Coral Reef Monitoring in Mozambique: The Program and 1999 Results

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ABSTRACT
Mozambique initiated a Coral Reef Management Programme (MCRMP) in 1998, with the core aim to ensure the long-term sustainable utilization of the coral reef resources of Mozambique. Within the programmed activities, the monitoring of coral reefs is one of the most important. Thus, a long-term monitoring programme was launched in 1999 with most of the monitoring stations being visited in November 1999. Several reefs along the coast were surveyed, using standardized methodology. The preliminary results of this study showed already that protected or inaccessible reefs were in better conditions than those freely exploited, and highlighted the need for management measures and establishment of marine protected areas. The present paper reviews the preliminary results of the monitoring program and discusses its objectives and importance.

RESUMO
Em 1998, Moçambique iniciou um Programa de Gestão dos Recifes de Coral (PGRCM) com o principal objectivo de assegurar, a longo prazo, o uso sustentável dos recursos dos recifes de coral em Moçambique. Dentre as actividades programadas, a monitoria dos recifes de coral é uma das mais importantes. Assim, um programa de monitoria foi lançado em 1999, tendo sido visitadas a maior parte das estações em Novenbro de 1999. Os resultados preliminares deste estudo revelaram que os recifes protegidos ou de difícil acesso, encontram-se em melhores condições que os recifes livremente explorados e realçou a necessidade de medidas de gestão e estabelecimento de zonas protegidas. O presente trabalho faz uma revisão dos resultados preliminares do programa de monitoria e discute os seus objectivos e importância.

INTRODUCTION

Mozambique initiated its Coral Reef Management Program (MCRMP) in 1998 (MICOA, 1998) with the core aim to ensure the long-term sustainable utilization of the coral reef resources of Mozambique. Within this context, other specific objectives were derived, including research on the ecology of coral reefs and the establishment of a network of monitoring sites.

In 1999, the first coral reef monitoring program initiated (Rodrigues *et al*., 1999) being its main objectives:

- Monitor the occurrence of further coral bleaching, COTS (crown-of-thorns starfish) outbreaks and other natural/human disturbances;
- Monitor the biophysical impacts of coral mortality;
- Propose and develop effective measures for sustainable management of the coral reefs as well the possible restoration of damaged reefs;
- Propose and develop pilot activities to provide alternatives to the communities affected by coral degradation consequences;

This monitoring program is a joint initiative of UGC (Unidade de Gestão Costeira), IIP (Instituto de Investigação Pesqueira) and UEM (Universidade Eduardo Mondlane) and is being undertaken with the technical assistance of Sida's CORDIO (Coral Reef Degradation of

the Indian Ocean) and ORI (Oceanographic Research Institute). DANIDA and SIDA/SAREC provided funding. Surveys were conducted covering various reefs from different parts of the country, as representative as possible, using standard, accessible and widely used methodology (described in English *et al*., 1994). For further details the reader is referred to Rodrigues *et al*. (1999).

PRELIMINARY RESULTS AND DISCUSSION

Table 1, summarizes the results of the surveys conducted. Nine reefs, distributed into seven locations, were surveyed. These reefs were considered representative of different situations as far as reef environment is concerned in Mozambique: some are protected, some are over exploited, some are in embayments and others are exposed to ocean conditions.

Table 1. Summary results, based on the main benthic cover and fish trophic groups, of the reefs surveyed during the coral reef monitoring program (Rodrigues *et al*., 1999).

Location	Reef	Benthic cover (%)	Main fish trophic groups (%)
Quirimbas Archipelago	Sencar Channel	Plant material (36) Hard coral (27)	Herbivores (48) Carnivores (37)
Pemba	Ponta Maunhane	Hard coral (70) Plant material (3)	Carnivores (72) Herbivores (13)
Mozambique Island	Sete Paus Island	Hard coral (37) Plant material (37)	Herbivores (78) Corallivores (11)
	Goa Island	Hard coral (28) Plant material (22)	Herbivores (39) Carnivores (17)
Bazaruto Archipelago	Lighthouse Reef	Hard coral (70) Plant material (21)	Carnivores (44) Herbivores (38)
Inhambane	Anchor's Bay	Plant material (19) Hard coral (16)	Herbivores (42) Planktivores (35)
	Mike's Cupboard	Plant material (48) Soft coral (26)	Herbivores (35) Carnivores (26)
Inhaca Island	Barreira Vermelha	Hard coral (61) Dead coral (13)	Carnivores (67) Omnivores (11)
	Ponta Torres	Hard coral (39) Plant material (32)	Carnivores (87) Herbivores (9)

Two main variables were analysed. Benthic cover percentage and main fish trophic groups. From the first variable, the amount of plant material (which included macroalgae, filamentous algae, coralline algae and seagrasses) and coral was selected. In the case of the fish trophic groups, only the two major groups are referred. According to the observations, the following aspects characterize each reef:

Sencar Channel. This reef was severely affected by the 1997/98 bleaching event. Poor status of the reef revealed by high percentage cover of plant material and herbivore fish. Small sized fish dominated.

Ponta Maunhane. Deep reef with good coral cover recovering from previous bleaching. However there is still significant amount of dead coral. Good fish community, with all sizes represented.

Sete Paus Island. Considerable amount of dead coral and plant material characterized this reef, probably due to the effects of bleaching and storm damage. Poor fish diversity. Fish community dominated by herbivores and small sized fish, reflecting fishing pressure.

Goa Island. Seriously damaged reef, from previous storm and bleaching events. Fish community composed mainly by small sized fish and herbivores, reflecting also some fishing pressure.

Lighthouse Reef. Reef in good condition. However, there's a considerable amount of dead coral colonized by coralline algae, indicating probable damage from tidal stress and sedimentation. This a protected reef where fish of > 20 cm were common.

Anchor's Bay. Typical rocky reef from south of Mozambique, fairly colonized by corals. Fish community composed by small to medium sized fish, with a dominance of herbivores.

Mike's Cupboard. Similar to Anchor's Bay, this reef shows a richer community of soft corals. Fish community composed by small to medium sized fish, with a dominance of herbivores.
Barreira Vermelha. Reef in relatively good condition, with physical damage showed by the amount of dead coral, probably from bad fishing practices. This is, however, a protected reef. Good fish community, with all sizes well represented.

Ponta Torres. Reef subjected to tidal and siltation stress, shown by dominance of massive *Porites* corals. Good fish community, where all sizes were represented. This is also, a protected reef.

FINAL CONSIDERATIONS

The installation of the first reef monitoring stations in the history of Mozambique is an important landmark on reef ecology research in Mozambique and a step forward in the implementation of the coral reef management program.

The preliminary results of the surveys reveal that reefs in protected areas (Lighthouse Reef – Bazaruto, Barreira Vermelha and Ponta Torres – Inhaca Island) or with accessibility limitations (Ponta Maunhane – Pemba), were in much better condition (higher values of coral cover, fish abundance and diversity and presence of fish of all size classes) than those reefs that were freely exploited (e.g. Sencar Channel, Goa and Sete Paus Islands). There is clearly a need for ongoing monitoring as in the coming years, monitoring data will reveal trends in Mozambican coral reef conditions and lead to the development of appropriate measures for their management.

An important aspect shown by the preliminary results is the scarceness of marine protected areas (MPAs) considering the length of Mozambique coastline. Recently, Sousa (1998) highlighted the fact that Mozambique has, so far, only two MPAs covering an area of approximately 250 Km^2: Inhaca and Portuguese Islands and Bazaruto Archipelago. In addition, there are three coastal game reserves however, only Pomene Game Reserve protects coral reefs. Protected areas comprise important sources of invertebrates and fish larvae for adjacent harvested areas. The fact that in most of the non-protected reefs large fish were hardly seen provides an important sign of the need for management measures. The growth of

tourism and diving in this country must also be taken into consideration. There is thus, an urgent need for the establishment of more MPAs and sanctuaries as shelters of biodiversity and breeding reservoirs (Rodrigues *et al.*, 1999).

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