

Management During Mass Coral Bleaching Events

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Workshop overview

Mass coral bleaching events and associated coral mortality have now affected every coral reef region. Bleaching caused the destruction of 16% of the world's reefs in 1998 alone, with some locations losing 50-90% of their living coral. These events are predicted to become increasingly frequent and severe, with few areas immune to the effects of warming sea temperatures. But what can coral reef managers and conservation practitioners do about coral bleaching? What sorts of strategies and responses are available to managers, and how effective are they? This workshop provided an opportunity to share experiences among coral reef managers about management during coral bleaching events. The workshop aimed to distil important lessons, synthesise accumulated wisdom and identify strategies for coordinating methods and responses to mass bleaching events in the future. This session included discussion of:

- Predicting coral bleaching events
- Measuring and monitoring coral bleaching
- Attributing coral bleaching to climate variability
- Direct management actions aimed at minimising impacts
- Developing a Coral Bleaching Response Plan

In this session five case studies present examples of management responses during past bleaching events to synthesize activity to date. The first case study highlights experience from the Florida Reef Resilience Program and lessons learnt to date from bleaching response. The second summarizes local and broad-scale responses to the record-breaking Caribbean bleaching event in 2005. The third describes how bleaching in the Kiunga Marine Reserve in Kenya provided an opportunity to strengthen the engagement of local fishers in monitoring and co-management. The fourth describes a regional network in the Asia-Pacific, the Friends of The Reef Program that is building up a Coral Bleaching Response Program. The final case study details direct management actions in response to coral bleaching from experience in the Great Barrier Reef.

Case Studies

1. The Florida Reef Resilience Program: Lessons Learnt to Date from Bleaching Response

Philip Kramer³

Coral bleaching and associated climate change impacts in south Florida are increasingly recognized as major threats to coral reef biodiversity as well as the economies of reef-dependent commercial enterprises. With the frequency and intensity of climate-related impacts expected to increase significantly in the coming decades, the Florida Reef Resilience Program (FRRP) was initiated some two years ago through discussions between the State of Florida, The Nature Conservancy (TNC), the National Oceanic and Atmospheric Administration (NOAA), and the Great Barrier Reef Marine Park Authority (GBRMPA). Ultimately, the FRRP

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³ The Nature Conservancy

seeks to improve management of coral reef resources by raising awareness and providing new tools to coral reef managers that enhance their ability to improve ecological conditions and economic sustainability of south Florida's coral reefs.

The initial program focus has been to examine existing information and address gaps to strengthen the science behind predicting coral reef vulnerability to climate change impacts in south Florida. A steering committee with representative stakeholders and partner institutions has been established along with two working groups: the benthic working group and the human dimensions working group. The benthic-working group developed a regional bleaching disturbance response plan involving 12 different management and academic agencies, which has been successfully implemented for the past two years. Optimising the sampling design for quantifying bleaching impact and incorporating high resolution (1 km) sea surface temperature remote sensing datasets are two of the unique aspects of the bleaching response plan.

The human dimensions working group has developed a framework for linking socio-economic use patterns and is coordinating several stakeholder studies across the south Florida region. In addition to the working groups, community meetings are being held every six months to communicate progress and information to private and public users. This study reviewed lessons learned to date in developing this large and ambitious program.

2. Coral Bleaching: Global Drivers, Local Responses, and the Record Breaking 2005 Caribbean Bleaching Event

C. Mark Eakin, Jessica Morgan, Tyler Christensen, Gang Liu, Scott Heron, William Skirving, Alan Strong and Dwight Gledhill⁴

Coral bleaching has become a major threat to coral reef ecosystems worldwide. In 2005, researchers witnessed the most extensive Caribbean coral bleaching event on record through a variety of approaches. The most intense bleaching was seen along the Antillean Arc, where the thermal stress exceeded any seen in the previous 20 years of satellite data; it was also the warmest in 100 years of instrumental data. Coral bleaching was severe, exceeding 90% at many sites, extending across most of the wider-Caribbean region. Mortality exceeded 40% in some sites. This event highlights the need for managers to prepare for bleaching at two time scales: event response and planning for future climate.

NOAA's Coral Reef Watch program provides a suite of products that can alert managers to potential impending coral bleaching and has developed hydrodynamic models that can be used to help MPA planners prepare for bleaching impacts. NOAA is also developing bleaching forecasts to provide outlooks of bleaching potential months in advance. In conjunction with the World Bank/GEF, NOAA has developed training programs for managers and scientists and has taught these around the world. This talk will discuss coral bleaching (with a focus on the 2005 Caribbean as an example), climatic causes of bleaching, the prospects for future coral bleaching, tools for managers, and the potential for local solutions. More effort is needed to understand how these tools can best be applied to meet local needs.

⁴ NOAA Coral Watch

3. Engaging Local Fishers in Monitoring and Co-management - Identifying Issues, Evaluating Risk and Responding to Future Change

David Obura⁵ and Julie Church

The Kiunga Marine National Reserve (KMNR) lies at the northern extreme of the Kenya coast, at the border with Somalia in the Indian Ocean. The reserve extends over some 60 km in length. Coral reefs of the KMNR are marginal and broken up, unlike the continuous fringing reef of southern Kenya or the extensive reef systems of Tanzania and northern Mozambique. Coral bleaching and mortality during 1998 were severe, at levels of > 80% at all depths. From 1998 to 2006 recovery progressed slowly in shallow inner and outer reefs to levels varying from 20-100% of pre-bleaching levels.

Management actions related to coral bleaching in the KMNR have focused on monitoring, community participation and education. Significantly for the impact of the monitoring programme, the first year's baseline assessment coincided with the onset of mass coral bleaching in March 1998, and gave the first report of bleaching in Kenya during the event. The white corals were clearly observed by participants, but their significance was not apparent due to the common belief that corals are 'stones' and therefore dead (the local Swahili name for coral is 'stone' - '*mawe*').

Participation of fishers and community members in the monitoring programme offered a direct avenue for dialogue between them, scientists and managers on the significance of bleaching. As in many other cases fishers were not easily convinced by scientists and managers preaching on the negative impacts of fishing, however the understanding that their reefs and future fisheries were being threatened by a completely external threat was a powerful eye-opener. The monitoring programme used the opportunity to emphasize the need to manage local threats, primarily the continual increase in destructive fishing practices within the reserve. In subsequent years, repeated sampling on the same reefs inculcated in the monitoring team a real appreciation for how slow and variable recovery of coral communities can be. This paper presented some of the challenges and lessons learned in conducting the monitoring programme to stimulate debate on strengths and weaknesses of the approach.

4. Friends of The Reef Program. Coral Bleaching Response Program in Asia Pacific

Naneng Setiasih⁶

Mass coral bleaching events have now affected every major coral reef ecosystem on the planet, including the Asia Pacific. Understanding the different responses of different sites and environmental conditions is crucial in helping reef managers to cope with the likelihood of more regular bleaching events.

Eight sites were chosen to develop a set of regionally coordinated coral bleaching response plans for the Asia Pacific. The response plan includes a comparative analysis to understand extent and severity of a bleaching event (historical or actual), recovery from a historical mass bleaching event, the relationship between bleaching/recovery and environmental conditions and the relationship between environmental conditions and anthropogenic stressors. The bleaching response plan

⁵ CORDIO East Africa

⁶ Conservation management specialist & Reef Chek Indonesia Foundation

was developed to also provide information on general reef health at each site.

For an early warning system, Friends of the Reef project developed a program called "KEYS" (keep your eyes on reef). This includes monitoring the likelihood of a bleaching event using a scientific information network, as well as reef users on the lookout for the first signs of bleaching at particular sites. Monitoring has been conducted once or twice a year since 2003, depending on the site. Sites inside and outside marine protected areas were selected to test the effect of different levels of protection.

From 2003 to 2006 there was not a significant bleaching event. However, there were several findings that provide management inputs for reef managers. For example in North Bali National Park, the proportion of high resistance taxa increased with distance from the park. Also over time there was an increasing trend in the proportion of low-resistance taxa. Thus the lack of protection of areas outside the park seemed to have no influence on the recovery of corals.

In addition to the regular reef monitoring, we should also consider other research to strengthen our understanding of bleaching events and factors that influence recovery, such as herbivore abundance, acclimatization potential, larval recruitment, connectivity, etc. The findings of the coral bleaching response and the additional research can also be used to understand differences in resilience across sites. This knowledge in the future can support reef managers in managing their area. With limited knowledge and understanding bleaching, it is suggested to widen the area for monitoring by working with more partners sharing the same interest.

5. Direct Management Actions in Response to Coral Bleaching

*Paul Marshall*⁷

There is a significant and growing body of research looking at ways to support the ability of coral reef ecosystems to survive and recover from bleaching events. Experience from sites worldwide is providing case studies and insights about how to prepare for bleaching events, assess impacts from bleaching, engage the public, manage activities that may impact reefs during bleaching events, identify resilient reef areas, and incorporate reef resilience into marine protected area design. The Great Barrier Reef Marine Park Authority (GBRMPA) has developed a Climate Change Response Programme to guide activities during bleaching events. This approach is also being used in Indonesia and the Florida Keys.

Three key actions that GBR managers are taking to address coral bleaching are: (1) increase observations of reef condition before, during and after bleaching to increase information and understanding of impacts and areas that may be especially resistant to bleaching; (2) reduce stressors (e.g., pollution, human use) on reefs during severe bleaching events to help corals survive the event; and (3) design and implement reef management strategies to support reef recovery and resilience. The latter includes strategies such as reducing land-based sources of pollution and protecting areas that may be resistant to bleaching and sources of coral larvae for "reseeding" damaged reefs.

In the GBR, tourism operators are also exploring responses to coral bleaching and climate change. The tourism industry has formed a Climate Change Action group to

⁷ Great Barrier Reef Marine Park Authority

assess risk and identify strategies to increase their capacity to adapt to climate change. Leading operators have also been exploring the feasibility of reducing the intensity of coral bleaching through shading of key tourism sites.

Summary of Recommendations

Coral bleaching events have now affected every coral reef region in the world. It is inevitable that coral reef managers will be required to incorporate coral bleaching into their management approaches. This will deliver multiple benefits, including greater preparedness, timely impact assessments, timely communication, effective engagement with stakeholders, greater knowledge about the implications of coral bleaching and accelerated learning about what can be done. Case studies in this session illustrated the value to reef managers of developing formalised plans for responding to coral bleaching events. Key recommendations from the workshop include:

1. Resources need to be provided to support development of bleaching response plans, especially in developing countries where financial resources and technical capacity may be limited.
2. Reef managers should develop and maintain networks relating to coral bleaching management responses. This is not only important for understanding bleaching in a regional/wider scale, but also for building local and international capacity to predict bleaching risk, respond to bleaching events and manage reefs in the context of climate change.
3. Bleaching response efforts should strive to use standard methods and protocols. This will maximise the potential for regional and international comparisons, and accelerate learning in relation to coral bleaching management responses.
4. The wider community should be involved in monitoring, where feasible. Public engagement is important to access local (non-scientific) expertise and to raise awareness of the implications of climate change for coral reefs. The BleachWatch program (Great Barrier Reef and Florida Keys) and KEYS (Bali) provide good models for this.
5. Further analysis should be undertaken of the feasibility and cost-effectiveness of intervention measures for reducing the bleaching risk at small-scale, high-value (ie tourism) sites.
6. Managers should maintain or initiate baseline monitoring programs to assess long-term impacts of coral bleaching events, and develop protocols for including coral bleaching assessments in existing monitoring programs.
7. Countries with established capacity for coral bleaching response should assist developing countries to develop coral bleaching response capacity. This could occur through training workshops, staff exchanges, or formation of peer networks for managers that link developing with developed country managers.

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