

BOOK REVIEW

Title: Coral reefs in India - status, threats and conservation measures

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Coral reefs, mangroves, and seagrass beds provide food security and livelihood options for hundreds of millions of people in tropical countries. An increased demand from growing coastal populations, often in combination with unsustainable management practices, causes a continuous degradation of these coastal habitats, which adversely affect fisheries, tourism, biodiversity and the coastline stability in many regions. Worldwide, coral reefs are under pressure from destructive fishing, coral mining, coastal development, uncontrolled reef tourism, and climate change induced sea surface temperature rise and ocean acidification. In India, the major coral reef areas are located in Gulf of Mannar, Gulf of Kachchh, Andaman & Nicobar- and Lakshadweep Islands and they are all managed through the Forest Department. This book was prepared to share data, stimulate further research and capacity building, and to contribute much needed information for enhanced reef management. The book consists of 26 scientific articles presented in four chapters.

In Chapter 1 (“Coral status and conservation”) eight articles focus mainly on the status, threats and conservation measures taken in practice in the four major coral reef areas. The comprehensive overview of the status, biodiversity and management of the coral reefs, as well as the threats to the same, provides an interesting account of ongoing programmes, as well as of research and management gaps. The first paper provides a very useful framing and preface for the more topic and/or area focused approach in the subsequent articles. The baseline information provided in the different articles can inform further research, monitoring, restoration and conservation programmes. The review of the biodiversity of octocorals in India, for example, illustrates the need for further research on this group.

It is also interesting to read that the “Participatory marine biodiversity conservation” initiative, which was initiated with support from UNDP-GEF through the Gulf of Mannar Biosphere Reserve Trust, inaugurated a new era of conservation in the Gulf of Mannar, which harbour all key coastal habitats such as coral reefs, mangroves and seagrass beds. Conservation and management of this area is very complex as the coast is densely populated and over 150,000 traditional fishers depend solely on coastal habitat associated fishery resources for their livelihood. Other stressors to the marine environment in the Gulf of Mannar include commercial fishing, industries, port activities, thermal power plants, pollution and coastal development. The majority of the reef areas in Gulf of Mannar are located within the Marine National Park and there used to be conflicts between conservation managers (Forest Department) and the coastal community. The formation of 252 Village Marine Conservation and Eco Development Committees (VMC & EDC) along a 160 km coastal stretch, through the UNDP-GEF project, not only contributed to a more conducive environment for coordination among conservation managers and local communities. It also formed a platform for enhancing environmental awareness along the coast. The author points out that this inclusive approach contributed to a total control of coral mining at the 21 islands constituting the Marine National Park. The author also suggests that the enhanced management has contributed to an increase in live coral cover in the Gulf of Mannar between 2005 and 2008.

Chapter 2 (“Coral associates”) presents ten focused research articles altogether covering a wide range of marine organisms, such as crustaceans, molluscs (with a separate chapter on the giant clam, *Tridacna maximus*), ornamental reef fishes, marine turtles, dugongs and whale sharks. Seagrass beds and mangroves, often associated with coral reefs, are treated in a paper each. The articles mainly focus on the present status, threats and conservation initiatives, including community led conservation efforts. An up-to-date account of the status, threats, and afforestation initiatives of mangroves in the country provides useful benchmark information. Also, the data on dugongs in India is generally scarce

and the information gathered in the Andaman and Nicobar Islands through interview based surveys and the pilot scale field surveys can guide further research and the ongoing conservation efforts of these protected species. This also applies for the pilot study on fish spawning aggregations in the Mandapam and Keezhakkarai coasts of the Gulf of Mannar.

In the following chapter (3, "Reproduction, recruitment, and restoration"), featuring only two articles, one article accounts for a study on reproduction and recruitment of corals in Tuticorin coast, Gulf of Mannar. To the reviewer's knowledge the monitoring data of spawning, including in situ observations and recruitment patterns of staghorn corals (*Acropora* sp.) constituted the first published records of this kind in India. The first efforts of coral restoration in India, initiated in 2002 by the Ministry of Environment and Forests and Coastal Ocean Research and Development in Indian Ocean (CORDIO) in the Tuticorin Coast of Gulf of Mannar, are discussed. In the second paper in this chapter, including reports on the relatively high survival rates and the growth of corals successfully transplanted onto artificial substrata. It is suggested that the transplantation of corals has improved live coral cover, coral recruitment and fish abundance in the area as a whole, although the study design and statistical methods behind these results are not clearly accounted for in this paper.

It is worth to add that a valuable effect of the direct involvement of the local community in this restoration project is the enhanced awareness of environmental issues among fisher folks along the coast, which the authors did not choose to focus on in this particular paper. The regular monitoring of restoration sites and presence by the researchers could stimulate local support for further restoration efforts. Coral restoration programmes have subsequently been initiated in the islands of Gulf of Mannar, Gulf of Kachchh and the Lakshadweep Islands.

The final section of the book (Chapter 4, "Coral environment and threats") consists of six research articles on coral diseases, climate change impacts, human threats, water quality changes in reef areas and the impact of the invasion of a non-native seaweed species, *Kappaphycus alvarezii*, on coral reefs and seagrass habitats. In addition to a brief overview of coral diseases in Indian reefs, more

detailed information is given from the Gulf of Mannar and Palk Bay where nine and five coral diseases have been recorded respectively. An overview of the threats to coral reefs in the Gulf of Mannar Marine National Park, including coral bleaching, industrial and domestic pollution, algal blooms, coral mining, destructive fishing practices using a wide range of gears, seaweed harvesting and shell collection, as well as increased sedimentation rates, is also provided.

Moreover, the cultivation of *Kappaphycus alvarezii* (the invasive algae species mentioned above) on rafts above seagrass beds (previously productive fishing areas for local fishers) in the Palk Bay is described. The reduced light penetration due to the seaweed rafts on the surface is suggested to result in inhibited growth and lower shoot density in the seagrass beds, and its potential impacts on fish production in the area are discussed. With reference to this and the observed impacts of the spread of *Kappaphycus alvarezii* to coral reefs, the authors call for targeted policy and management measures in relation to the introduction of non-native species in the marine environment.

The coral reef related research in India has clearly reached a momentum in the last two decades, which has also resulted in an increased awareness of the function and value of the coral reefs among relevant stakeholders, as well as enhanced capacity among researchers and conservation managers. International initiatives, such as Global Coral Reef Monitoring Network (GCRMN), Coastal Ocean Research and Development in Indian Ocean (CORDIO) and International Coral Reef Action Network (ICRAN), contributed substantially to this development in the late 1990s and early 2000s. The Ministry of Environment and Forests of India plays a lead role with considerable financial support through State Forest Department and focused research efforts. The editors have carefully selected the articles to seek to cover a diversity of subjects and baseline data relevant for conservation and management of coral reefs and associated ecosystems in all the major coral reef areas in India.

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