Concluding Remarks: Future Perspectives on Coral Reef Studies of Japan – From Biology, Earth Science, and Conservation and Restoration

12

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Abstract

In this chapter, we discuss the future direction of coral reef studies of Japan to facilitate multidisciplinary approaches for understanding various aspects of coral reefs. In particular, we emphasize that the scientific knowledge of coral reefs of Japan would be applicable to practices for conservation and restoration of coral reef ecosystems in the world.

Keywords

Multidisciplinary approach • Global-local impacts • Human activities • Conservation • Restoration

In previous chapters, this book has provided the information on recent important studies in coral reefs of Japan. It is based on various research fields and their significant advances to deepen coral reef science as the results of recent studies of biology, ecology, physiology, ocean chemistry, sedimentology, paleoclimatology, and coastal engineering. It would be difficult to understand coral reefs by focusing on only specific research field. Hence, multidisciplinary insights and approaches will be required to provide a better understanding of coral reefs, to which this book would significantly contribute.

As introduced in some chapters in this book, reef-building coral, which is a most important animal supporting the diversity of coral reef ecosystem, has been well studied from various biological research fields such as ecology, genetics, physiology, and so on. Recent development of high-throughput sequencing technology has been also applied to corals at earlier stage, and decoding of genomic information of corals has been well progressed (e.g., Shinzato et al. 2011). The genomic information has provided various DNA markers for understanding population dynamics and health condition of corals under some environmental conditions, which would contribute to the prediction of coral communities in Japan after disturbances such as coral bleaching, coral disease, and outbreaks of crown-of-thorns starfish (e.g., van Woesik et al. 2011; Harii et al. 2014). Hence, unifying the approaches of biological research fields based on genomic information of corals would be necessary to develop coral reef science further. In parallel, the geological data of coral reef have rapidly increased for the past several decades (Montaggioni and Braithwaite 2009). For example, sedimentological knowledge regarding the growth pattern and internal facies of coral reefs has shown a marked improvement. In this context, knowledge for its controlling factors such as sea level, sea surface temperature, wave condition, and water quality has increased, as the results of field observation and analysis of proxy for paleoclimate. Similarly, knowledge of global-/local-scale future projection for the controlling factors has increased as a result of numerical simulation (Stocker et al. 2013). These findings above imply that future reef growth pattern and its internal facies will be probably projected, but the researches are poorly documented. Generally,

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the geological records provide the information on pristine reefs and its surrounding environmental conditions before the human occupation of the reefs. However, present-day coral reefs have been subject to dramatic declines as a consequence of both global and local impacts. In order to predict future coral reefs, it is necessary to combine the knowledge of pristine coral reefs based on analysis of geological records with that of present-day coral reefs based on analysis of biology, ecology, and the related research fields.

We reemphasize that coral reefs around Japan will provide important knowledge on the topics above because the area is located at the northern limit of the coral distribution, composed by mainly fringing reefs along archipelago, and easily impacted by human activities around coastal areas. Actually, a number of coral reef researches from past to present based on biological and geological studies have been well documented in Japan (e.g., Japanese Coral Reef Society and Ministry of the Environment 2004; Kayanne 2016), and a reanalysis of the accumulated data will probably contribute to understanding the future coral reefs in Japan. In order to collect paleoecological data on coral reefs, the Ryukyu Archipelago is one of the key regions in Japan because the region is characterized by a tectonically active situation, and the Pleistocene and Holocene uplift reefs have developed (e.g., Konishi et al. 1970; Koba et al. 1982). This implies that fossil corals and other marine organisms such as calcareous algae and foraminifera are well preserved. Moreover, archeological and anthropological data in Ryukyu Islands since late Pleistocene are recently accumulated (Nakagawa et al. 2010; Takamiya 2012), and the knowledge of the impact of human activities such as fisheries around coral reefs after human settlements on the region has also been accumulated as a result of analysis of anthropologic remains (e.g., Yamaguchi 2016). Consequently, the area is one of the unique regions to understand temporal change in reef condition from past to future. The knowledge regarding coral reefs around this region would be also informative for the studies of conservation (e.g., marine protected areas: MPAs, world heritages) and restoration (e.g., coral transplantation) of coral reef ecosystems in the world, especially Southeast Asia because the coral reefs around this region have been already degraded by human impacts and emergent measures have been intensively searched.

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