Coral Reef Conservation and Management in China[1]

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Abstract

This paper summarizes the status of coral reef conservation and management in China. Coral reefs in China include fringing reefs found in southern China's coastal waters and associated with 128 atolls in the South China Sea Islands. These atolls have a combined area of about 30 000 km^2. As a result of rapid socioeconomic development and population growth in the coastal region of South China over the last several decades, many coral reefs have been seriously damaged or degraded, largely by inappropriate human activities and consequent pollution. Until now, even though the government has taken some measures to protect and manage the reefs – including issuing relevant laws, establishing natural reserves, creating marine zones – the condition of the reefs has continued to worsen. Surveying, monitoring, assessment and research of coral reefs in China needs to be strengthened in order to meet the changing needs for protection, management, restoration, reconstruction and sustainable development of the coral reef ecosystems.

Distribution of coral reefs in China

Coral reefs in China include fringing reefs found in southern China's continental coastal waters and around offshore islands, and as atolls in the South China Sea (Zhao et al. 1999). Typical fringing reefs occur mainly on parts of the coasts of Hainan Island and Taiwan Island. Owing to the high latitude and low winter temperature, only limited and scattered, sub-tidal coral communities and locally fringing reefs occur along the southern coastline of continental China. These fringing reefs stretch from Dongshan Bay (23°45′N), the western-most bay of Fujian Province, to the western coast of Luizhou Peninsula, and from around the Diaoyudao Islands (25°45′N), to the north of Taiwan Island, to Weizhou Island in Guangxi. Within the vast waters of the South China Sea there are about 128 atolls, or platform reefs, (with a total area of about 30 000 km^2) forming the South China Sea Islands. About half of the atolls (covering an area of only about 5 000 km^2) are emerged atolls, while the remainder are drowned atolls (Zhang 2000, 2001a). The total areas of all reef flats and limesand islets (of which there are about 53) on emerged atolls of the South China Sea Islands are only 907.1 km^2 and 11.41 km,^{2} respectively (Zhao et al. 1999).

Status of coral reefs in China

Because of rapid economic development and population growth in the coastal regions of South China over the last several decades, many coral reefs have been seriously damaged or degraded. This damage and degradation can be traced to human-induced causes, such as coral mining, over-fishing, destructive fishing, and pollution (Zou 1995; Liu 1998; Zhang 2000, 2001a). It has been estimated that as much as 80 per cent of the fringing reefs along the coasts of Hainan Island are damaged or degraded (State Oceanic Administration 1996). In the 1960s, hermatypic corals of the Luhuitou coastlines around Sanya City on Hainan Island consisted of 12 families, 24 genera and 83 species (Zou et al. 1975). They formed approximately 70 per cent of all species on Hainan Island. By the 1990s, these corals had been reduced to only 10 families, 21 genera and 58 species. About one third of hermatypic coral species have become extinct and more than 70 per cent of coral colonies are less than 30 years old (Yu and Zhou, 1996). In the area near Sanya Port and Sanya River inlet, the hermatypic corals are almost completely destroyed and cannot be restored (Zhang 2001b, 2001c).

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The threats to coral reefs in China vary from place to place. The threats to fringing reefs in Hainan Island arise mainly from extractive activities, such as coral mining for building materials and limestone; corals and shell collections for the curio trade; over-fishing and destructive fishing etc. Such activities usually have direct and immediate detrimental effects on the biological and ecological conditions of the reefs. In July 1994, in the northeastern embayment of Hong Kong (Bay of Hong Kong), a strong hypoxia event caused massive mortality of benthic organisms. In that event, the damage to hermatypic corals caused up to 80 per cent mortality on some reefs (Hodgson and Yau 1997). This hypoxia event may have been related to a 100-year record freshwater discharge from the Pearl River combined with calm weather; the combination of the two possibly created the stratified condition (Hodgson and Yau 1997). Higher temperature discharge from the third nuclear power plant at Kenting in southern Taiwan has caused coral degradation and summer bleaching (Zou 1995; Dai 1991) and become an important local threat. In the South China Sea Islands, the greatest pressures on coral reefs come mainly from over-fishing in reef waters and from climate change, with high sea surface temperatures causing coral bleaching.

The general condition of coral reefs in China is still deteriorating. Human impacts are continuing in some coral reef regions, while the rapidly developing coastal tourism industry is expected to seriously increase the pressures on China's coral reefs.

Coral reef conservation and management in China

The general situation

In 1984, the Chinese government declared "environment protection" to be a fundamental national policy; in 1997 "sustainable development" was adopted as a national development strategy. The government has also promulgated a series of laws or regulations related to the protection and management of coral reefs. For example, the State Law of Marine Environment Protection, and the State Management Regulation Preventing Coastal Engineering Projects from Marine Environmental Damage and Pollution, both laws issued in 1983 strictly prohibit coral destruction by any coastal engineering activities (Chen 1993). The former was revised in 2000, putting more emphasis on coral reef protection, restoration of damaged reefs and establishment of marine reserves.

The State Environmental Protection Administration of China conducted the China Biodiversity Protection Action Program in cooperation with nine other government departments with the support of UNDP/GEF. The "China Biodiversity Protection Action Program" was published in 1994). The protection of the coral reef ecosystem was listed as one of the priorities of the program.

The "Hainan Province Regulation of Coral Reef Protection" issued in 1998 prohibits coral mining for building materials and limestones; blast fishing and cyanide fishing; coral and shell collection for the curio trade; and the establishment of waste outfalls into coral reef marine reserves.

In 1996, a program called "Restoration of Coral Reef Ecosystem and Protection and Management of its Biodiversity in South China Sea of China" was included as one of the priority programs of the "21st Century Ocean Agenda of China" (State Oceanic Administration 1996). The "State Law of Ocean Use Management" issued in 2001 requires that all coastal development programs accord with the division of marine functional zones declared by the government. The State Oceanic Administration issued the State Regulation of Natural Reserves in 1994, and the Rules of Marine Natural Reserves Management in 1995. In 1990, the State Council of China approved the first five national marine protected areas managed by the State Oceanic Administration. A further two were approved in 1991. In 1990, the government established the Sanya National Coral Reefs Nature Reserve (5 568 ha) in Hainan Province, and, in 1998, the Dongshan Bay Provincial Coral Reefs Nature Reserve (11 070 ha) in Fujian Province. The reserves implement a policy of "prioritize conservation, appropriate utilization, and sustainable development" (Zhang 2001a). In addition, since 1996, several marine parks or marine protected areas, with the sole aim of conserving coral reefs, have been established in Hong Kong (e.g. Hoi Ha Wan Bay, 260 ha, 1996; Cape d'Aguilar, 18 ha, 1996; and Ping Zhau Island, 270 ha, 2000) (Morton 2000).

A series of studies have been completed on coral reefs associated with fringing reefs and atolls in the South China Sea Islands. These have focused on the resources, environment and ecology of

coral reef ecosystems, with some emphasis on the protection and management of coral reef ecosystems (for example, Zou 1995; Zhao 1996; Chen 1997).

Coral reef conservation and management in Sanya Reserve

The Sanya Reserve, the only extant national coral reef reserve, is located midway along the coastline of Sanya City, lying between 109°21 to 109°40E and 18°10 to 18°15N. It has a total area of 56 km^2, of which about 50 km^2 is in coastal waters. It was established in 1990, and the management office was set up in 1992. The Sanya Reserve is made up of three different coastal regions or sections, namely Luhuitou–Dadonghai coastal section; Dongmaozhou Island and Ximaozhou Island section (in Sanya Bay); and Yalong Bay section (including Yezhudao Island, Dongpai Reef and Xipai Reef). Yalong Bay is the most remote region; and has the most luxurious corals (Wang et al. 1997) in the reserve. The coral reef ecosystem along Sanya City coastline has, for some time, been the source of income for coastal populations that derive their livelihood from the resources. Some of the goods and services generated by the reefs are shoreline protection, nutrient cycling, recreation, tourism and fisheries. The initial aim of the reserve's management was to monitor and end destructive extraction activities in the reef region through both education and enforcement of rules and regulations. In 1995, the authority, in collaboration with a local enterprise, started an experiment on the appropriate use of coral reef resources for tourism in Yalong Bay. The activities included permitted underwater sightseeing of coral reefs from glass-bottom boats, swimming and water sports. Sanya City became one of the 119 major national scenic spots in 1993, with unique tropical coastal tourism resources. Its coral reef ecosystem has become one of the key resources for coastal tourism. Yalong Bay and Dadonghai have become tourism resorts for viewing coastal and underwater coral reefs.

In 1997, 1.3 million tourists visited Sanya City; of these 120 000 were foreigners. About half of the tourists directly or indirectly participated in activities related to coral reef ecosystems. In 2001, Sanya City's GDP was 3 295 million Chinese Yuan (US$399 million), of which 73.75 per cent was generated by tourism activities. A portion of the income from the Yalong Bay tourism enterprise has been used in the construction of Yalong Bay sub-stations of Sanya Reserve and for management activities. The experiment appears to be successful in that alternative sources of livelihood have been established while coral reefs appear to have been protected (Chen 1997). However, in developing similar projects, the authority should closely monitor the carrying capacity of the reef sites to ensure that the reefs are protected. Already, Yalong Bay and Dadonghai are both subject to increasing pressures from tourism activities, highlighting the need to ensure that the Reserve and the coastal activities are sustainably managed. Although tourist operators are trained to disseminate environmental messages to visitors, appropriate protection cannot be achieved if existing tourist programs are not monitored (WWF Hong Kong 1999).

Currently, there is little coral reef monitoring in China. The first Reef Check training and practical activity in continental China was conducted at Dadonghai in the Sanya Reserve in December 2000. UNEP EAS/RCU and Reefcheck Foundation Hong Kong supported this activity (Chen Gang, personal communication 2001).

Marine zones in China

In China, a system of marine zones determines dominant functions for zones. It is based on natural attributes and takes into account social requirements. It is an important basis for, and approach to, integrated coastal zone management, sustainable management, and conservation of marine resources and coral reefs in China. The marine zones for China and onshore provinces in Guangdong, Guangxi and Hainan were published during 1990-93 (Lin Xingqing et al. 1991; Oceanic Bureau of Hainan Province 1992). With the marine zone for Hainan Province, one national coral reef natural reserve (Qinglan Habour–Bo'ao Habour, on the east coast of Hainan) and two provincial coral reef natural reserves (Yangpu Habour-Junbijue Cape, on the west coast of Hainan, and Xisha-Zhongsha-Nansha Islands, in the South China Sea) will be established in the future. Since 1997, the more detailed mapping of marine zones for each onshore city and county has been in progress. National standards (GB17108-1997) for marine zones were issued in 1997 (State Technical Control Bureau 1998).

Perspectives on coral reefs management in China

For the last twenty years, coral reefs in China have been under great stress and management has faced many problems. Special coordinated efforts from the government, local community and scientists are needed to address these problems. The major challenge of coral reef conservation and management for China is to strike a balance between the growing economic development of activities that depend on coral reefs (for example, fishing, aquaculture and tourism activities) and the protection, maintenance and sustainable management of those resources. Both the government and society need to seek a balance between short-term economic benefits and long-term sustainable use of the resources, despite the difficulties involved. Effort needs to be directed to the development of ecologically and socially sound models for better management, and to effective education or awareness programs related to marine parks conservation. Regional and international cooperation programs will also need to play a vital role in these aspects. Surveying, monitoring, assessment and research related to fringing reefs and atolls in China need to be strengthened to satisfy the changing requirements for the protection, management, restoration, reconstruction and sustainable development of coral reef ecosystems.

In the past two decades, the government and general public of China have allocated increasing resources to overcome environmental problems and, specifically, to conserve and manage coral reefs. This has been elaborated in more research projects and financial support dedicated to these matters. Nevertheless, the challenges for ecological and environmental conservation in China, as well as for coral reef conservation and management, relate to the need to address the fact that improvements at some places are counter-balanced by degradation at many other places; improvements at some points are counter-balanced by deterioration across entire areas; and the rate of destruction exceeds the benefits accruing from improvements. The scope of the degradation continues to expand and the intensity of this destruction continues to worsen. The overall scenario of coral reef management in China is not good. (Zhang 2001a).

References

Chen Gang. 1997. Sustainable development and ecological utilization of coral reef resources. Research and Development of South China Sea 4:53-55. (In Chinese).

Chen Zhenyu. 1993. Legislation on mangrove ecosystem conservation in China. Journal of Guangxi Academy of Sciences 9(2):132-135. (In Chinese).

Compiler Group of the China Biodiversity Protection Action Program. 1994. The China biodiversity protection action program. China Environment Science Press. Beijing. (In Chinese).

Dai C. F. 1991. Reef environment and coral fauna of southern Taiwan. Atoll Resources Bulletin 354:1-28.

Lin Xingqing, Ma Yingliang, Yu Mianyu and Xu Guoxuan (eds.) 1991. The division of marine functional zonation of Guangdong Province. Science Press, Beijing: 1-134. (In Chinese).

Liu Ruiyu. 1998. The effects of human activities on benthos diversity, p. 39-46. *In* Center for Coastal Ocean Sciences and Technology, Zhongshan University (ed.). Symposium on Coastal Ocean Resources and Environment '97, Proceedings of SCORE '97. Center for Coastal and Atmospheric Research, The Hong Kong University of Science and Technology. (In Chinese with an English abstract).

Hodgson G. and E.P.M. Yau. 1997. Physical and biological controls of coral communities in Hong Kong, 459-464 . *In* H.A. Lessios and I. G. Macintyre (eds). Proceedings of the 8th International Coral Reef Symposium. Panama, Smithsonian Tropical Research Institute.

Morton B. 2000. Coastal zone management for marine conservation in Hong Kong: The need for regional co-operation in southern China, p. 3-33. *In* B. Morton (ed.). The marine flora and fauna of Hong Kong and Southern China. Proceedings of the Tenth International Marine Biological Workshop, The Marine Flora and Fauna of Hong Kong and Southern China, 6-26 April 1998, Hong Kong. Hong Kong University Press, Hong Kong.

Oceanic Bureau of Hainan Province. 1992. The division of marine functional zonation of Hainan Province. Ocean Press, Beijing, P.R. China, 134 p. (In Chinese).

State Technical Control Bureau. 1998. Technical directives for the division of marine functional zonation. National Standard (GB17108-1997). China Standard Press, Beijing, P.R. China, 20 p. (In Chinese).

State Oceanic Administration. 1996. 21st century ocean agenda of China. Ocean Press. Beijing, P.R. China. (In Chinese).

Wang Lu, Wang Daoru and Chen Gang. 1997. Distribution of submarine landscape in Yalong Bay. Research and Development of South China Sea 2:45-52. (In Chinese).

WWF Hong Kong. 1999. Environment education survey at Yalong Bay, Sanya, Hainan Island, China. WWF Project Final Report (Contract REFERENCE: CN0073.05/China), P.R. China, 39 p.

Yu Dengpan and Zou Renlin. 1996. Study on the species diversity of the scleractinian coral community on Luhuitou fringing reef. Acta Ecologica Sinica 16(5):

469-475. (In Chinese with an English abstract).
Zhao Huanting. 1996. Development of organic reef study in China. Quaternary Sciences 3:253-262. (In Chinese with an English abstract).
Zhao Huanting, Zhang Qiaomin, Song Chaojing, Qiu Zhang, Lin Xigui and Yuan Jiayi. Geomorphology and environment of the South China Coasts and South China Sea Islands. Science Press, Beijing, P.R. China: 370-453. (In Chinese).
Zou Renlin, Ma Jianghu and Song Shanwen. 1975. Hermatypic Scleractinia in Shallow Waters of Hainan Island. Science Press, Beijing, 66 p. (In Chinese).
Zou Renlin. 1995. Status and protection initiatives of coral reefs in China, p. 281-290. *In*
Biodiversity committee of the Chinese Academy of Sciences and Department of Protection for Wild Animals and Forest Plants, Forest Ministry of China (eds). Research progress of biodiversity: Proceedings of first meeting on biodiversity and sustainable development. Chinese Scientific and Technologic Press, Beijing, P.R. China. (In Chinese with an English abstract.)
Zhang Qiaomin. 2000. Mangrove and coral reef coastal resources of China and its development, p. 228-234. *In* Chen Bang-Fuh, Wu Chaoyu, Chen Jaychung (eds). Symposium on Coastal Ocean Resources and Environment '99: Proceedings of SCORE '99, Guangzhou. Center for Coastal and Atmospheric Research, The Hong Kong University of Science and Technology, Hong Kong. (In Chinese with an English abstract).
Zhang Qiaomin. 2001a. Status of tropic biological coasts of China: Implications on ecosystem restoration and reconstruction. Oceanologia et Limnologia Sinica 2(4):454-464. (In Chinese with an English abstract).
Zhang Qiaomin. 2001b. The biogeomorphology of Luhuitou fringing reef of Sanya City, Hainan Island of China. Paper presented at the International Symposium on Monsoon Climate, Geomorphologic Processes and Human Activities, 2000 IAG Thematic Conference, 25-29 August 2000, Nanjing, P.R. China. Chinese Science Bulletin 46(Suppl.):97-102.
Zhang Qiaomin. 2001c. Sad stories of coral reef. Men and the Biosphere 1:21-22. (In Chinese with an English abstract).