation groups (e.g., Planck *et al.* 1988; Doumenge *et al.* 1990; Nature Conservation Society of Japan 1991); this generated wider recognition of the ideas behind, and necessity for, coral reef conservation. As a result, the filling of this reef was avoided.

Later, in June 1992, the United Nations Conference on Environment and Development (UNCED, or the Earth Summit) was held in Rio de Janeiro, Brazil. This conference focused the attention of Japanese society at large, along with the government and the business establish-

ment, on the importance of environmental conservation. Economic stagnation in Japan and government deficits also stimulated progress in conservation. Following the U.S.-Japan on bilateral summit in 1994, the Japanese Government joined the International Coral Reef Initiative (ICRI) and, in February 1997, the 2nd East Asian Seas Regional Workshops in Okinawa focused more attention on reef conservation.

Societal awareness of the importance of coral reef conservation in Japan is thus increasing. However, problems remain; a new U.S. military base is planned, which is to be built on coral reefs in Okinawa, and new concerns, such as the aforementioned coral transplantation tours, are emerging. However, conservation practices in the last decade or so have changed; confrontations with construction interests have given way to cooperative activities with government, local residents, NGOs/NPOs, and researchers. Such cooperation makes possible the formulation of systems and rules for a local society and economy that are based on the sustainable use of nature (Nakai 2002).

2. Need for comprehensive coastal management

A comprehensive coastal management plan that includes entire watersheds as well as the myriad human uses of coastal areas is necessary for effective coral reef conservation. The U.S. Coastal Zone Management Act (CZMA) offers an example of such a management plan (Vernberg and Vernberg 2001). Japan, so far, lacks such a plan. Coastal management in Japan is enforced through three separate laws: the Fishery Act, which affects marine industries, the Harbor Act, and the Coast Act, for coastal disaster prevention. Local ordinances are similarly divided, and government agencies in charge of coastal management are separate from each other. Therefore, despite the fact that development laws have begun to include conservation measures, and conservation projects are underway in some areas, legal plans or institutions to effectively control them do not exist.

The framework for a comprehensive coastal management plan should be made at the national or the prefectural level; however, rules and operations for each region should involve local stakeholders, including individuals and industry. Education will play an important role in ensuring that such local involvement can result in a regionally relevant plan.

3. Role of MPAs

Marine protected areas (MPAs) and no-take areas (NTAs) are effective conservation tools at the local level; they also provide insurance, at least potentially, against more widespread impacts, such as coral bleaching events (e.g., GBRMPA *et al.* 1995; Hughes *et al.* 2003). Most of the Great Barrier Reef, an area stretching over 2,000 kilometers, is now a protected area. The reef is finely divided into zones allowing different uses, including NTAs, with satisfactory results. Japan has a total of 64 marine parks that were established under the Natural Parks Law; 13 of these contain coral reefs. However, these parks are extremely small and the boundaries have not been defined with any consideration for the regional ecosystem. Moreover, despite some limited educational activities, implemented by the Ministry of the Environment and the municipalities, there is a lack of information and education on the natural environment and usage rules in the parks. Consequently, some reefs endure heavy anthropogenic impacts, even in the marine parks of Japan. MPAs must take local factors into account, including ecology and the physical and chemical environment. Monitoring of reef ecosystems, enforcement of use restrictions, and the education of local residents and visitors are integral to the success of MPAs in Japan.

In coral reef regions in Southeast Asia, the top-down establishment of NTAs triggered strong protests from local fishermen (Akimichi 2002). Akimichi pointed to the necessity of education for coastal area residents and to the promotion of 'fisheries that don't catch fish', such as eco-tourism. Wells and White (1995) have also emphasized the importance of community-based management in the establishment and operation of MPAs, an emphasis that is based on their experience in such matters. Under this model, local residents who are educated to have a full understanding of the importance of coral reef conservation are integrally involved in the MPA establishment process. This prevents the problems caused by top-down decision-making.

Coastal use restrictions, including zoning, have existed in Japan since ancient times; these restriction were implemented for the purpose of avoiding overexploitation of natural resources, as well as the friction with neighbors that ensued from such exploitation. These historical rules have evolved into the current system of fishery rights and the Living Aquatic Resource Protection Law. If this unique system were to be expanded to include the

entire coral reef ecosystem, as well as the management of other activities, such as non-commercial fishing, sightseeing, and educational activities (Hamamoto *et al.* 1996; Simard 1995), it could constitute a global model for coral reef conservation.

4. Restoration technology

Coral reef restoration projects are now beginning in Japan (Chapter 5). Law promoting reef restoration was established in 2001, in response to widespread damage to reefs by mass bleaching events. Hughes *et al.* (2003) invoked the possibility of technology to promote the establishment of bleaching-resistant symbiotic algae (zooxanthellae) and coral species, based on findings that some zooxanthellae are resistant to temperature and to other environmental changes that cause coral bleaching. In view of the current state of coral reefs, the development of this technology and its practical application is very important. Japan, with its highly developed technological capabilities, could contribute to domestic and global coral reef conservation in this area.

As noted earlier, however, technological fixes can sometimes unintentionally cause problems. Guidelines and rules for their use, within the framework of the aforementioned comprehensive coastal management plan, are necessary. Research to establish such guidelines should take place concurrently with the development of the technology. However, when taking into consideration the possibility of the international use of these potential technologies, it is necessary to consider whether local communities can effectively implement them.

5. Role of the academic society in coral reef conservation

The Japanese Coral Reef Society (JCRS) was established in 1997, in part to promote research in, and projects on, coral reef conservation. Previously, coral reef researchers in Japan did not have an effective voice in conservation decision-making, largely owing to the lack of a forum for systematic information exchange and discussion, rather than to a lack of individual concern. There were only a few coral reef researchers involved in the government's decision to join the ICRI; this lack of involvement was the impetus for establishing the JCRS. The Japanese Coral Reef Society includes a wide range of members interested in corals and coral reefs, including public citizens and NGOs/NPOs, as well as researchers and government agencies. JCRS involvement has resulted in the decision to host the 2004 International Coral

Reef Symposium (ICRS) in Okinawa. Coral reef conservation was an important theme at the last ICRS, and will be a dominant theme at the Okinawan Symposium as well. Cooperative relations between government and civil organizations for the purpose of promoting conservation have been stimulated by plans for the symposium; in addition, the JCRS formed a coral reef conservation committee in 2002 in order to retain the momentum begun with the planning of the ICRS in Okinawa.

It should be clear from the above that diverse approaches are necessary to achieve sustainable resource use in coral reef regions; these approaches include biological and socio-economical research, environmental education, and the involvement of society as a whole, from those at the administrative level to local residents. The JCRS has an important role to play at all these levels.