STATUS REPORTS FROM DIFFERENT REGIONS 6 (10)

Assessment of the extent of damage, socio-economic effects, mitigation and recovery in Tanzania: Proposal

Christopher Muhando
Institute of Marine Science, University of Dar es Salaam, Zanzibar, Tanzania

Introduction

Coral reefs play a crucial role to the well-being of coastal communities in Tanzania. Coastal fisheries, ecotourism and coastal land protection are, to some extent, sustained by coral reefs. A variety of fish species, spiny lobsters, octopus, sea cucumbers, clams, oysters and turtles form the basis of harvestable reef resources. More than 30% of marine fish landings are harvested on or adjacent to coral reef environment. Coral reefs also support offshore fisheries by providing feeding and nursery grounds for some oceanic (pelagic) fish stocks. Tourism based on coral reef ecosystems is peaking up, creating new opportunities for employment and substantial amounts of income for the people of Tanzania.

The coral reef environment is also an excellent laboratory for demonstrating biological and ecological complexity to students, as well as to the general public. Thus, it has a potential role to play in education and research. Extraction of natural products have shown that the reef environment accommodates organisms whose extracts have pharmaceutical potential.

Recent surveys, using SCUBA, suggest that there are more than 150 coral species in Tanzania (Johnstone *et al.*, 1998). Corals in the genera *Acropora*, *Porites*, *Galaxea*, *Montipora,* are the main reef builders. Other important organisms occurring in and among the coral reefs include fish, crustaceans, molluscs, sponges, algae, seagrasses, polychaetes, bryozoans, echinoderms and ascidians. In spite of several attempts (Horrill *et al.*, 1994; Richmond, 1997, Johnstone *et al.*, 1998), the species inventory of the coral reefs of Tanzania is far from complete.

Due to the narrowness of the continental shelf in Tanzania, coral reefs are close to land. Abundant reefs occur around islands and sand banks in the Mafia, Zanzibar and Pemba channels (see map). The healthier corals occur around the small islets and sand banks, rather than adjacent to mainland, e.g. around the Zanzibar channel islets and in the Songosongo archipelago. In general, as would be expected, coral reefs located far from urban centres have richer resources than nearby coral reefs (e.g. Songosongo archipelago, Mnazi Bay and Mafia islets). Furthermore, due to limited accessibility, fish are more abundant around relatively deeper and/or high current coral reefs than around shallow and protected reefs.

The main environmental factors affecting coral distribution include water depth, substrate type, turbidity, sedimentation, salinity, tides (emersion), water pollution, population explosion of predatory organisms (especially crown-of-thorns starfish) and ecological competition with algae and other non-reef building organisms. The main anthropogenic threats to coral reefs include over-exploitation, destructive activities (fishing and anchor damage), sedimentation (unplanned agriculture and deforestation) and pollution.

In order to prevent and eradicate overfishing and destructive fishing, laws and regulations aimed at preventing overfishing, destructive fishing and environmental pollution have been enacted. Zoning of coastal marine protected areas for reef conservation purposes is another positive step taken by the Government (e.g. the establishment of Mafia Island Marine Park).

Although useful, the current efforts to regulate exploitation of coral reef environments and resources are facing two serious obstacles. The first obstacle is lack of human and financial resources to facilitate proper enforcement of existing regulations, carry out research and monitor the coral reef environment. The second obstacle is that given the current trend in human population increase and the system of free entry to reef resources, efforts to reduce fishing efforts and destructive activities on coral reefs are unlikely to be realised unless new management strategies are instituted.

The status of coral reefs in Tanzania before the bleaching event in 1998

Most reports suggest a widespread degradation of coral reef environments and their associated living resources in Tanzania (UNEP, 1989; Horrill *et al.*, 1994). While a decline in coral reef resources and environment near urban centres is obvious, reefs in remote areas seem to be in relatively "better condition", such as SongoSongo, Mafia, islets in the Zanzibar channel, Misali in Pemba, and off Mnazi bay in Mtwara (this may be incorrect, due to lack of initial or pristine reference conditions). However, after the recent coral bleaching event, the condition of the reefs in Tanzania needs to be assessed again.

Table 1. Bottom cover category summary in some of the monitored coral reef sites in Zanzibar in 1997

Benthic category	Bawe (W-coast)	Changuu (W-coast)	Chapwani W-coast)	Chumbe (SW-coast)	Kwale (SW-coast)	Mnemba (E-coast)
Hard coral	53.11	50.17	44.31	51.85	29.73	13.95
Softcoral	2.45	0.74	2.85	0.76	1.66	30.67
Rhodactis	0.97	6.65	2.37	0.49	0	0.1
Zoanthids	0.14	1.65	0.58	0.05	0.03	0.05
Sponges	0.85	0.09	0.17	0.36	0.18	0
Algae	2.94	10.97	3.88	8.87	28.06	2.44
Others	2.04	2.27	0.74	0.12	0.39	0.03
Substrate	37.5	27.46	45.1	37.5	39.95	52.76

Source: IMS-LGL Coral reef monitoring programme, 1997.

Table 2. The extent of hard coral bleaching on monitored plots in Zanzibar

Coral category	Chapwani	Changuu	Bawe	Chumbe	Kwale
Hard coral before bleaching, October 1997	44.31	50.11	53.11	51.85	29.73
Hard coral after bleaching, November 1998	25	33	45	42	15

Bleached	12.7	14.8	11.8	49.4	36.4
Pertly bleached	21.0	25.8	14.1	9.3	15.0
Dead coral	19.9	5.8	33.2	11.5	7.1
Partly dead coral	2.0	10.0	7.6	13.3	7.7

Source: IMS-LGL Coral reef monitoring programme, 1998

Two factors seem to be associated with coral bleaching in Tanzania: water temperature and rainfall (salinity). The water temperature was 30.5 ^{o}C (according to a temperature logger placed at 3 m on a coral branch at Bawe, Zanzibar), about 2 ^{o}C higher than in the previous year (28.5 ^{o}C) (Figure 1). Even casual swimmers in Zanzibar noticed the rise in water temperature during from the first week of April to the second week of May in 1998. During this period, Tanzania was also experiencing heavy El Niño-rains. The effects of dilution, especially in shallow waters, cannot be ignored, considering that the tidal range was about 4.5 m at spring tides during the bleaching period.

Different views have been expressed on the survival of corals after bleaching. In Zanzibar, survival after bleaching seems to differ between sites. Survival appears to have been high in some reefs, such as Bawe and Chumbe coral reefs (pers. obs.), while in other reefs, like Changuu and Chapwani, coral survival was very low, probably less than 40%. In some of the reefs in the Mafia Island Marine Park, coral death after bleaching was estimated to more than 70%. Due to the lack of a proper coral monitoring programme, the rates of coral survival after bleaching has remained largely unknown for most Tanzania reefs.

The coral death has triggered ecological disturbances likely to start a chain of ecological reactions. After bleaching and eventual death, the dead corals were colonised by filamentous algae. By November 1998, macroalgae and coralline algae had replaced the filamentous algae. Observations made in January 1999 show that small corals have started to recruit in some places, while in other places corallimorpharia and soft corals have established on the skeletons of dead coral. It is unclear how animals that depend on corals have reacted. Obvious, however, is an abundance of herbivorous (algae eating) fish. Although important, animal and plant succession on dead corals has not been given attention in Tanzania, yet.

The effects of coral death on reef fauna and flora have not been clearly established at a national level. However, Pemba dive operators have reported that Misali Island coral reefs may have lost their tourist potential after the bleaching event. There are no such complaints from other tourist diving locations, but the actual economic effects remains to be investigated.

Scientific work on Tanzania coral reefs

A number of national institutions (Training and Research), as well as Government institutions and NGOs are dealing with coastal zone environment and resource management in Tanzania. Among these, only the Institute of Marine Sciences, Frontier-Tanzania (NGO) and Tanga coastal zone program conduct research and monitoring of coral reefs on regular basis. Coral reef monitoring methodologies are not harmonised between the reef study groups, and there is no agreed procedure for exchanging results of research or monitoring. Some actions are required to unify coral reef monitoring activities in Tanzania, but how this should be attained is open for discussion.

At the Institute of Marine Sciences, there are a number of coral reef studies and programmes going on. The main activities on the Zanzibar coral reefs include coral reef monitoring, coral reef mapping,

sponsored by CIDA, Canada, (1994– 1998) and the main objective was training in coral reef monitoring techniques and establishment of baseline data for reefs located off Zanzibar town. The coral reef mapping project is a Sida-SAREC funded activity aiming to describe the distribution of coral reefs in Tanzania. This project is in its final stages.

Other reef programmes at IMS include coral settlement and reef environmental restoration by transplantation of coral fragments. The aim of these activities is to find out whether coral larvae availability and settlement form a problem, and whether coral transplantation is possible and useful or not in enhancing the coral replenishment process in Tanzanian reefs. After preliminary results (Franklin *et al.*, 1998; Lindahl, 1998), more detailed studies are now in progress in Mafia and Zanzibar reefs.

Visiting scientists, PhD and MSc students have been participating in the research on coral reefs. Some examples of these studies are nutrient dynamics on Zanzibar reefs (Muhammed, submitted MSc thesis), coral reef settlement on Tanga reefs (Nzali *et al.*, 1998), distribution of corallimorpharia on Zanzibar reefs (Kuguru, MSc study), distribution pattern of scleractinians on the eastern and western coasts of Unguja Island (Mbije, MSc study) and effects of heavy metals on the growth of coralline algae (Kangwe, submitted MSc thesis).

According to Dr Jean-Luc Solandt of Frontier Tanzania, the current Frontier activities on coral reefs include baseline surveys, scientific research, rapid assessment and monitoring of coastal resources (including coral reefs) and a Marine Education and Training Program. Frontier Tanzania has surveyed and monitored the health of corals in the Mtwara area since 1997. Fish assemblages have also been investigated, from a biodiversity (species) and a commercial (family) perspective. Permanent monitoring plots were selected, and a reef check undertaken in Mnazi Bay in 1997 and 1998. Coral mining and fish landings in Mtwara harbour are being investigated now. Frontier is also currently carrying out a rapid assessment of marine reserves in Dar Es Salaam. At the moment, Frontier has five scientists that could collaborate with the IMS in assessing and monitoring the effects of coral bleaching in Mtwara.

As you may have noted, none of the programmes mentioned above plan to assess the extent of coral death, socio-economic effects or mitigation and recovery of coral after a bleaching event.

References

English, S., Wilkinson, C. and Baker, C. (eds) 1994. Survey manual for tropical marine resources. Australian Institute of Marine Science. Townsville. 368 pp.

Franklin, H., Muhando, C. and Lindahl, U. 1998. Coral culturing and temporal recruitment patterns in Zanzibar, Tanzania. *Ambio* 27 (8): 651-655.

Johnstone, R., Muhando, C. and Francis, J. 1998. The status of coral reef of Zanzibar: One example of a regional predicament. *Ambio* 27 (8): 700-707.

Lindahl, U. 1998. Low-Tech rehabilitation of degraded coral reefs through transplantation of staghorn corals. *Ambio* 27 (8): 645-650.

Nzali, L. M., Johnstone, R. and Mgaya, Y. D. 1998. Factors affecting coral recruitment on a nearshore reef in Tanzania.

Horrill, J. C., Machano, H. and Omar, S. H. 1994b. Baseline monitoring survey of coral reefs and

fisheries of the Fumba peninsula, Zanzibar. *Environmental Study Series*, No. 16.

Richmond, M. (ed.) 1997. A guide to the seashores of Eastern Africa and the western Indian Ocean islands. 448 pp.

UNEP 1989. Coastal and marine environmental problems of the United Republic of Tanzania. *UNEP Regional Seas Report* Stud. No. 106. 33 pp + annex.

Home | **Status report 7**