Preface

Objectives and backgrounds

Coral reefs, including non-reefal hermatypic coral communities, are distributed over almost entire southern half of the coast line of the territory in Japan. In spite of this, most Japanese people are not aware of this fact and have been caught by an illusion that coral reefs belong to more tropical areas. Even Japanese scientists seemed to have believed the same way until recent and thought that coral reef studies could be performed only in the mandated territory of Micronesia and overseas territory of Taiwan. For this reason, when these territories were lost after World War II, they thought that they could no longer carry out coral reef research. This caused a blank period of over 30 years and not a single textbook on the Japanese coral reefs published after even nearly 60 years from the end of World War II. Under such a context, the 10th International Coral Reef Symposium (ICRS) was held on Okinawa where it is the central coral reef distributed area in the country. Taking this perfect opportunity, this book was published by the Ministry of the Environment, government of Japan and the working group which mostly consisted of members of the JCRS (Japanese Coral Reef Society). The primary purpose of this book is to introduce the Japanese coral reefs to both home and abroad. I also expect this book to serve as a good textbook for the better understanding of Japanese coral reefs.

History of research on the Japanese coral reefs

The history of coral reef research by Japanese scientists can be traced to early 1930s. These early researches, made between 1930s and the end of World War II (1945) are almost exclusively made on the coral reefs of the oversea territories, and only few studies were in the home territory.

In 1950, the University of the Ryukyus was established on Okinawa and studies on the coral reefs of the Ryukyu Islands started. But it was only after the administrations of the Amami Archipelago (1963) and the Okinawa Islands (1972) were returned to Japan when the reefs of these islands became fully accessible to the Japanese scientists. Since then, particularly after the last half of 1970s, the coral reef researches became very active.

The Japanese Coral Reef Society

In 1980s, many Japanese coral reef scientists started to express their desire to organize some research organization. JCRS was established in November 1997 with the initiatives of those who attended the 8th ICRS in Panama. The JCRS started with 220 members at the time of establishment and has now increased to 399 (as of May 2004). The fields of specialization of the members are various including; biology and fisheries (144 members), environment and conservation (122), geology and geomorphology (72), sociology and humanity (21), and others (40). Through establishment of domestic organization and expansion of coral reef research in Japan, it was successfully achieved to get nominated to host the 10th ICRS in Okinawa, which had been one of the objectives for the establishment of the JCRS.

Distribution of coral reefs in Japan

The distribution of major coral reefs is now restricted mainly to the Ryukyu Islands (Okinawa and Kagoshima prefectures) and the Ogasawara Islands (Bonin Islands, Metropolis of Tokyo), both ranging between 24°N and 30° N. This range is the northern limit of the World coral reef distribution. In addition, smaller scale coral reefs are found in Senkaku Islands, Daito Islands, Iwojima

(Is.), Minamitorishima (Marcus) (Is.) and Okinotorishima (Parece Vela) (Is.). Okinotorishima (20°N) is the southernmost coral reef in Japan. The northernmost coral reefs in Ryukyu Islands are found at Tanegashima (30° 43′ N) (Nakai 1990) in Kagoshima Prefecture and non-reefal herlmatypic coral communities are distributed beyond north of Tanegashima except at Iki Islands (33° 48′ N) in Nagasaki Prefecture where the highest-latitude coral reef was discovered recently (Yamano *et al.* 2001). These High-latitude coral communities along the Pacific coast can be seen up to Tateyama Bay (35°N) (Nishihira and Veron 1995) which is located at the entrance of Tokyo Bay, owing to the influence of warm Kuroshio Current. These high-latitude non-reefal communities do not develop coral reefs but have similar function and characteristics as coral communities on coral reefs. Therefore, we also included them in this book.

According to Veron (1992), the coral fauna of Japan (400 species) is essentially similar to that of the Philippines (414 species.), which is situated in the center of coral distribution in the West Pacific. Moreover, community structure of the coral reefs of Ishigaki Island, one of the southernmost islands of the Ryukyu Islands, is also similar to those of the central West Pacific (Nakamori 1986).

The characteristics of the Japanese coral reefs

Most of the Japanese coral reefs are the fringing type while Daito Islands are the raised atolls. The deep bore hole made at Kitadaito Island by H. Yabe and his group proved that the reef limestone accumulated over 432 m in thickness and was assigned to the period from lower Miocene to upper Oligocene (Aquitanian to Chattian) (Hanzawa 1941). This showed that the coral reefs on Daito Islands are different in origin from those of the Ryukyu Islands. The ages of the recent coral reefs were 7,000 years in Kume Island (Kan *et al.* 1991) and 8,000 years in Kikaijima (Konishi 1980) both belonging to Holocene in origin.

Coral reef degradation

The Japanese coral reefs are facing with various disturbances both natural and anthropogenic causes in recent years. Accordingly, subjects such as disturbance, monitoring, conservation, restoration, and related legal laws on conservation are dealt as important subjects in this book. The major degrading factors of coral reefs in Japan are reclamation of coastal areas, construction of shore protection and roads, terrestrial outflow of soils, crown-of-thorns starfish (*Acanthaster planci*) outbreak, and mass coral bleaching event due to recent high water temperature trends.

On Okinawa, the first recorded outbreak of *A. planci* occurred in 1969, and by 1980s, the whole coastline of Okinawa Island experienced devastation of coral communities. While the outbreak seemed to be terminated in 1990s, it again occurred at many locations in 2000. The first recorded coral bleaching event took place in Okinawa in 1980, and it had occurred almost in every El Niño years subsequently. The most extensive bleaching event took place in 1998, when a high seawater temperature of 31°C extended as deep as 50 m, many corals bleached and died out from the surface to this depth. The mean live coral coverage decreased to 18 % on Okinawa Island, 8 % on Kume Island, and 62 % on Kerama Islands after this event, indicated large variation among islands (Research Institute for Subtropics 1999).

Conservation and recovery of coral reefs

One of the most effective ways to protect coral reef communities and restore from damages is said to establish marine protected areas. The Japanese Government established marine park zones inside the national parks and quasi-national parks at coastal areas including coral reef areas. These parks have been effective in protecting coral communities from various direct human impacts, but not for the *A. planci* predation and bleaching event.

National and local governments have been conducting extermination of *A. planci* for long time in and near the marine parks. These activities have been effective in removing particular starfish populations, but have not functioned as complete control. The effective countermeasures to control the starfish population are expected to be developed by the new projects supported by national and local government. For controlling coral bleaching, one effective measure must be to establish a larger marine park zones in which a variety of habitats with different sets of environmental factors are included. Among different habitats, there may be some favorable factors for preventing bleaching.

Okinawa Prefecture has established regulations which prohibit collection of corals and controls discharges of sediments to the sea. These are expected to conserve coral reefs on Okinawa. Coral communities can be artificially rehabilitated by culturing the seedlings produced from larvae and transplanting parts of the stock colonies. However, there remains possibility of genetic disturbances and these techniques should not be practiced unless there is no possibility for natural recovery.

The national government has formulated the 'Law for the Promotion of Nature Restoration' in 2003 which is to promote recovery of lost natural environments. Under this law, national government is initiating a coral reef recovery project in the Yaeyama Archipelago. The success of this project is highly expected.

Last remarks

This book gives the first comprehensive description of the Japanese coral reefs including above mentioned disciplines, such as; biology, geology, geomorphology, physico-chemistry and socieology. I truly hope this book will afford a clue to readers a better understanding on Japanese coral reefs, and contribute to succeed beautiful coral reefs to the future generations.

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