

SESSION 7

Managing the Great Barrier Reef World Heritage Area

The Global Coral Reef Monitoring Network: building on Australian research and development

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ABSTRACT

The Global Coral Reef Monitoring Network was established as a response to large-scale damage and destruction of coral reefs around the world. The impetus arose out of the International Coral Reef Initiative, in which Australia has been a driving force since its inception in 1994. The Network, co-sponsored by IOC(UNESCO), UNEP and IUCN and co-hosted by AIMS and ICLARM (Manila), aims to improve the conservation, management and sustainable uses of coral reefs. It will establish a global network, which integrates current efforts to document the biophysical status and trends in the ecosystems and socioeconomic uses of the resources. More importantly, the GCRMN will build capacity in countries with coral reefs, through training and provision of equipment, to monitor the status and trends in their reefs. The GCRMN aims to provide high-quality data on the status of coral reefs for the preparation of predictive global change models as part of the GOOS Coastal Zone Module, as well as providing and disseminating monitoring results to parties responsible for environmental management. The goal is to provide accessible data directly to decision makers and the user public. Monitoring will be based on methods developed in collaboration by AIMS with Asian countries as part of the ASEAN-Australia Living Coastal Resources project (1984-94).

INTRODUCTION

The Global Coral Reef Monitoring Network (GCRMN) has been established to provide data for better management of coral reefs, by harnessing the interest and skills of all users in reef assessment and management. Two major products are envisaged: data on reef status and trends; and people trained to observe reefs closely for cause and effect relationships.

The GCRMN is a component activity of the International Coral Reef Initiative (ICRI), to provide Research and Monitoring information on coral reefs and related ecosystems for more efficient management and long-term conservation (ICRI 1995). The GCRMN is supported by the Intergovernmental Oceanographic Commission of UNESCO, the United Nations Environment Programme and the World Conservation Union (IOC-UNEP-IUCN) and hosted by the Australian Institute of Marine Science and the International Center for Living Aquatic Resources Management (AIMS and ICLARM). Advice will be provided by a widely representative Scientific and Technical Advisory Committee (GCRMN-STAC).

The first concerted effort to document coral reef status and damage by S.M. Wells and others (UNEP/IUCN 1988) reported widespread damage, but found that for significant areas of the reef world, there were no valid data, other than occasional anecdotal observations. The need for long-term coral reef monitoring was the major conclusion at two recent international meetings. At a workshop on coral bleaching and global change in June 1991 (D'Elia et al. 1991) and another in June 1993, featuring collected case histories on effects of stress on coral reefs (Ginsburg 1994), it was recognised that many reefs were being severely damaged by a variety of natural and anthropogenic stress, but data were insufficient to be precise on the extent. This was evident when predictions were attempted on the future of coral reef ecosystems under the growing pressures of human use of reefs (Wilkinson 1993).

To determine long-term patterns over broad scales, monitoring must be both extensive spatially, as well as inclusive of many different reef habitats and states. Much previous monitoring has started with the 'Hughes paradox' – many scientists started monitoring

healthy reefs with high coral cover; rarely did they monitor devastated or damaged reefs with low cover (Hughes 1994a). Thus, many studies reported a decline in coral cover.

To be effective, reef monitoring must encompass the ecological and temporal scales of organism life cycles and rare episodic events, like tropical storms or predator plagues (Hughes 1994a). A few long-term monitoring studies revealed widely different conclusions. Jamaican reefs showed virtually no change in coral cover for approximately 20 years (Goreau 1959), but during the last 16 years there has been a steady decline in coral cover (from 30–80% to < 5%), paralleled by increases in algal cover (Hughes 1989, 1994b). These long-term studies of both algal and coral populations demonstrated the magnitude of changes and the predominant agent responsible – gross over-fishing.

During a 16-year study on the central Great Barrier Reef, Done (1992; Done, in press), demonstrated distinct cycles in the coral communities with a periodicity of approximately 12 years, corresponding to outbreaks of *Acanthaster planci*. During a 30-year study on Heron Island, southern Great Barrier Reef, Connell (1978; Connell, in press) showed marked changes in coral cover and species composition, corresponding to irregular tropical storms. Monitoring of reefs in Kaneohe Bay, Hawaii showed a steady decline due to nutrient pollution, interspersed with periodic community crashes due to freshwater inundation, until the coral community recovered when the sewage was diverted offshore (Smith et al. 1981; Jokiel et al. 1993).

Selective 'short-term' sub-samples within these widely separated studies show very conflicting stories. For example, between 1983 to 1988: Jamaican reefs were gradually declining in coral cover; on the central Great Barrier Reef, reefs were in the initial stages of recovery from almost complete coral loss; on Heron Island, coral cover on the protected crest was declining, but increasing on an exposed crest; and Kaneohe reefs were recovering rapidly. Thus, any attempts of global comparisons based on few, widely dispersed studies are meaningless.

These studies are, however, valuable for management of these locations, and only indirectly applicable to global reef management. Thus, the GCRMN will supplement these detailed studies, using the model of long-term monitoring along the length of the Great Barrier Reef to provide management authorities with valid information of reef status and trends (Oliver et al. 1995). This Australian project was also a model for similar monitoring in Southeast Asia during the ASEAN–Australia Living Coastal Resources project (Chou 1994).

Background to the Global Coral Reef Monitoring Network

The concept of global coral reef monitoring has been discussed in international forums for many years. International environmental agencies assembled a 'group of experts' in Monaco in December 1991, to discuss growing evidence of damage and reef and mangrove monitoring (IOC 1991). This group recommended a pilot scale monitoring project using methods developed during the ASEAN–Australia Living Coastal Resources project (UNEP 1993; English et al. 1994).

At the 7th International Coral Reef Symposium in Guam, 1992, the Global Coral Reef Task Team supported a global monitoring project using the methods recommended (IOC 1992a). Many coral reef scientists and managers reported their willingness to participate in proposed global reef monitoring (IOC 1992b). However, funding was not available to initiate action.

The Global Task Team provided the focus for the GCRMN, stating that the major, imminent threats to coral reefs were anthropogenic, with climate change as a longer-term threat, but an immediate one to coral island communities (Wilkinson and Buddemeier 1994).

A United States Coral Reef Initiative was launched at the UN Global Conference on Sustainable Development of Small Islands Developing States in Barbados in 1994 as a response to the problems facing coral reef countries and to maintain the emphasis on reefs expressed in Agenda 21 of the 1992 UNCED meeting (Crosby et al. 1995). Soon after, another 7 countries (Australia, France, Japan, Jamaica, Philippines, Sweden and the UK) joined the USA to form the International Coral Reef Initiative (ICRI) at the First Conference of Parties of the Convention on Biological Diversity in Bahamas in 1994. ICRI held a major

international meeting in Dumaguete City, Philippines, in mid-1995, which established the GCRMN, and appointed a Coordinator to be administered by the IOC, using US State Department funds.

Objectives of the Global Coral Reef Monitoring Network

The GCRMN aims to improve management and sustainable conservation of coral reefs for people by assessing the status and trends in the reefs and how people use and value the resources. It will do this by providing many people with the capacity to assess their own resources, within a global network, and to spread the word on reef status and trends. These will be achieved through strategic objectives that link existing organisations and people to monitor biophysical and social, cultural and economic aspects of coral reefs within interacting Regional Networks. This will involve strengthening the existing capacity to examine reefs by providing a consistent monitoring program, that will identify trends in coral reefs and discriminate between natural, anthropogenic, and climatic changes. The results will be disseminated widely at local, regional, and global scales as annual reports on coral reef status and trends to assist environmental management agencies implement sustainable use and conservation of reefs. The data will also aid preparation of predictive global climate change models for the GOOS Coastal Zone Module.

Operating Principles of the Global Coral Reef Monitoring Network

The GCRMN *will* emphasise the involvement of local communities in monitoring with equal emphasis on biophysical as well as social, cultural and economic data. Wherever possible, the GCRMN will use existing organisations and networks, integrate existing monitoring programmes, and maintain flexibility to incorporate different methods of monitoring, other than the standard methodology. Much of the monitoring will be in current or planned Marine Protected Areas and adjacent unprotected areas. The Network will be responsive to reef users and provide information back in an understandable format.

Strategies of the Global Coral Reef Monitoring Network

The GCRMN will monitor the current status and future trends in coral reefs and their use through 6 independent ICRI regions: Western Indian Ocean and East African States (island states and countries of East Africa); the Middle East Gulfs (countries bordering the Red Sea to the Persian/Arabian Gulf); South Asia (India, Sri Lanka and Maldives); East Asian Seas (countries from Burma/Myanmar and Japan to Indonesia and the Philippines); the Pacific Island states; and the Caribbean and Intra-Americas, including countries with reefs bordering the Atlantic Ocean.

Within each region, there may be one or more GCRMN Sub-Nodes to coordinate training, monitoring and data management for the 3 to 8 participating countries. For example, Mauritius will be a GCRMN Sub-Node for Western Indian Ocean countries, and Kenya will be another for East African States.

Each Sub-Node will employ a team of trainers and database operators to train other trainers and assist in database operations in adjacent countries. Funding for each Sub-Node will be requested from country, development bank or agency donors, with the responsibility for monitoring devolving to the countries after about 5 years.

The GCRMN will have three interlinked levels: local communities (fishers, schools, colleges, and tourists) monitoring broad areas with less detail; moderate coverage at higher resolution and detail by tertiary trained personnel in Government environment or fisheries departments and universities; and high resolution assessment over small scales by scientists and institutes currently monitoring reefs for research. Considerable monitoring is in progress by institutes around the world and the GCRMN will request these bodies cooperate with developing countries to introduce monitoring. Sub-Node and country trainers will monitor key national sites while providing training to local communities.

A wide range of reef types will be monitored along line transects, assessing easily recognisable lifeforms and fish, especially commercial or recreational species. As people gain more experience, monitoring will be upgraded to species level using the same methods. Local communities will be questioned on their use and knowledge of reef resources and how management may be improved.

Existing or planned Marine Protected Areas (MPAs) will be amongst the main monitoring sites, to provide data on the resources and effectiveness of management. This will be coordinated with the World Bank, IUCN/CNPPA, GBRMPA Global Representative System of Marine Protected Areas project (Kelleher et al. 1995) for site selection and questions asked by management.

Monitoring data will be used to generate annual, country, regional and global summaries of reef status and all data will be stored in ReefBase (ICLARM, Manila).

Two special monitoring projects will be supported by the GCRMN: a pilot programme undertaken simultaneously by research institutes around the world to give a snapshot of reef status; and the development of a tourist monitoring programme, coordinated through tourist operators.

Methods

The GCRMN will feature simultaneous gathering of biophysical, social, cultural and economic data. Biophysical monitoring will be based on a 'standard methodology': manta tow (or equivalent for a broad perspective); line intercept transect with initial identification at 'lifeform' level (or equivalent transect method); and fish censusing, with emphasis on fisher target species and indicator fish, like butterfly (chaetodont) fish (English et al. 1994). Socioeconomic parameters will focus on use of reef resources and community knowledge and attitudes to reef management, along with demographic data and legal and economic parameters.

Monitoring Sites

Countries and GCRMN Sub-Nodes will recommend sites for monitoring based on local requirements and recommendations adapted from the Monaco meeting (IOC 1991). These include assessing: 'pristine' reefs remote from human populations compared to reefs under a range of human impacts; reef flats, reef slopes, both windward and leeward; reefs at geographic extremes e.g. high latitudes, within high and low salinity concentrations; reefs from high to low biodiversity; reefs experiencing the range of storm effects (from equatorial reefs to tropical storm belts at latitudes of more than 7°), the range of oceanic turbulence and current influences, and the range of land run-off; sites monitored in the past, especially those with continuous monitoring data or monitored many years ago; reefs in Marine Protected Areas and adjacent, unprotected reefs; and reefs that have been extensively damaged (natural or human causes). This last category is particularly important to determine the ability of reefs to recover and will require methods aimed at detecting the survival of newly recruited corals.

These sites should cover the complete geomorphologic range of reef types and locations, from fringing reefs close to land to oceanic atolls. The sites should permit discrimination of changes and trends between natural coral reef impacts (storms, fresh water run-off) to global climate change (sea level rise, increased temperatures and radiation, changes in rainfall and current patterns) and anthropogenic pressures (pollution, increased sediment loads and over-exploitation).

Outputs of the Global Coral Reef Monitoring Network

There will be tangible and intangible outputs: data on reef status and trends generated by communities, governments and research institutes; **methods manuals, annual reports and major reports coinciding with the International Coral Reef Symposia every 4 years; an interactive, international network of trained people monitoring coral reefs; and greater awareness by users, public, governments and international agencies, of the need for reef management and conservation.**

DISCUSSION

The GCRMN is an ambitious project aimed at providing data to enhance reef management. The methods and protocols have been largely drawn from studies performed in Australia during the past 15 years. The degree of success will largely depend on the international

community providing funds to support reef monitoring, as there is considerable willingness amongst a large reef user and research community to assist. Simultaneously there will be other projects providing more data, including monitoring by tourists and volunteer divers.

A novel approach has been undertaken by Birkeland and Randall (in press), of relocating sites that had been surveyed previously in Samoa in 1917 and 1973. The GCRMN will benefit from similar studies in progress to provide additional long-term data to the surveys that the GCRMN will add, starting from now.

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