



Conservation, management, and restoration of coral reefs[☆]



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ABSTRACT

The 8th International Conference on Coelenterate Biology (ICCB 8) was held in Eilat, Israel from December 1st to 5th 2013. The conference included 15 sessions, one of which discussed the latest information on the conservation, management, and restoration of Coelenterata in different parts of the world. A total of 16 oral presentations and 5 posters were presented in this session. Of these 21 papers, 11 were related to conservation issues, 7 described management, and 3 discussed restoration. This session provided insights on the current conservation, management, and restoration of coelenterates in different parts of the world.

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1. Introduction

The 8th International Conference on Coelenterate Biology (ICCB 8) was held in Eilat, Israel from December 1st to 5th 2013. The conference included 15 sessions, one of which concerned the latest information on the conservation, management, and restoration of coelenterates in different parts of the world. It also discussed how multi-disciplinary approaches can be applied to the success of conservation plans and management strategies. A total of 16 oral presentations and 5 posters were presented in this session. The presenters were from around the world, including Brazil (3), Canada (2), Finland (1), Italy (2), Israel (5), Norway (2), Taiwan (2), Thailand (3), and the United Kingdom (1). Topics in the session included (i) management of pests and invasive species, (ii) management of anthropogenic activities, (iii) restoration and rehabilitation of coral reefs, (iv) techniques for monitoring organisms, population dynamics, and the health of ecosystems, (v) integrated coastal zone management, (vi) socio-ecological aspects of conservation and management approaches, and (vii) extinction of organisms. Of

the 21 papers, 11 were related to conservation issues, 7 described management, and 3 discussed restoration.

Some novel approaches were presented during the session. For example, Simone Branchini et al. introduced the use of a citizen science program to monitor coral reef biodiversity. Patricia Moreira et al. illustrated a new technique of lowering salinity to manage pest corals. Marco Abbiati et al. described how population genetic research provided invaluable information for scientific management and conservation plans for exploited marine species. Tom Schlesinger and Yossi Loya showed the importance of understanding the dynamics of coral settlement and survivorship to reef management.

2. Reef conservation

Coelenterates, particularly corals, provide valuable and vital ecosystem services. They act as home and nursery grounds for many economically important marine species, protect coastlines from erosion, and provide food sources and income to millions of people living along coastlines (Wilkinson, 2008; Burke et al., 2011). Coral reefs are also potential sources of medicines (Higa et al., 2001; Jain et al., 2008; Rocha et al., 2011). Many marine species found in reefs produce chemical compounds that may be used to treat a variety of cancers, bacterial infections, virus infections, and other diseases (Amador et al., 2003; Fenical et al., 2009; Rocha et al., 2011). More than 3000 natural products from cnidarians have been described so far (Jain et al., 2008; Rocha et al., 2011).

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Over the past years, losses and changes of marine biodiversity in coral reef ecosystems by anthropogenic activities, natural phenomena, and poor land management practices have become urgent issues (Norse, 1993; Côté and Reynolds, 2006). Examples of anthropogenic activities and natural phenomena include pollution release, overfishing, destructive fishing practices, coastal development, introduction of non-indigenous species, unsustainable tourism, climate change, ocean acidification, and tsunamis (Brown, 1987; Bellwood et al., 2004; Chavanich et al., 2005; Wilkinson, 2008; Hoegh-Guldberg et al., 2007; Burke et al., 2011). Coral bleaching is also rapidly becoming a global concern. Abnormally high ocean temperatures are being observed more frequently, and these temperatures could lead to mass bleaching events (Hoegh-Guldberg, 1999; Whelan et al., 2007; Hoegh-Guldberg et al., 2007; Eakin et al., 2009). For example, the coral bleaching event in 2010 caused over 50% of corals to die in some areas (Brown and Phongsuwan, 2012; Chavanich et al., 2012; Phongsuwan and Chansang, 2012).

At present, approximately 75% of coral reefs worldwide are threatened by a combination of local and global stressors (Burke et al., 2011). Among the six affected regions (Atlantic, Australia, Indian Ocean, Middle East, Pacific, and Southeast Asia), coral reefs in Southeast Asia are the most severely threatened (95%) (Burke et al., 2011). Scientists have predicted that if current stressors continue, no reefs will be under low threat by 2050, and 75% of world reefs will be at a high or critical threat level (Burke et al., 2011).

3. Reef management

Increasingly, international and national programs have been initiated to protect and conserve coelenterates. Effective management can minimize threats to coral reefs. To conserve marine biodiversity and communities, an understanding of ecological functions and community structures, including identification of the effects of disturbance, is necessary. However, understanding the limits to sustainability and managing human activities within reasonable limits present challenges. An understanding of the total value of the goods and services of reefs must be achieved to be able to make better management decisions. Effective communication to improve understanding of risks and to ensure sustained application of management measures is also a must (Burke et al., 2011). In

addition, support from all stakeholders at the local to global levels is necessary for management efforts to succeed (Burke et al., 2011).

Inadequate governance and lack of awareness regarding the problems coral reefs are faced with can be observed in many developing countries (Burke et al., 2011). Thus, mechanisms for implementing governance and increasing public awareness including environmental policies and regulations for effective marine conservation are required. One of the best ways of protecting coral reefs is by establishing marine protected areas (MPAs). At present, approximately 27% of all reefs around the world are located inside marine protected areas; however, only 6% are inside effectively managed MPAs (Côté and Reynolds, 2006; Burke et al., 2011). Unsuccessful MPAs may be attributed to a lack of staff and resources, poor enforcement, absence of community involvement, and missing political commitment from governments. If these issues are addressed, MPAs can become effective tools for coral conservation and management. The effectiveness of MPAs can also be enhanced by asking local stakeholders to become more involved in the planning processes, including participating in resource monitoring and ownership.

4. Reef restoration

The need for a strategic approach to restoration to maximize the effectiveness of conservation efforts has become urgent (Edwards and Gomez, 2007; Rinkevich, 2014). Therefore, the restoration and rehabilitation of corals are important endeavors. According to Edwards and Gomez (2007) and Edwards (2010), restoration is the act of bringing degraded ecosystems back to their original condition while rehabilitation is the act of partially or fully replacing the structural or functional characteristics of an ecosystem that may have been diminished or lost, or the substitution of alternative qualities or characteristics, different from those originally present, with the proviso that they have more social, economic, or ecological value than those that existed in the disturbed or degraded state.

Many reefs are severely affected by local stressors; however, despite limited opportunities for survival or recovery, several reef areas have shown resilience to stressors and mass bleaching (Burke et al., 2011). A combination of reef rehabilitation techniques and effective management intervention can improve ecosystem recovery and can provide alternatives to sustainable conservation

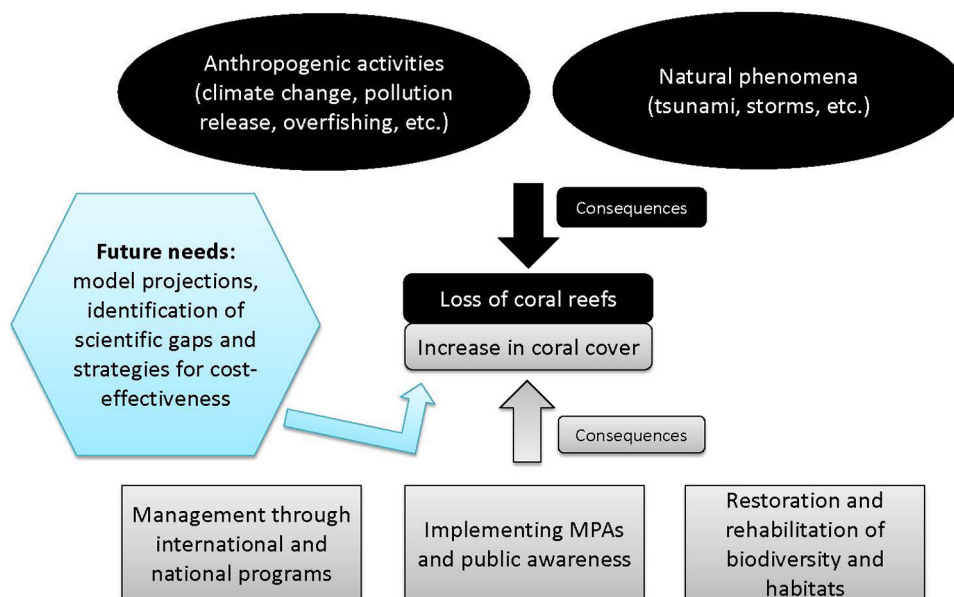


Fig. 1. Main points discussed and presented during the conference session: threats, outcomes, solutions, and future needs for protecting coral reef ecosystems.

(Edwards, 2010; Rinkevich, 2014). Techniques for reef restoration include both physical and biological restoration (Edwards and Gomez, 2007). A common example of physical restoration is artificial reef creation (Edwards and Gomez, 2007). For biological restoration, the techniques include sexual propagation using both broadcasting and brooding corals and asexual propagation using fragments and nubbins (Chavanich et al., 2014).

The management of marine non-indigenous species, as well as marine invasive species is another hot issue. Widespread invasion by marine non-indigenous species has resulted in the loss of native species and damage to fisheries and aquaculture (Williamson, 1996; Carlton, 1999; Senanan et al., 2009). Although the impact of marine non-indigenous species can be observed worldwide, in some areas, such as the Southeast Asia region, the impact of invasive species is minimal or not clearly visible (Chavanich et al., 2010). To protect, eradicate, and manage marine invasive species, a more accurate understanding of invasion vectors and the risk of invasion including collaboration between government sectors and locals is necessary (Lockwood et al., 2007).

5. Conclusion

In conclusion, the ICCB 8 session on the conservation, management, and restoration of coral reefs provided valuable insights into current conservation, management, and restoration measures in different parts of the world (Fig. 1). To conserve and manage coral reefs during the next 25–50 years, multiple stressors and their interactions that threaten reef ecosystems will have to be dealt with. Model projections of possible global situations are crucial for future conservation and management. In addition, scientific gaps need to be identified, strategies to ensure cost effectiveness need to be developed, and measures at both the national and international level should be implemented to ensure the protection of reefs (Fig. 1).

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