

6. STATUS OF CORAL REEFS IN EAST AFRICA 2004: KENYA, TANZANIA, MOZAMBIQUE AND SOUTH AFRICA

DAVID OBURA, JULIE CHURCH, CAROL DANIELS,
HASSAN KALOMBO, MICHAEL SCHLEYER AND MOHAMMED SULEIMAN

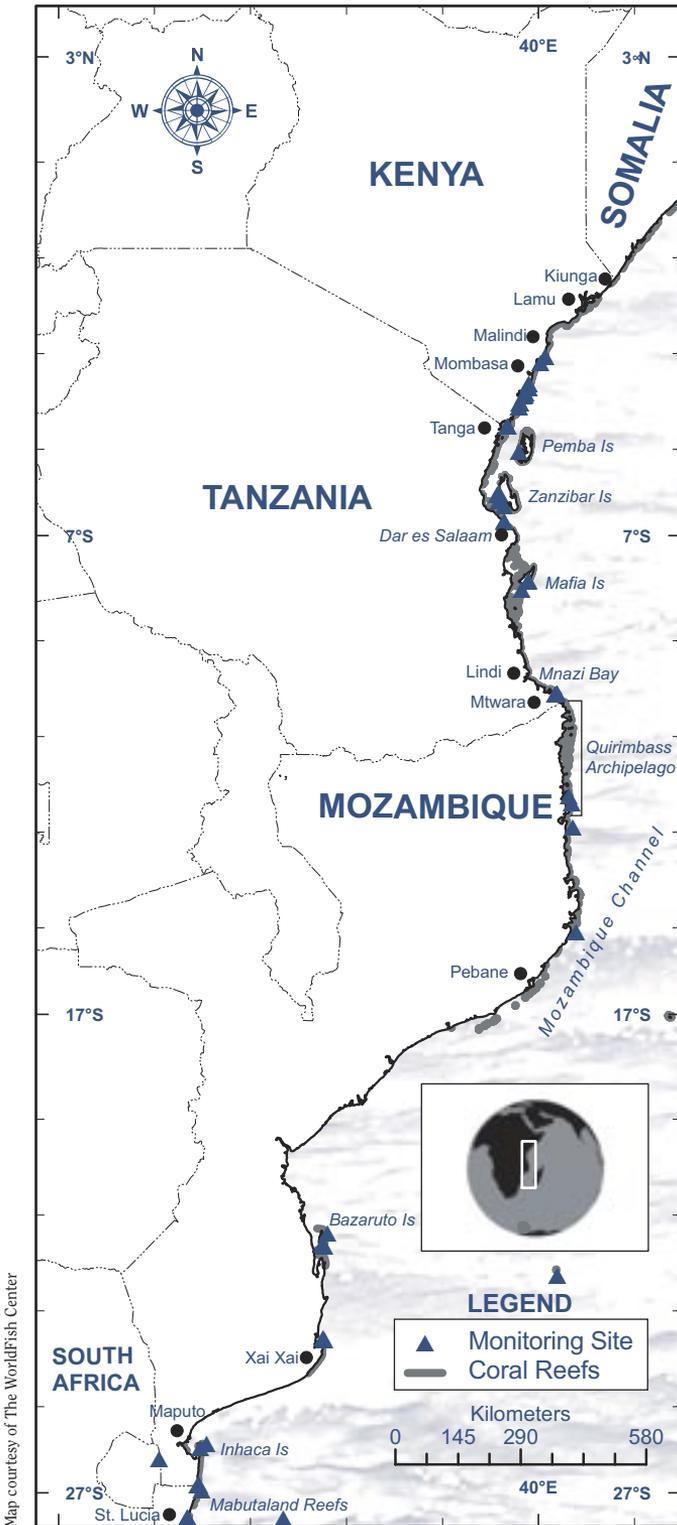
ABSTRACT

The East Africa coral reef bioregion stretches from Somalia to South Africa, and is interspersed with soft sediment habitats caused by the large rivers flowing into the Indian Ocean. The reefs in the region were heavily damaged by the El Niño Southern Oscillation coral bleaching event in 1998. Since then there has been significant recovery, although this has been patchy and influenced by many other local to regional threats. Coral reef monitoring has been conducted by many national agencies, and local and international NGOs, which have been recently coordinated under a developing Coral Reef Task Force. This combines national commitments through the Nairobi Convention and international support through the International Coral Reef Initiative. In the last 2-4 years, there have been significant improvements in the management of coral reef MPAs due to national and regional initiatives, and greater commitment to increase the area of MPAs, (e.g. in Mozambique) and integrate MPAs into larger networks (e.g. Tanzania). Ecological and socio-economic research on coral reefs is expanding in the region, resulting in outputs that are accessible to broader scientific communities. Socio-economic activities on coral reefs are expanding through a number of research and monitoring programs that are raising awareness of the social dimension and importance of coral reefs to local communities and national economies.

This status report summarises the current status of East African reefs by highlighting current threats, recent developments in management and policy, and case studies. This updates the chapter in the previous Status of Coral Reefs of the World: 2002 report by David Obura and 9 other contributors.

100 Years ago: The coral reefs in East Africa were largely pristine, except for localised exploitation and point-sources of pollution around the towns and villages.

In 1994: The coastal population had grown to 10-15 million, and subsistence and small-scale fishing were the dominant threats to coral reefs in East Africa, along with some bomb and



beach seine net fishing. There were few MPAs, and little awareness of the need for improved management of coral reefs.

In 2004: Major coral bleaching similar to that of 1998 and a coastal population of 22 million are the two primary threats to East African reefs. The bleaching caused the decline of 30% of the region's reefs; the population threats are probably slowing coral reef recovery. On the positive side, the coverage and management is improving in MPAs, as is fisheries management and environmental legislation in all countries.

Predictions for 2014: The prognosis for the coral reefs is poor, with a predicted coastal population of 39 million people and the probability that coral bleaching events of similar magnitude to the 1998 event will be repeated. Significant investments in management capacity are needed in all areas, particularly funding to mitigate the likely hardships in vulnerable coastal communities.

GEOGRAPHY, ENVIRONMENT AND POPULATION

The coast of East Africa covers 40° Latitude from the cool upwellings off the coast of Somalia (10°N) to the cool temperate waters off South Africa (30°S). The major influence is the South Equatorial Current that splits north and south near the Mozambique-Tanzania border. The major reef systems include: the complex barrier and island reef systems of northern and southern Tanzania (800 km long) and northern Mozambique (800 km); the narrow fringing reefs of southern Kenya (200 km); smaller isolated reefs along the southern Mozambique coast (500 km) to South Africa (150 km); and patchy reefs in northern Kenya and southern Somalia (500 km).

There are 22 million people living in the East African coastal region, with the population growing at 5–6% per annum due to births and migration from inland rural areas. Coastal poverty levels are high. The indigenous communities of the coast practised traditional fishing for several hundred years, building up strong cultural and religious ties to the marine environment and the resources. These traditional beliefs are being lost as population densities increase and people move in from other areas. This is resulting in a decline in resource status and a replacement of traditional belief systems and values with more 'modern' beliefs and patterns of use.

Coral reef and coastline statistics (modified from the UNEP-WCMC World Atlas of Coral Reefs) indicate that most of the coral reefs on the coast of East Africa are under a high level of risk from human activities. The South African coastline with coral reefs in KwaZulu-Natal is 400 km long, and the area estimates for Tanzania and Mozambique are based only on the MPAs. The Reefs at Risk assessment is adapted from the process in Box 460.

	Somalia	Kenya	Tanzania	Mozambique	South Africa
Marine area (x 1000 km ²)	828	117	241	565	1,525
Reefs at Risk (%)	95	91	99	76	0
Reef area (km ²)	710	630	3580	1860	50
Coral diversity (# sp)	308	>300	>370	>370	90
MPAs - Number	0	9	11	5	2
MPAs - Area (km ²)	0	1,389	1,964	170	2,790

ECOLOGICAL STATUS OF REEFS

The reporting on the status of the coral reefs in East Africa has been dominated by the damage caused by the coral bleaching and mortality during the El Niño event in 1998 and subsequent recovery. The coral cover recovery has been wide ranging at locations along the coastline and is now at 50 to 100% levels. However, many of the reefs that have shown 'full recovery' to pre-bleaching levels had displayed signs of human induced degradation prior to the bleaching. The apparent rate of recovery was more rapid on these degraded reefs, but only on coral communities that already had lost many slow growing and vulnerable coral species and was instead dominated by opportunistic (*Pocillopora*, *Stylophora*, branching *Porites*) and stress resistance species (massive *Porites*, *Coscinaraea*, *Pavona*). In contrast, the reefs showing the least recovery since 1998 are those that were in better health prior to bleaching. Recovery on these reefs has been affected by chronic and local threats, including over-fishing, crown-of-thorns starfish (COTS - *Acanthaster planci*) infestations and repeated minor bleaching events.

Minor bleaching was reported in northern Tanzania and Kenya during the marine summer of March/April 2003. However mortality was generally low, and in some cases the species that suffered the most bleaching damage in 1998, showed less bleaching than others, for example, *Pocillopora damicornis* and common small *Acropora* species.

A patchy, but widespread increase, in COTS numbers was recorded in 2003 and 2004 in Tanzania and Kenya. The first reports in February 2003 were of aggregations of 10-30 individuals per 10 m² spread over 100 m of reef front on an inner patch reef in the Songo Songo Archipelago. In 2004, COTS aggregations appeared on reefs in Tanzania around Unguja Island (Zanzibar), Pemba, Mafia Island, Dar es Salaam, Tanga, and north to Mombasa in Kenya. Some were reported on an isolated reef near St. Lucia, South Africa. COTS numbers have increased a hundred-fold on reefs on the west coast of Zanzibar, from initial densities of 10 per 1,000 m² in early 2003, to 10 per 10m² in August 2004. These are the largest populations seen around Zanzibar for the last 7 years. There are ongoing attempts to control the COTS with the park staff removing starfish from Chumbe Island Coral Park. Dive operators have also assisted in removing COTS and started a collaborative monitoring program. More than 500 COTS have been collected since April 2004. There has been up to 50% mortality of corals from these COTS outbreaks in some areas, and the damage extends down to 30 m depth. Monitoring is continuing to determine the long-term impacts.

The long-term damage from coral bleaching and mortality are becoming apparent with increased rates of coral reef erosion. Surveys in Mozambique in 2004 showed that some reefs had small decreases in coral cover, attributed to a collapse in the reef framework, while coral diversity and community complexity was still increasing. There are examples of coral tables and plates that died in 1998 subsequently collapsing due to bioerosion. These are now being observed elsewhere in the region, such as southern Tanzania, The Maldives and the Chagos Archipelago.

ANTHROPOGENIC THREATS TO CORAL REEFS

The most common threat to reefs in East Africa are the effects of fishing, although the specific threat levels will vary at different sites e.g. the relative damage from excess harvesting, destructive gears and migrant fishermen varies. Beach seines and gill nets, and bomb fishing are typical of destructive methods that cause significant damage to habitats, juvenile fish populations and vulnerable species. The high level of effort by migrant fishing on the larger reef systems

This rating of threats to coral reefs for 3 sample areas in East Africa is based on the experts rating the threat from 1=high to 5=low; 0=no threat. Fishing is the major threat followed by climate change induced coral bleaching.

Country	South Africa	Tanzania	Kenya
Area	Maputaland	Tanga Coastal Zone Program	Kiunga Marine Reserve
% Degraded reefs	<5	75	30
Threat Rating			
Fishing			
Over-fishing	1	3	1
Destructive Gears	1	1	2
Illegal Fishing	1	3	3
Migrant Fishing	0	1	4
Development Threats			
Coral Mining	0	0	0
Natural Gas/Petroleum	0	0	5
Port Development, Pollution	4	0	4
Population Growth	0	2	5
Tourism Development	3	0	0
Other Issues			
Climate Change	3	2	2
Harmful Algal Blooms	0	5	2
Coral/Other Disease	2	5	2
Crown-of-thorns	1	0	0
Others			
Shipwrecks	1	0	0
Isolation	3	0	0

is rated as a serious problem in places such as Tanga, Tanzania. This poses specific challenges to locally-based management. There has been a resurgence of bomb fishing reported on reefs in northern Tanzania (Dar es Salaam, Tanga) in 2003-04, after there had been successful eradication programs by the Tanzanian Government in the late 1990s. The development of fisheries management practices to mitigate these threats is the primary objective in both places. There is an increasing focus on district-level opportunities for management through collaborative arrangements between local government and communities, and cross-sectoral cooperation among government institutions. Increasing human populations are the major driving force behind the increase in fishing damage. Intensive and growing pressure, combined with high isolation and vulnerable environments, such as in the Maputaland reefs of South Africa, contribute to a high threat level.

FRINGING REEFS IN KENYA

Coral reefs in Kenya have been monitored by the Wildlife Conservation Society (WCS) since 1987, with a special focus on the response of these reefs to the 1998 coral bleaching and the 2002 fungal disease events. The studies included 7 fished and 5 unfished (protected) reef sites, and showed that the amount of herbivory (grazing on algae) is 20 times higher on unfished than fished reefs. On the unfished reefs the 1998 bleaching mortality resulted in a temporary transition from dominance by hard and soft corals to turf and fleshy algae, then eventually to calcifying algae. There was less change on the fished reefs, where there was a higher cover of algae and sponges after the disturbance, whereas the herbivores reduced the abundance and persistence of macro-algae on the MPA reefs and created space for new coral recruits; however, the annual rates of coral recovery were still low at all sites. Consequently, the positive value of reduced competition with algae and more space for new coral colonization was probably balanced by higher mortality of corals in the MPAs. The reefs in the MPAs are more diverse and complex than the fished reefs, and the lack of fishing pressures probably makes the MPAs less resilient to climate change disturbances. Coral bleaching and mortality are expected to increase with climate change and algae are expected to replace corals when herbivory is low; the amount of change will be influenced by fisheries management and marine protected areas (MPAs). An interesting finding, was that the high temperature bleaching events had less impact on the structure and species composition of back reef sites, where there are normally large variations in temperatures, compared to the sites in more open water, where temperatures are buffered by oceanic waters. The 1998 event resulted in losses of some of the branching species of *Porites* and *Stylophora*, and relative increases in massive *Porites* and *Favia* species; but there were fewer changes in coral cover and community structure on the back reef sites.

In early 2002, there was extensive coral mortality along 600 km of the coastline from Tanzania to Kenya. *Astreopora*, *Echinopora*, and *Montipora* species were severely affected, with *Montipora* being nearly eliminated from Kenyan reefs. *Acropora*, *Platygyra*, *Goniopora*, and massive *Porites* were also affected; however, *Porites* and *Goniopora* rarely died and recovered rapidly, whereas death for most other species occurred within 2 weeks. The coral tissue showed a dull, ash colour and the skeletons were brittle. Eventually the corals appeared to be covered in white calcareous dust. When examined under an electron microscope, the corals that died were covered in fungi; whereas the others had fewer fungi. This may mean that the fungi possibly invaded and killed the corals after they had been weakened by another, unidentified disease. From: Tim McClanahan, Wildlife Conservation Society, Kenya, tmclanahan@wcs.org.

Potential and actual climate change threats are particularly important, but are outside the management control of local and national MPA authorities in Kenya and Tanzania. Nevertheless, East African countries have been active in the search for local opportunities to respond to climate change threats, by focusing primarily on monitoring and improved communication. The examples of Kiunga (Kenya) and Tanga (Tanzania) are pertinent. Participatory monitoring programs have been established with local communities as the primary implementers of coral

reef monitoring. These have stimulated strong education and communication programs with local stakeholders to raise their awareness of the threat of climate change. This has contributed to developing guidelines on management responses to climate change.

Tourism is often cited as a threat to coral reefs. Unmanaged growth of tourism developments and direct-use activities such as uncontrolled scuba diving often results in reef degradation. A recent study in southern Mozambique of the cross-border diving industry with South Africa, however, found that the damage to destination reefs is still minimal; although scuba diving is increasing with no evidence of management. There are recommendations to determine the carrying capacity of reefs and assess these levels with monitoring and research.

SOCIO-ECONOMIC STUDIES ON CORAL REEFS

The development of socio-economic monitoring of coral reef use is a priority activity under the 2004-2005 biennial work program of the Nairobi Convention, within the ICRI Call for Action, and by regional organisations. Training in socio-economic assessment of coral reefs in East Africa started in 2000 with the publication of the GCRMN Socio-economic Manual for Coral Reef Management and the use of the manual in the first training course for MPA and research staff. In early 2003, the Western Indian Ocean Marine Science Association (WIOMSA) hosted a regional workshop to identify socio-economic research and monitoring needs, and opportunities for capacity building. CORDIO (Box p 110) developed a Socio-Economic Monitoring Program (SEMP) in 2002 targeting MPA and fisheries management institutions in Kenya and Tanzania. This is currently operating in 4 sites on the coast, and focuses on collecting data on the occupational structure, resource use patterns and fisher perceptions of conflict among user groups. These data assist local management agencies improve their management effectiveness, and contribute to regional assessments.

More in-depth socio-economic coral reef assessments have been conducted in Tanzania and Kenya. One study, funded by the UK aid agency DFID in 2003, examined fisheries-associated livelihoods and the constraints to their development. A comprehensive socio-economic assessment of the communities and resource use patterns in the MPA was funded through IUCN at the Mnazi-Bay Ruvuma Estuary Marine Park in southern Tanzania in 2004. It also included a detailed study of the occupational structure of villages adjacent to and in the MPA boundaries. This was the first use of detailed socio-economic data on a MPA Management Plan for East Africa. At a broader level, these studies provide detailed baseline data for future assessments of benefits from MPA and fisheries management at the sites, as well as providing reference areas for understanding the dependence of local communities on coral reef goods and services. The importance of local, indigenous knowledge and the intimate dependence of communities on reef resources is being increasingly recognised by MPA managers in the region, and is forming the foundation of new initiatives for conservation (Box p 178).

MARINE PROTECTED AREAS

MPA management in East Africa has been supported through several key regional initiatives in 2003-04, in addition to national MPA agency initiatives. The East African Marine Ecoregion initiative, spearheaded by the World Wide Fund for Nature (WWF), identified priority sites and seascapes for protection, including some that are currently given some protection as national MPAs. The initiative identified 21 priority areas; 8 were ranked as being of global importance, 7 of ecoregional importance, and 6 of sub- regional importance. Particularly notable at the

LOANS FOR THE FUTURE, AND FOR CONSERVATION – CHOLE, TANZANIA

Hamidu and Nahoda are 16 year old budding entrepreneurs on the small island of Chole, Tanzania. Chole is part of a small archipelago rich with coral reefs, seagrass beds, and mangrove forests, and visited by turtles, humpback and sperm whales, 400 species of fish, and occasional dugong. There are also 15,000 people earning a living from coconuts, fishing and tourism; but life has an easy pace... *Pole pole*, as they say, or 'slowly, slowly'. However, by the early 1990s many islanders' livelihoods were threatened by destructive fishing practices, coral mining, and uncontrolled tourism developments. So villagers asked WWF for help, and with the Tanzanian government, created the Mafia Island Marine Park in 1995.

Since then, they have worked together to eliminate bomb fishing, resulting in a slow recovery of fish stocks. They have also tackled the problem of small-mesh seine nets that catch juvenile fish and damage corals and seagrasses when dragged over the seabed. But replacing the nets and introducing alternative livelihoods is expensive, and the islanders have little money. Thus WWF started an interest-free loans scheme to enable fishers to buy more sustainable fishing gear, and small outboard engines to go out to sea where fishing is better. WWF provided training in running a small business and established 10 village-based savings and loan societies that offered loans to encourage saving. The loans are used to repair boat engines or buy new gear.

"The system is working quite well so far. Most fishers here don't have any experience of owning and maintaining capital assets like fishing gear. The project's aim is to help them develop skills to manage their finances and run a small business - which, of course, they are," explains Jason Rubens, who runs the WWF Mafia conservation support program. "Although the sums involved are relatively modest by outside standards, they do the job and many people here are keen to get involved." New businesses have since started, such as women farming seaweed for carrageenan, and fishermen building fence traps to catch small barracuda and mangrove snapper for the local market. WWF is now investigating the feasibility of a project to grow the local, lustrous bronze coloured pearl oyster for seeding.

After leaving school, Hamidu and Nahoda had little chance of employment, but now they have set up a trial fish-farm with simple 4 x 4 metre cages containing 1,000 juvenile fish which they feed with marine algae. The boys are paid a nominal wage of US\$1 per day to maintain the cages, but when their first harvest is ready at 8 months, they could sell the 250 kg of fish for about 125,000 shillings (US\$125); about 3 to 4 months income for a good fisherman. These are start up loans to provide long-term sustainable livelihood options for the community. The WWF project aims to further the conservation of the coastal systems and species by helping the residents earn sustainable livelihoods through the maintenance of a healthy resource base. From: Peter Denton, Principal Editor, WWF-UK, pdenton@wwf.org.uk; and Jason Rubens, WWF Mafia Island, JRubens@wwftz.org

national level was the expanded commitment by the Mozambique Government to increase the area protected under MPAs with the declaration of the Quirimbas National Park and the Quilalea Reserve, and a national review of MPA coverage for Tanzania, supported by the World Bank (Box p 180).

Two major tools were developed to assist managers in the region by the IUCN East Africa Regional Office: 'Toolkit for MPA Practitioners in the Western Indian Ocean' (www.wiomsa.org/mpatoolkit.htm), and 'Management Effectiveness Workbook'. An IUCN Regional Task Force identified the need for more locally accessible and applicable materials for use by MPA managers within the Western Indian Ocean Marine Biodiversity Conservation Project (funded by NORAD). MPA managers and practitioners recognised that many guidelines, training manuals and other relevant materials already existed but were not readily available. They recommended preparation of a Toolkit and Workbook on Management Effectiveness to assist MPA managers and practitioners access existing information on MPA establishment, management and assessment.

The Third Regional Training Course in Marine Protected Area (MPA) Management in the Western Indian Ocean region was held in August 2004, in Malindi, Kenya. The course was run by WIOMSA and attended by 27 people from 7 countries, following earlier courses held in February 2000 in Malindi, Kenya and June 2002, in St Lucia, South Africa. The course provided training in skills, techniques and tools for effective management of MPAs, in order to build a pool of competent MPA managers who would promote an effectively managed system of MPAs in the region, and provide an opportunity for MPA professionals to learn and share experiences on MPA management in the region. The course was for senior staff from existing MPAs in the region and other organisations involved in MPA management, and was based on the 'Training for the Sustainable Management of Marine Protected Areas' manual, and the IUCN tools, the 'Toolkit for MPA Practitioners in the Western Indian Ocean' and the 'Management Effectiveness Workbook'.

As an example of increased capacity and management technology, coral reef research and monitoring efforts in South Africa are focused on assessing the entire coral reef system in order to develop a comprehensive management plan. There is extensive dive tourism on these reefs; much higher levels than in nearby Mozambique. Scientists of the Oceanographic Research Institute in Durban characterised and mapped the reefs of KwaZulu-Natal using underwater digital image analysis, hydrographic surveys and remote sensing techniques. They will make recommendations on the establishment and efficacy of sanctuaries to protect sensitive areas with important concentrations of biodiversity.

NATIONAL AND INTERNATIONAL POLICIES AND INSTITUTIONS

The 'revitalization' of the Convention for the Protection, Management, and Development of the Marine and Coastal Environment in Eastern Africa (the Nairobi Convention, adopted in 1985) has contributed significantly to the increase in activities for coral reef conservation and management. Most recently, regional integration of coral reef activities in East Africa and the Indian Ocean Island countries was given a boost through a renewed call for action and the formation of the regional Coral Reef Task Force under the Nairobi Convention (the Regional Seas Convention for the Protection of Marine and Coastal Environments). Initially established at the Conference of Parties of the Convention in 2001, the Task Force held its second meeting during the COP meeting in Madagascar, in July 2004, where the need to strengthen and

A NETWORK OF MPAs IN TANZANIA

Tanzania declared its intention to increase protection of its seas to 10% by 2012, and 20% by 2025 to participants at the World Parks Congress in Durban in 2003. This new network of MPAs would include more coral reefs of Tanzania than the 1.9% that is totally protected now. A study which identified options to develop a national MPA system using support from the World Bank is the basis for a new World Bank and GEF project - Marine and Coastal Environmental Management Project. This is intended to support marine and nearshore policy reforms and policy implementation to improve the quality of life of coastal populations and maintain the integrity of coastal and marine resources of national, and international, significance. A series of subregional MPA networks was proposed, based on the multi-stakeholder visioning exercise coordinated by WWF's Eastern African Marine Ecoregion Program to include the main high biodiversity areas as follows:

1. The northern Tanga Region: a transboundary area with Kenya including reefs and fisheries managed under Collaborative Management Areas Plans and implemented jointly by villages and the Districts. This includes Maziwe Island Marine Reserve, managed by Pangani District for the National Marine Parks and Reserves Unit;
2. Pemba Island: the northern island of Zanzibar with only one MPA, the Misali Island Conservation Area (a no-take zone and a low use zone), managed jointly by the Misali Island Conservation Association (MICA) and the government;
3. Unguja Island: the main island of Zanzibar with 3 MPAs: Chumbe Island, a small no-take MPA with management by the private sector; the Mnemba Island Conservation Area and the Menai Bay Conservation Area are larger MPAs where regulated fishing is allowed and managed by the Department of Fisheries with a private lodge and local villages;
4. Dar es Salaam-Bagamoyo: the Dar es Salaam MR System with 4 designated Marine Reserves managed as a single system;
5. Latham Island: an offshore island south of Dar es Salaam with significant coral reefs and seabird populations;
6. Rufiji-Mafia-Kilwa-Songo Songo complex: Mafia Island Marine Park; potentially a World Heritage designation, and proposed for a Ramsar site with the mangroves of the Rufiji Delta; and
7. Mtwara. District: including the multiple-use Mnazi Bay-Ruvuma Estuary MP; a potential transboundary conservation area with Mozambique.

An important addition to achieve the 10% and 20% goals will be the development of an MPA network for offshore and oceanic waters. These potential subregional networks of mixed MPAs will require the development of new MPAs to ensure that the sites are systematically linked. New research is needed on bleaching and recovery patterns on reefs to help understand larval dispersal and current patterns. Socio-economic data and information are also needed, notably fishing patterns (there is close correlation between high biodiversity areas and high fishing effort) and plans for tourism development (coastal areas are top priority in the national Tourism Development Plans). From Sue Wells, WWF Tanzania.

coordinate national task forces was identified as a primary goal. Potential options for funding of improved coordination were investigated.

CONCLUSIONS

East African countries are making significant national commitments to conserve and manage coral reef resources because of their importance in supporting coastal populations. However,

This table summarises the current status of the reefs in East Africa and makes predictions for the future. These are based on estimates from East African experts, however, it is acknowledged that there are large gaps in knowledge about coral reefs in the region and extrapolations were necessary from the limited amount of long-term monitoring data.

	Kenya	Tanzania	Mozambique	South Africa	REGION
1. seriously damaged or totally destroyed –	10	10	10	0	7.5
2. strong recovery since 1998	30	30	30	NA	30
3. high risk: clear damage -	30	20	20	10	20
4. medium risk: moderate damage -	30	30	10	30	25
5. low risk: healthy and relatively stable	0	10	30	50	22.5

- 1. 90% of the corals are gone and unlikely to recover soon
- 3. 50 to 90% loss of corals and likely to join category 1 in 10 to 20 years
- 4. moderate signs of damage - 20 to 50% loss of corals and likely to join category 1 in 20 to 40 years.
- NA. not applicable, as there were no losses in 1998.

this is occurring as the coral reef resource baseline is declining due to over-exploitation linked to increasing population levels, and climate change threats derived from an expansion of the global economy. There are insufficient data to fully understand the threats and set management priorities, e.g. for over-fishing, destructive fishing or coral bleaching. Substantial management interventions will be necessary to relieve the worst impacts of change on vulnerable coastal populations, and to contribute to possible long-term recovery of the coral reefs.

100 Years ago: While there is no quantitative information from this time, coral reefs in East Africa would have supported subsistence fishing of small indigenous communities, and the urban populations of the main Swahili towns and settlements. Impacts were probably minimal and localised, as local populations had adequate marine and terrestrial (agricultural) resources to exploit. Therefore the reefs were in near pristine condition with only small examples of damage near towns and losses of some species e.g. turtles and dugong.

In 1994: The coastal populations of Mozambique, Tanzania and Kenya had increased dramatically to approximately 10-15 million. The expansion of subsistence and small scale fishing was still the dominant threat to coral reefs in East Africa, with only the most remote areas of northern Kenya, southern Tanzania and northern Mozambique showing minimal exploitation and damage. These areas were exploited by migrant fishing, and the use of destructive techniques (bombs, seine nets) was common. Around some major population centres, coral reef fisheries had been depleted for more than 20 years, and pollution of coastal waters from urban centres

was evident. There were few concerns expressed by governments about the status of the coral reefs and management of existing MPAs was focused on tourism benefits rather than resource conservation.

In 2004: The coastal populations have increased to 22 million people, with ever increasing pressures on coral reefs and their resources. The massive coral bleaching of 1998 which caused declines in approximately 30% of the region's reefs, further exacerbated the continuing increases in fishing pressure. While there has been notable recovery of corals in some areas since 1998; the recovery is estimated at about 30-50%, however, many depleted reefs have shown no recovery. Management efforts are increasing in all countries, with significant commitments being made to increase the area of Marine Protected Areas, improve fisheries management and implement environmental legislation. There is also a sense of cooperation between countries along East Africa to develop networks of MPAs to ensure the availability of coral reef larvae.

Predictions for 2014: At a current growth rate of 6%, coastal populations will be nearly double at 39 million in 10 years time, exerting even greater pressure on reef resources. A repeat coral bleaching event similar to that of 1998 is likely. Pollution around major urban centres will increase, and the growth of secondary towns will add to the number of sites with significant point-source pollution threats. The area of marine habitats under strict management will increase in all countries, possibly approaching the regional goal of 20-30%. However, without significant investments in capacity in all areas, the effectiveness of these efforts may be limited, resulting in greater declines in the regions' reefs.

RECOMMENDATIONS

The recommendations for improved management expressed in the Status of Coral Reefs of the World: 2000 and 2002 reports are as valid in 2004 as they were then. These called for: improved monitoring and adaptive management; the incorporation of socio-economic information into management and policy development; and streamlining regional networks, collaboration and support. Implementation of these recommendations is underway in numerous ways in the region. Therefore the current recommendations focus on improving and institutionalising current trends, including:

- Strengthening and institutionalising cross-sectoral and between-country collaborations in all areas of management, legislation, policy and science. This should include improving management within MPAs and in adjacent un-managed areas;
- Strengthening cooperation in ecological and socio-economic coral reef monitoring and the sharing of data and information;
- Increasing national and local support for management through greater allocations from governments, and investments by the private sector; and
- Increasing funding support from external agencies to fill the widening gap between resources and required actions to mitigate the degradation of reefs in the region.

AUTHOR CONTACTS

The National Coral Reef Task Force/Coral Reef Monitoring Program coordinators are:
Kenya - David Obura, CORDIO East Africa, Mombasa. dobura@africaonline.co.ke; Tanzania - Christopher Muhando, Institute of Marine Science, Zanzibar, muhando@zims.udsm.ac.tz;

Mozambique - Alice Costa, WWF Mozambique. adabulacosta@wwf.org.mz; South Africa - Michael Schleyer, Oceanographic Research Institute, Durban, schleyer@freemail.absa.co.za.

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ICRAN

MALINDI AND WATAMU NATIONAL PARK AND RESERVE, KENYA

The Malindi and Watamu National Reserve encompasses Watamu and Malindi Marine National Parks, the first marine parks established in Kenya in 1979. These MPAs encompass coral reefs, seagrass beds and mangroves and used by nesting turtles and several marine mammal species. The ICRAN project focuses on coral reefs, developing management action strategies and small-scale infrastructure, a review of socio-economic issues and current management plans, and development of a training and education network. Monitoring equipment has been upgraded and small-scale infrastructure has been renovated and constructed, including community boat storage and repair facilities, and offices and community shops. Conflict and maintenance data, visitor and fisheries catch statistics have been compiled and a biophysical profile developed. A community mangrove boardwalk was constructed in Watamu, and bird hides rehabilitated for ecotourism to demonstrate sustainable mangrove uses and help generate funds for local schools.

The Malindi Resource and Training centre facilities were upgraded and receive more than 120 visits from schools and universities every year. In 2004, the Centre hosted the Reef Check/ West Indian Ocean Marine Science Association 'Training of Trainers for Voluntary Monitoring of Coral Reefs', and the training course for regional MPA managers. Malindi will continue as a centre for awareness raising and training. Despite early challenges, this project has resulted in a consultative partnership between local communities and managers. The focus on management effectiveness has generated momentum within Kenya Wildlife Service, and managers now collect information for an initial MPA assessment.

Ecological Monitoring: Ecological monitoring is undertaken in Malindi by the KWS, the Wildlife Conservation Society, Coral Reef Conservation Project, and the CORDIO project, but MPAs are also initiating their own basic monitoring. Information on benthic cover, coral and fish diversity, coral recruitment, fish abundance, predation, herbivory, and density of invertebrates is collected annually. There has been some recovery from the 1998 mass mortality with new coral recruitment and re-growth. There are also indications that more rapid recovery, higher species diversity and higher fish abundance occurs in no-take zones than adjacent fished areas.

Socio-economic Monitoring: The draft management plan needs updating. During its development, considerable socioeconomic data were collected, and fisheries catches monitored. A socio-economic assessment of Malindi boat operators highlighted gaps in business management and investment practices.

Contact: Mr. Korir, Senior Warden, Kenya Wildlife Service, malindimnp@swiftmalindi.com, or Nyawira Muthiga, nmuthiga@Africaonline.co.ke

Coral reefs are 10% of the natural resources.

Ecological Monitoring is effective.

Socio-economic Monitoring is planned.






ICRAN

CHUMBE ISLAND CORAL PARK EDUCATION PROGRAM, ZANZIBAR – ICRAN FUNDED PROJECT

Chumbe Reef Sanctuary covers 30 ha of fringing reef with about 50% coral cover, 20% seagrass beds, and 30% sand flats. The reef is one of the most pristine in the region, with more than 370 species of fish and 200 species of reef-building corals, representing about 90% of all reef fish and corals in East Africa. Chumbe Island Coral Park (CHICOP) was established in 1991 as a privately funded coral reef conservation project that designated Chumbe Island and its western fringing reef into a fully managed no take area and became an officially gazetted MPA in 1994. CHICOP conducted baseline surveys, built a visitors' centre and a small eco-lodge, trained local fishermen as park rangers, produced a Management Plan for 1995-2005, and raised awareness of government and community through an Advisory Committee.

A few years ago, these coral reefs were under serious threat from: overfishing; destructive fishing practices; pollution; and sedimentation, which led to a decline of fish landings and increasing destruction of the formerly pristine reefs. Public awareness about the need for sustainable management of these precious resources was urgently needed, but coral reef ecology was poorly covered in the school syllabus. Field excursions were rarely organised, and few children had the opportunity to visit a coral reef. School children, particularly girls, do not normally learn how to swim and snorkel. To raise awareness and knowledge of reefs, CHICOP conducted school field trips and a course for secondary students and their teachers. Guided by park rangers, the children learned firsthand about Marine Biology and Environmental Protection. Recently, CHICOP has conducted school excursions (600 children and 60 teachers), facilitated a stakeholder meeting, provided training of Rangers, negotiated to integrate this course into all secondary schools and teacher training, and conducted public evaluation of the project to further include all local stakeholders.

Ecological Monitoring: Park rangers have been stationed on the island since 1992 and produce weekly reports on coral bleaching and storm and anchor damage. They are now ReefCheck trained to complete systematic ecological monitoring including surveys of corals, fishes, and invertebrates.

Socio-economic Monitoring: Socio-economic monitoring includes research on short-term and long-term benefits to local communities. A recent study established that local fishermen have reported 'spill-over-effects' (increased catches in adjacent fishing grounds), contributing to their acceptance of the no take area.

Contact: Sybille Riedmiller, (sibylle@chumbeisland.com, info@chumbeisland.com)

Coral reefs are 50% of the natural resources.

Ecological Monitoring is occasional.

Socio-economic Monitoring is occasional.

ICRAN

DAR ES SALAAM MARINE RESERVE, TANZANIA – DEMONSTRATION SITE

North of the commercial city of Dar es Salaam, there are marine reserves around 4 islands: Mbudya, Bongoyo, Pangavini, and Fungu Yasini. Their coral reefs, mangroves and seagrass beds are jointly managed as the Dar Es Salaam Marine Reserve System (DMRS). In the past, the reserves have been overexploited by fisherman and physically damaged by unregulated tourist activity and dynamite fishing. To help manage the park, the Marine Parks and Reserves Unit (MPRU) has developed a collaboration whereby community members are certified to become Honorary Rangers (HR). The HRs, many former beach boys whose status has been raised with an education and job qualification, improve services for visitors by keeping the beaches clean, providing first aid and information, confirming that visitor fees have been paid and helping with park surveillance. Since the introduction the number of paid fees has increased dramatically, making the scheme self-financing. The HRs are responsible for giving informative tours at the visitor centres and have been trained in coral reef monitoring, snorkeling, rescue and life saving together along with other community members, park staff, and students.

The ICRAN project has provided the MPRU with a boat and engine, GPS equipment, binoculars, demarcation buoys, radios and handsets to strengthen the communication and enforcement activities. There have been several arrests and convictions and dynamite fishing has been significantly reduced. In addition, 2 visitor centres have been constructed at Bongoyo and Mbudya which provide outreach materials and information. Community members and MPRU staff have visited other MPAs in the region, to observe their conservation management strategies in order to establish the best practices at DMRS. Initial community engagement for the DMRS General Management Plan, has involved 3 awareness meetings on effective community participation in the sustainable use of marine resources. As a result of these meetings, community fishers have been selected as ambassadors for the park.

Ecological Monitoring: Reef fish biomass and species diversity have increased over the past four years, mainly as a result of improved enforcement of reserve regulations. However, coral cover is now over 95% *Montipora*, whilst other species have decreased in abundance. There are few lobsters, ornamental and edible molluscs, and sea cucumbers, primarily due to over-fishing. Non-commercial starfishes have declined while coral-eating crown-of-thorns-starfishes (COTS) are on the rise.

Socio-economic Monitoring: There has been very little work on the stakeholder interactions with the resources of Dar es Salaam Marine Reserve. The key stakeholders have been identified and their attitudes and interests have been assessed as well as the potential socio-economic benefits relevant to the sustainable use of marine resources.

Contact: Chikambi Rumisha, (ckrumisha@hotmail.com)

Coral reefs are 30% of the natural resources.

Ecological Monitoring is occasional.

Socio-economic Monitoring is occasional.



KIUNGA MARINE NATIONAL RESERVE, KENYA – MAN AND THE BIOSPHERE RESERVE

Kiunga Marine National Reserve is a MPA covering 250 km² in northern Kenya, near the border of Somalia. It was formed in 1979 and together with the terrestrial Dodori National Reserve became a UNESCO Biosphere Reserve in 1980. The reserve includes a chain of about 50 offshore islands and coral reefs in the Lamu Archipelago, running parallel to the coastline and adjacent to Dodori and Boni National Reserves on the mainland. The islands vary in size from a few hundred square metres to larger than 100 hectares and provide important nesting sites for migratory seabirds and serve as a refuge for dugongs. The area is also known for having the world's largest breeding populations of roseate terns, and is a key feeding ground for many migrant species.

Kiunga Reserve is of local and global importance for its habitat, species and physical and biological processes. Mangroves, seagrass beds and coral reefs act as homes, nurseries and spawning grounds for populations of fishes, crustaceans, invertebrates and mammals. It is a key nesting site for the 3 species of turtles found in Kenya, the Green, Hawksbill and Olive Ridley.

Ecological Monitoring: Monthly catch assessments are made in each village around the reserve and provide valuable data to management authorities and local fishermen. Catch data are complemented by fish surveys and coral reef assessments. The Kiunga Marine National Reserve team, in collaboration with the Wildlife Conservation Society, carried out the first coral reef survey in 1998, just before a coral reef bleaching event. This survey allowed researchers to determine the rates of recovery of affected coral reefs that have also been recently protected from heavy fishing. There are also projects to assess methods to restore degrading reefs. A local community turtle-monitoring program, supported by Kenya Sea Turtle Conservation Committee, was established in 1997.

Socio-economic Monitoring: An environmentally friendly handicraft industry has been created to generate income for households and tidy up the beach. Rubber flip-flops washed onto the beach are collected and carved into a variety of handicrafts including key rings, necklaces, belts and bags. The income goes directly to the community and to funding long-term management strategies for the area.

Contact: Kenya Wildlife Service, P.O. Box 40241, Nairobi, Kenya (Phone: 254-020-600800, Fax: 254-020-603792, E-mail: kws@kws.org)

Coral reefs are 50% of the natural resources.

Ecological Monitoring is effective.

Socio-economic Monitoring is effective.



GREATER ST LUCIA WETLAND PARK, SOUTH AFRICA - WORLD HERITAGE SITE

The entire north-east coast of Africa is connected by a chain of coral reefs (covering 239,566 hectares) that extends into the Greater St Lucia Wetland Park World Heritage Site. This site includes the Ramsar site Turtle Beaches/ Coral Reefs of Tongaland. The coral reef comprises 3 reef complexes: the Kosi Reefs or Northern Complex; the Sodwana Bay reefs or Central Complex; and Leadsman Shoal or the Southern Complex. The Northern and Southern complexes both lie within highly protected sanctuaries, which limit recreational diver use. The Central Complex is the largest and most accessible, receiving about 100,000 dive visits per year. The reefs are favoured by sport-fishermen and they have become increasingly popular for sport diving.

The major coral reefs in South Africa all are a part of the Greater St Lucia Wetland Park and the combined research and monitoring results have contributed towards the development of a management strategy for the central area. The reefs constitute one of South Africa’s most diverse and valuable, yet scarce and fragile ecosystems. They have especially rich biodiversity (over 125 coral species and almost 400 fish species have been identified) and tremendous potential for ecotourism. There are also 32 species of marine mammals including whale sharks and dolphins. Agriculture, road construction, and development along the upstream area of St. Lucia has impacted the marine environment. Oil pollution and active dredging of the St. Lucia estuary are ongoing management concerns and other potential threats.

Ecological Monitoring: Monitoring began in 1991 to provide baseline information on the ecology and management of the reefs. The Oceanographic Research Institute has conducted coral reef research and monitoring throughout the Southwest Indian Ocean. Research subjects include: the species composition of corals, sponges and tunicates; community structure of corals and associated organisms on representative reefs; the condition of the reefs; and effective management to ensure sustainable reef use. The presence of coral-eating gastropods and COTS is also monitored. These programs are in collaboration with the University of Cape Town and the University of Tel Aviv.

Socio-economic Monitoring: The governments of South Africa, Mozambique, and Swaziland have initiated the Lubombo Spatial Development Initiative and a regional plan and management framework are being prepared.

Contact: R. Porter, KwaZulu-Natal Nature Conservation Service (webmail@kznwildlife.com)

**Coral reefs are 40% of the natural resources:
Ecological Monitoring is effective.
Socio-economic Monitoring is planned.**