Research Update 20

Coral Reef Targeted Research & Capacity Building for Management

Coral Bleaching & Local Ecological Responses

Our understanding of current and future impacts of global climate change on coral reefs is relatively limited. However, we have now documented a steady increase in the frequency of elevated sea surface temperature anomalies and the often-resulting coral reef bleaching at large spatial scales. Improving our knowledge of the mechanisms, ecological outcomes and economic ramifications of such impacts has been identified as a priority for many coral reef countries. This is critical if we are to accurately project how the health of coral reefs and coastal environs might be impacted as the result of climate change. Gaining this information will be critical for planning strategies designed to stem the degradation of coral reefs and associated marine habitats, and the socio-economic benefits that these provide to reef-dependent communities.

We also need to understand the cost of climate change, especially the relative cost of measures aimed at mitigating the impact associated with climate change. Our understanding will also be critical in assessing the pros and cons of different strategies regarding energy use and the adoption of new forms of energy.

The Bleaching Working Group

The CRTR Bleaching Working Group is focused on filling critical information gaps with respect to coral bleaching and mortality with the aim of supporting management responses for the coming century of climate change.

The Bleaching Working Group has identified four major research themes where it is currently focusing its efforts. These themes are interconnected and aimed at improving the scientific basis upon which management responses will be developed as the climate warms and carbonate ion concentrations in our oceans decline. These themes are:

- Coral-symbiont responses to thermal stress
- Organismal mechanisms to ecological outcomes
- Biomarkers of stress
- Projections of change and socio-economic impact

The Bleaching Working Group is one of the most prominent groups working on the impacts of global warming on coral reefs and continues to bring together and lead research efforts in the area of coral bleaching and ecological change research. Key outcomes from the Group in the past year include:

Dynamics of coral populations under environmental change

The Group has made significant progress on ecological and environmental monitoring.

Coral bleaching within the Basdiot Marine Protected Area, Philippines, summer 2006. Photo: K. Rosell

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WORKING GROUP

The Coral Reef Targeted Research & Capacity Building for Management Program (CRTR) is a leading international coral reef research initiative that provides a coordinated approach to credible, factual and scientifically-proven knowledge for improved coral reef management.

The CRTR Program is a proactive research and capacity building partnership that aims to lay the foundation in filling crucial knowledge gaps in the core research areas of Coral Bleaching, Connectivity, Coral Diseases, Coral Restoration and Remediation, Remote Sensing and Modeling and Decision Support.

Each of these research areas are facilitated by Working Groups underpinned by the skills of many of the world's leading coral reef researchers. The CRTR also supports four Centers of Excellence in priority regions, serving as important regional centers for building confidence and skills in research, training and capacity building.

The CRTR Program is a partnership between the Global Environment Facility, the World Bank, The University of Queensland (Australia), the United States National Oceanic and Atmospheric Administration (NOAA) and approximately 50 research institutes and other third parties around the world.

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Eighteen sites have now being set up at four regional Centers of Excellence in the Philippines, Zanzibar, Mexico and Australia – to establish an integrated understanding of coral reef processes that influence population dynamics and the state of coral reefs.

Dr. L. David and PhD student Victor Ticzon examine observed bleaching in Balingasay Reef, Bolinao, Philippines. Photo: Yanneck Meunier

Fundamental mechanisms of coral bleaching

Progress on understanding the fundamental mechanisms of coral bleaching has now progressed to a point where the Group is developing a synoptic review. This work will summarise the advances in this research area from the past three to five years.

Effects of bleaching on coral and fish communities in the western Indian Ocean

Excellent progress has been made with the compilation of the Indian Ocean coral cover data coming to completion. In addition, a compilation of all species lists of corals in the Indian Ocean has been completed. The Group is now working to analyse coral cover, rates of mortality and numbers of taxa to determine the priority reefs in this region.

Functional diversity of *Symbiodinium*

The Group is examining the functional diversity of *Symbiodinium* (the algal symbiont in reef-building corals) and its role in explaining differences in stress susceptibility among corals and their symbionts. The Group is preparing a paper that will describe 1600 gene products. This is a very important step forward as Working Group members are now focusing on a number of projects looking at genetic responses of corals to stress, which has become a key issue of discussion among scientists. It is also a world-first as no other cDNA libraries of the key symbiont inhabiting reef-building corals have been published.

Geographical diversity of *Symbiodinium*

Research into the geographical diversity of *Symbiodinium* has found different strains in approximately 800 coral species from Zanzibar, Thailand and surrounding regions. Early results from DNA extractions, PCR-DGGE analyses and DNA sequencing of the 550 coral samples from the under-studied Thailand region indicate many new and unusual coral-algae symbioses. While a definitive assessment of how water quality affects these associations is premature, many of the same species of symbiont are being found at mainland and island locations. A conspicuous feature of the region is the occurrence of a 'clade D' species (a group of biological taxa that appears to be thermally tolerant) whose presence is not restricted to turbid inshore areas as previously thought, but which is also found on offshore islands where water clarity is greater.

A butterflyfish picks at the tips of the delicate coral *Seriatopora*, a species very susceptible to bleaching, western Indian Ocean. Photo: Tim McClanahan

Tools for Management

The Group has produced a number of tools or findings relevant to managers and policy-makers that will have significance for understanding and responding to mass coral bleaching.

Among such tools are:

- Colour cards to monitor coral bleaching: colour cards have been produced in partnership with The University of Queensland to monitor coral bleaching across reefs. NGOs, tourist companies and reef enthusiasts in Australia and several other countries are now using these cards.

Bleached corals, southern Great Barrier Reef, Australia. Photo: Ove Hoegh-Guldberg

- Members of the Bleaching Working Group contributed to *A Reef Manager's Guide to Coral Bleaching* which brings together the latest scientific knowledge and management experience to assist managers in responding effectively to mass coral bleaching events.
- 'The Carbon Crisis: Coral Reefs under Rapid Climate Change': This article was produced by the CRTR and published in *Science* Magazine in December 2007. It provides a comprehensive message highlighting the urgent action required to protect coral reefs from rising concentrations of carbon dioxide in the Earth's atmosphere.

On a broader policy front, the research being produced by the Group is confirming the extreme threat that unrestrained global warming and ocean acidification hold for the world's coral reefs.

Further Information

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