

The
**Eastern
African
Marine Ecoregion**



Towards a Western Indian Ocean

DUGONG

Conservation Strategy

The Status of Dugongs in the Western Indian Ocean
& Priority Conservation Actions



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Summary

Dugongs occur in shallow tropical and subtropical coastal and island waters of the Indo-Pacific. They are threatened worldwide due to loss and degradation of seagrass pastures, fishing pressure, indigenous use and hunting, and coastal pollution and are listed globally by IUCN as vulnerable to extinction. The WIO region harbours an important remnant population of the threatened dugong and in a recent UNEP/IUCN report on their global status, extinction of the dugong in the WIO region was considered inevitable without immediate and effective conservation measures.

Information on the status of dugongs in the WIO is scanty. To date, research and conservation activities have tended to operate in isolation and a regional-scale assessment has never been undertaken. Such an approach is considered essential given their critical status and the growing evidence that dugongs can travel long distances.

In 2001, in recognition of the need for effective management of dugongs in the WIO region, Decision CP.3/4 of the 3rd Conference of the Parties of the Nairobi Convention requested regional and international organisations to facilitate the development of a regional

initiative to protect the dugong. In response to this decision, UNEP with assistance from WWF provided financial support for countries in the region to carry out rapid national assessments of dugong status, the overall aim being to recognise key locations, critical habitats and threats to dugongs and to identify emergency conservation strategies and actions.

Between April 2003 and March 2004, 7 countries in the region - Kenya, Tanzania, Mozambique, Madagascar, Seychelles, Comoros and Mayotte/Reunion - gathered information on the status, distribution and threats to dugongs and made recommendations for research and conservation. Data were collected through a review of existing literature, questionnaire surveys and opportunistic sightings.

Historical data indicate that dugong populations have suffered a steep decline in most countries since the 1960s. In Kenya, large herds were reported in the 1950s and '60s and a 500-strong group was seen in 1967. In Tanzania groups of up to 20-30 animals were commonly seen in the Mafia - Rufiji area at this time. In Madagascar and Mayotte fishers have witnessed a decline since the early 1980s while in Mozambique the decline may have been more recent, escalating since the end of the civil war in 1992.

Prior to this study, dugongs were thought to be extinct in northern Tanzania and their status in the south of the country was unknown. In the Comoros Archipelago, small

numbers were believed to occur around Moheli Island but no data were available for Grand Comoro,

Anjouan and Mayotte. Information gathered during this survey have confirmed the existence of dugongs in Tanzania and Mayotte and established the regional significance of the Bazaruto Archipelago (Mozambique) as an important dugong habitat.



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Current information from qualitative and quantitative surveys show that dugongs are present in small numbers in Kenya, Tanzania, Mozambique, Madagascar, Seychelles and the Comoros archipelago (Moheli and Mayotte islands). They are also thought to occur off Somalia but their current status is unknown. Dugongs appear to have disappeared from Mauritius and are believed never to have occurred in Reunion.

- In Kenya, small populations still persist off the Lamu-Kiunga coast and at Gazi in the south near the Tanzanian border, the most recent incidental capture being in April 2003.
- The main dugong population in Tanzania is off the Rufiji Delta where two animals were caught in gillnets in January and March 2004, providing the first concrete evidence of their existence after a lapse of 74 years. Infrequent sightings also occur at Moa in the north and these animals probably form part of the southern Kenyan population.
- Aerial surveys in Mozambique indicate that the only remaining viable population, of around 100 animals, is in the Bazaruto Archipelago. Occasional sightings are made elsewhere along the coast, in the southern Quirimba Archipelago and Inhambane Bay but there are fears that they may be extinct around Maputo Bay in the south.
- In Madagascar, several dugong sightings and incidental catches were reported in 2002 and 2003. The most important dugong areas are: around the islets of Andavadoaka - Morombe; at Ambararata – Courier and Diego bay; the bays and estuaries of Sakoany - Bombetoka; Ambavarano - Vohémar; and Sainte-Marie Island. Dugongs seem to be absent along the southeast coast of Madagascar, although this may be due to lack of reliable data.
- Since 2001, regular dugong sightings in the sheltered lagoon at Aldabra Atoll (Seychelles) indicate a resident population of 3 dugongs: 2 adults and 1 juvenile.
- Further to the southwest, around Mayotte Island, groups of 5-7 dugongs have been sighted in the lagoon during 2002 and 2003 and one was caught accidentally in a net in September 2003.
- Dugongs are believed still to occur at Moheli Island in the Comoros but their current status is unknown.

In the past, dugongs were hunted for their meat, a prized source of protein. However, deliberate captures have declined over recent decades due to waning populations and low capture rates. The main contemporary threat is entanglement in inshore artisanal gill and shark nets. Other fishing gears such as seine nets and fence traps pose a lesser threat. Destructive illegal fishing techniques (dynamite and poison) may also be threatening dugongs in Tanzania and Kenya.

Unplanned coastal development, land clearance and land-based pollution are believed to be

impacting the condition and extent of seagrass habitats in all countries, with the exception of Aldabra Atoll. Habitat degradation and loss is also attributed to trawling (Kenya, Tanzania & Mozambique) and cyclones (Mozambique and Madagascar). In Mozambique and Mayotte, disturbance to dugongs from boat traffic and tourism activities were also cited as threats.



In all the countries cited in this report, dugongs are afforded protection under international and/or national legislation. However, most governments in the region have neither the capacity nor the resources to control and monitor all activities in the marine and coastal zone.

Recommended priority actions for dugong conservation in the WIO region are to:

- Improve the level of protection for dugongs inside and outside marine protected areas by: promoting co-management and co-ownership of marine and coastal resources among all stakeholders; strengthening or imposing measures to reduce the mortality from threatening fishing gears / techniques and considering the provision of incentives and alternative fishing gears; establishing dugong sanctuaries or community-protected areas in sites currently unprotected and unmanaged; and promoting trans-boundary conservation partnerships.
- Adopt the dugong as a regional flagship species and initiate a region-wide public awareness campaign.
- Strengthen capacity of relevant government authorities to enforce legislation.
- Determine and monitor dugong population characteristics (status, distribution, movements) & habitat through quantitative aerial surveys, catch monitoring and tagging, and assessments of seagrass distribution, health and diversity;
- Establish a regional network for dugong and general conservation practitioners and researchers through the existing Sirenian list server and promotion of national dugong conservation task forces to facilitate the development and implementation of dugong action plans and conservation strategies.

1. Introduction

The dugong (*dugong dugon*) is an herbivorous marine mammal that feeds primarily on seagrasses in the shallow tropical and subtropical coastal and island waters of the Indo-Pacific, from eastern Africa to Vanuatu.



Dugongs are listed globally as vulnerable to extinction (IUCN, 2000). Throughout most of their range, populations have become increasingly fragmented and anecdotal evidence indicates that numbers are declining worldwide as a result of loss and degradation of seagrass pastures, fishing pressure, indigenous use and hunting, and coastal pollution (Marsh et al., 2001).

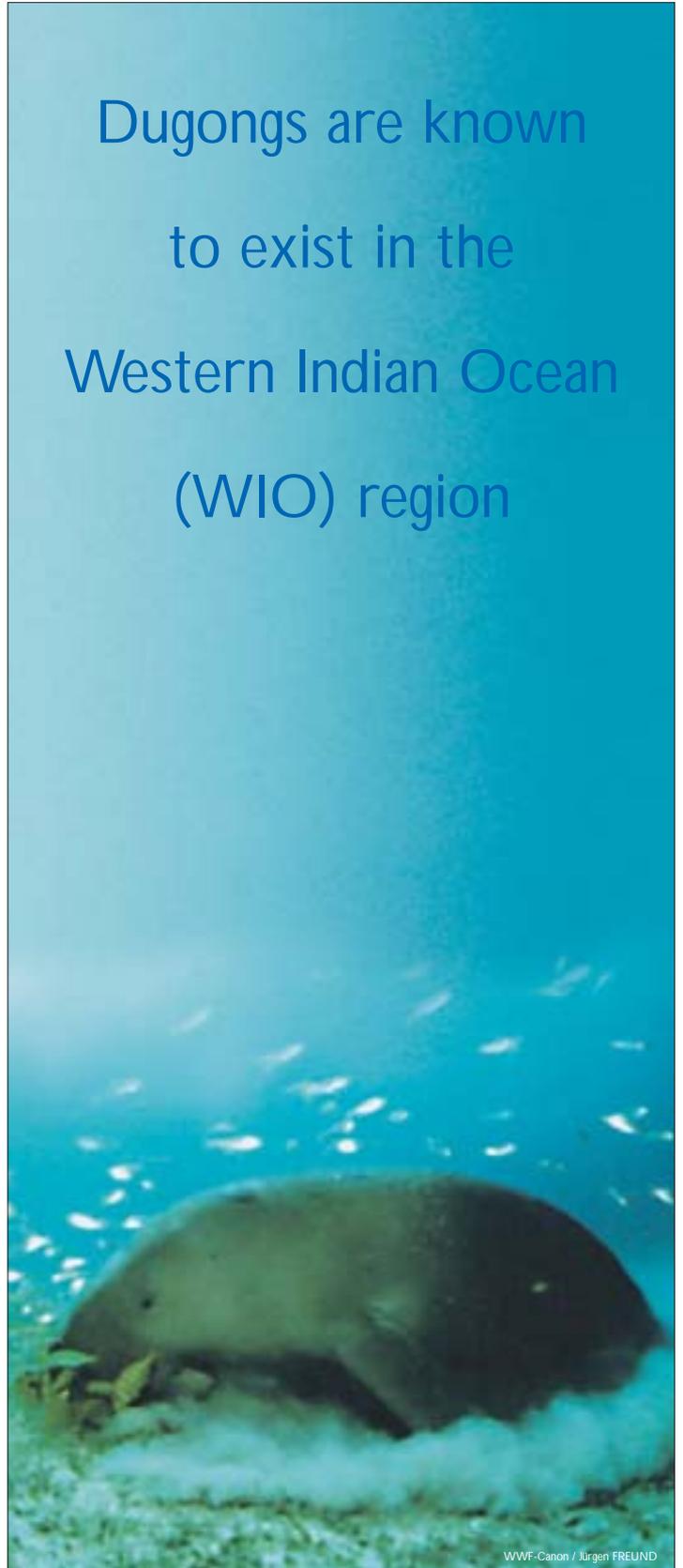
Dugongs are known to exist in the Western Indian Ocean (WIO) region. It is believed that their range extends from Somalia in the north, through Kenya, Tanzania, Mozambique and further east off the islands of the Comoros, Seychelles, Madagascar and Mauritius (Kemp, 2000). Isolated research has revealed that numbers have been declining rapidly in the area due to anthropogenic influence and pressures from artisanal gill and shark netting, commercial prawn trawling and habitat destruction. It is believed that dugongs may now only remain in small numbers at Lamu-Kiunga (Kenya), Rufiji-Mafia (Tanzania), Bazaruto (Mozambique), Moheli (Comoros) and Aldabra Atoll (Seychelles) (Dutton, 1994; Dutton, 1998; Wamukoya et al., 1996; Sirenews, 2001; Marsh et al., 2001). In view of their small and discrete populations, the dugong is now believed to be the most endangered large mammal in the region (Kemp, 2000).

In the WIO, a number of marine protected areas exist at sites where dugongs are known to occur and several projects and institutions are involved in research and education activities. These initiatives are playing a valuable role locally, but have tended to operate in isolation, and to date there has been no collaborative regional-scale approach to assessing dugong distribution and populations, or in developing strategies for their conservation. Such an approach is considered essential given their status and the increasing evidence that dugongs undertake large-scale movements. Satellite tracking of dugongs in Australia and Indonesia for example, has revealed that while most daily movements are localized in areas of seagrass habitat, some animals undertake trips of over 600km in a few days (Preen, 1995). At Aldabra Atoll, recent dugong sightings, after an absence of 100 years, confirms their capacity to move considerable distances (Sirenews, 2001).

In 2001, in recognition of the need for effective management of dugongs in the WIO region, Decision CP.3/4 of the 3rd Conference of the Parties of the Nairobi Convention, requested regional and international organisations to facilitate the development of a regional initiative to protect the dugong. In response to this decision, UNEP through the Nairobi Convention, with assistance from WWF and IUCN, provided financial support for countries in the region - Kenya, Tanzania, Mozambique, Seychelles, Comoros, Mayotte, Madagascar and la Réunion - to carry out a rapid national assessment of the status, distribution and threats to dugongs and identify key actions necessary for their recovery and long-term survival.

This report is a synthesis of the WIO country reports and aims to provide a regional synopsis of dugong status and distribution, detect gaps in current knowledge and identify emergency strategies and actions, thus ensuring more efficient use of both resources and effort.

Dugongs are known to exist in the Western Indian Ocean (WIO) region



2. Background Context

2.1 Western Indian Ocean region

The Western Indian Ocean region includes the coastlines of Somalia, Kenya, Tanzania, Mozambique and South Africa and the island states of Madagascar, Comoros including the French Territory of Mayotte, Reunion, Mauritius and the Seychelles (Figure 1).

Within the WIO, two marine ecoregions have been identified as representing globally outstanding examples of marine and coastal biodiversity; these are the Eastern African Marine Ecoregion (EAME), which stretches 4,600km from southern Somalia to the northern coast of South Africa, and the Western Indian Ocean Marine Ecoregion (WIOME).

The region has a mainland coast of over 11,000 km and is home to a coastal population of over 30 million people (IUCN, in prep.) which is increasing at a rate of 5-6% per year and is expected to exceed 40 million by 2020 (Sosovele, 2000). It is also home to some of the world's most important coastal and marine environments and resources.



Figure 1. Map of the Western Indian Ocean region

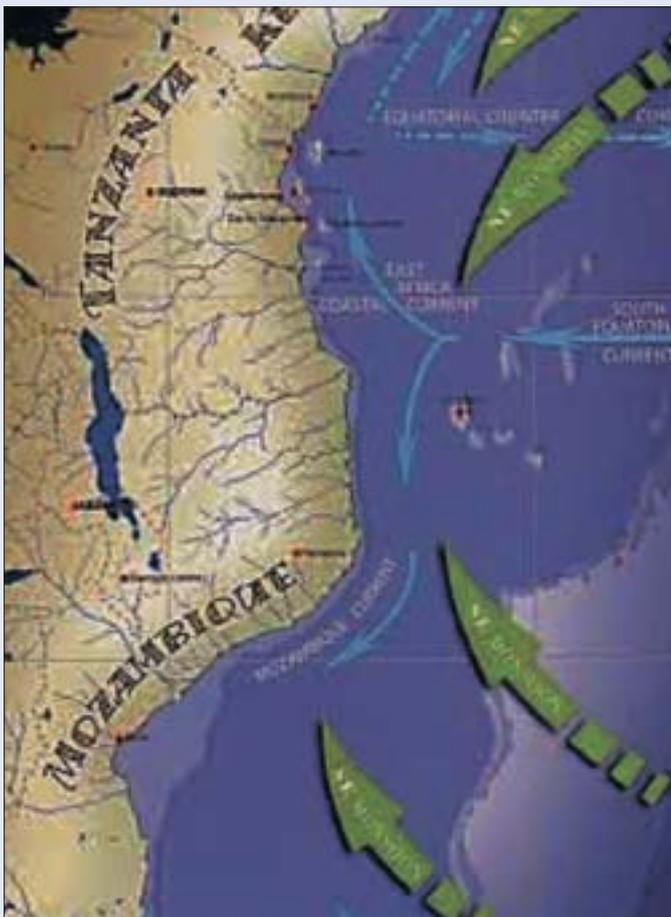


Figure 2. Monsoons & major oceanic currents affecting the WIO region

The warm waters support a rich and diverse variety of marine flora and fauna including 1,000 seaweeds, over 200 coral species, more than 3,000 species of molluscs and over 52 tropical inshore fish families, 22% of which are endemic. At least 20 species of cetaceans and an important remnant population of the threatened dugong also occur in the region (IUCN, 2001).

Characteristic marine habitats include beaches and coastal mud flats, extensive mangrove forests, coral reefs and open waters. These habitats provide important nesting and foraging grounds for 5 species of marine turtles. The physical and biological characteristics are closely connected and are linked through large-scale oceanic and long-shore currents, tidal influences and seasonal monsoon winds which transport nutrients, plankton and other marine fauna (Figure 2).

The coastal inhabitants of the WIO region are among some of the poorest in the world and livelihoods are largely dependent on coastal and marine resources, such as fisheries and mangroves. Rapid human expansion is having a significant impact on marine and coastal environments, which are now threatened by a variety of human activities including unplanned urbanization, over-exploitation of marine resources, pollution, habitat destruction, coastal tourism and industrial development (Kemp, 2000; IUCN, 2001). Regionally, the 1985 Nairobi Convention, one of the UNEP Regional Seas conventions, has played an important role in responding to the crisis facing marine and coastal biodiversity.

Traditionally, hunting of dugongs for food and medicine has been practiced in most countries of the region. Over the past 30 – 50 years however, over-exploitation has reduced populations to the point where both deliberate and accidental captures are now extremely rare. In Kenya, and to a lesser extent, Tanzania, dugongs have played an important role in local cultures. Dugongs have high value as a source of protein and various body parts are also used for medicinal and ornamental purposes (Marsh, et al., 2001). The hunting of dugongs is illegal in all countries of the region.

2.2 Existing programmes in the WIO involved in dugong conservation

A number of activities are already underway at national and site level focusing on strengthening, or creating, marine protected areas where dugongs are known to occur. These include: Kiunga Marine National Reserve (Kenya); Mafia Island Marine Park (Tanzania); Bazaruto and Quirimbas National Parks (Mozambique); Moheli Marine Park (Comoros); and Aldabra World Heritage Site (Seychelles). Public awareness and environmental education initiatives are also underway at some sites (e.g. Lamu-Kiunga, Bazaruto National Park and Mafia Island).

WWF's Eastern African Marine Ecoregion (EAME) programme has a target to increase the number of dugongs within the EAME by 10% of its current population by 2015, by boosting the interests and commitments of governments and other stakeholders, as well as supporting regional and local initiatives.

3. Global & Regional Dugong conservation status & distribution

Dugongs are classified globally as vulnerable to extinction due to a population decline of at least 20% in the last 90 years (IUCN, 2000) and are listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Dugongs only occur in tropical and sub-tropical waters of the Indo-Pacific region. Their range is extensive, spanning at least 37 countries and territories from the Arabian Gulf to Vanuatu between about 26° north and south of the Equator (Nishiwaki & Marsh, 1985; Jefferson et al., 1993; Marsh et al., 2001). The historical distribution of dugongs corresponds to the distribution of phanerogam plants of the families Potamogetonaceae and Hydrocharitaceae (Husar, 1978).

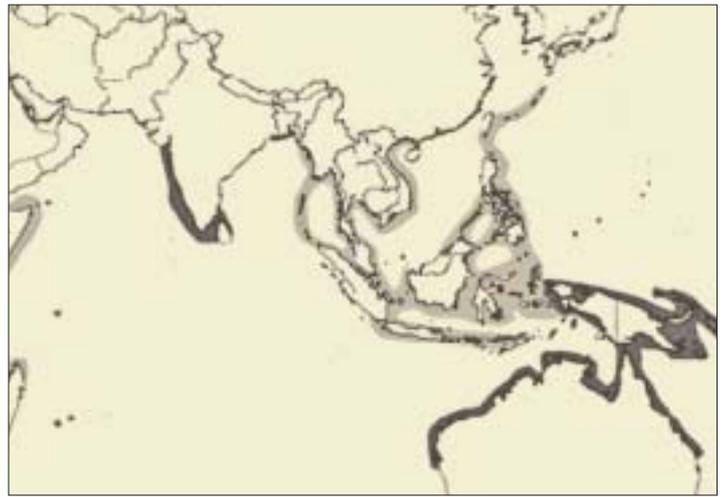


Figure 3. Distribution of the dugong (Source: United Nations Environment Programme).

Approximately 85,000 of the world's dugongs are found in the inshore waters of northern Australia (Marsh & Lefebvre, 1994). This is likely to be at least three quarters of the global population, possibly considerably more. The second largest dugong population occurs in the Arabian Gulf where approximately 7,000 remain (al-Ghais & Das, 2001). Elsewhere, populations are small and fragmented and in some areas, such as Mauritius, the Maldives and parts of Cambodia and Laos, dugongs may already have become extinct (Bryceson, 1981; Marsh & Lefebvre, 1994; Marsh et al., 2001).

In the WIO region, quantitative data on population distribution and size is deficient. The largest remaining population in the region is believed to be in the Bazaruto Archipelago in Mozambique, where approximately 50 - 100 dugongs are thought to remain (Mackie, 2001). In Kenya, aerial surveys of the entire coastline conducted in 1994 and 1996 indicate a sharp downward population trend with 10 and 6 dugongs counted respectively (Cockcroft, 1995; Komora, 1996; Wamukoya et al., 1997). At that time the Kenyan dugong population was estimated to be approximately 50 (Cockcroft, 1995). In Tanzania, dugongs formally occurred in northern Tanzania but until recently were believed to be locally extinct in the north (Cockcroft et al., 1994). Ray (1968) identified the Rufiji / Kilwa area as the last remaining refuge for dugongs and this was confirmed during interview surveys in 2001 and 2002 (Muir & Abdallah, 2002).

In Madagascar, dugongs were reported to occur in small numbers along the central, northwestern and northeastern coastlines in the 1990s but sightings in recent years have been rare (Cockcroft, 1993). In the Seychelles, 5 dugongs were sighted on four occasions in the shallow lagoon waters of Aldabra Atoll between August and October 2001 (Sirenews, 2001), the first sightings for many years. In the Comoros archipelago dugongs are still believed to frequent the waters off Moheli and Mayotte (Cockcroft et al., 1994).

4. Dugong Biology and Life History

4.1 Taxonomy and description

Dugongs (*dugong dugon*) are herbivorous marine mammals. They have high biodiversity value as the only species in the family Dugongidae, and one of only four species in the order Sirenia, the other members being the Amazonian, West African and West Indian manatees which all belong to the family

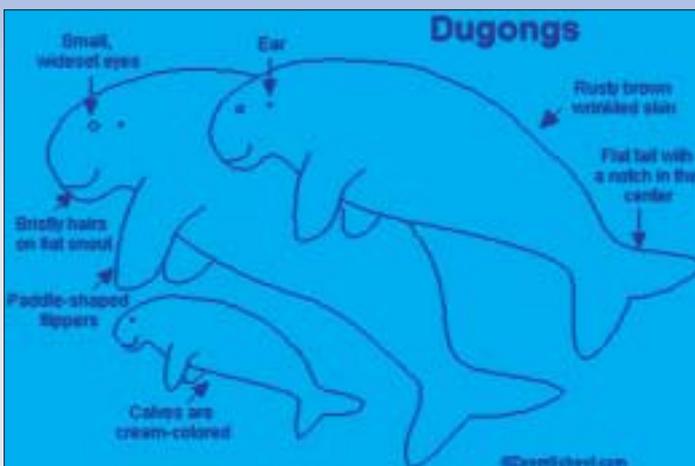


Figure 4. Dugong morphology

Trichechidae (Marsh et al., 1978).

Dugongs descended from terrestrial mammals that browsed in shallow grassy swamps during the Eocene, and their closest modern relative is the elephant (Ripple, 1999). The body is barrel-shaped and more streamlined than manatees, with a fluke-shaped tail and a pig-like head (Jefferson et al., 1993). Sprinkled with short hairs, the skin is grey-brown on the back and slightly lighter on the belly. Adults are large and can grow to 3.5 meters long and weigh up to 400 kg. Sensitive bristles covering the upper lip and a broad flat muzzle are used to uproot seagrasses, which form their main diet. They surface to breathe every few minutes using paired, valve-like nostrils positioned on the top of the head. Their lifespan is estimated to be 70 years (Marsh et al., 1984).

4.2 Life History and reproductive ecology

Dugongs are slow to reproduce (Marsh et al. 1978). Both males and females become sexually mature at about 10 years old although some females mature as late as 17. In Australia, females come into estrus in the latter half of the year and calve from

August to December (Marsh et al., 1984). Mating behaviour varies and males have been observed aggregating at mutually exclusive territories which the female then visits to mate, or they mate in herds, with males violently competing for estrus females (Anderson & Birtles, 1978; Preen, 1989).

A dugong cow produces a single calf every 2.5 to 5 years, after a gestation period of 14 months (Lawler et al., 2002). Calving occurs in the shallow waters of tidal sandbanks (Marsh et al., 1984). A newborn calf usually measures 1.2 m long, weighs approximately 30 kg and relies primarily on its mother's milk for up to 18 months (Ripple, 1999).

Population models indicate that a dugong population, reproducing optimally, will increase at a rate of about 5% a year and therefore can sustain only a low level of anthropogenic mortality of 1-2% (Marsh et al., 1984).

4.3 Habitat and diet

Dugongs commonly occur in shallow, sheltered bays and lagoons, less than 5m deep. They normally avoid inshore areas where flooding may influence salinity that hinders growth of seagrasses. However, they do occasionally move into river mouths and creeks and are sometimes observed in deeper water further offshore in areas where the continental shelf is wide, shallow and protected such as in the Torres Strait between Australia and Papua New Guinea where dugongs are seen more than 10 km from land (Marsh & Saalfeld, 1989) and at the Sahul Banks off northwestern Australia where they have been observed in waters up to 90m deep (Whiting, 1999).

Dugongs feed primarily on seagrasses. They are non-ruminant herbivores and therefore select species with a high protein and low fibre content (Murray et al., 1977). Recent studies indicate that they prefer delicate, pioneer species high in nitrogen and low in fibre such as *Halophila ovalis* and *Halodule uninervis* (Preen, 1995). Dugongs can manipulate seagrass beds to encourage regeneration of these fast-growing pioneer species. Maintaining a highly palatable area of food has been coined "cultivation grazing" (Preen, 1995). They generally uproot whole plants producing distinctive feeding trails.

4.4 Movements

Dugong movements have been tracked in a number of studies using VHF or satellite transmitters (Marsh & Rathbun, 1990). Generally, dugongs tend to be fairly resident and most movements are within areas of seagrass beds and are dictated by the tides. These localized movements highlight the importance of protected area networks in dugong conservation.

At the southern limits of their range, dugongs make seasonal journeys to warmer waters (Lawler & Marsh, 2001). Both short-distance movements, of 15-40 km a day and long distances of up to 600 km have been recorded in Australian waters (Preen, 2001). There is also evidence that dugongs move long distances under stress. In Hervey Bay in Australia, some animals moved up to 900km in search of food after extreme flooding destroyed extensive areas of seagrass habitat (Preen & Marsh, 1995). The capacity of dugongs to travel large distances indicates the importance of international collaboration in their management (Marsh et al., 2001).

5. Threats

The shallow, near-shore habitat requirements of dugongs and slow rate of reproduction render them particularly vulnerable to anthropogenic activities. Processes that threaten the dugong vary to some degree across its range.

In most countries, loss and degradation of seagrass habitats either directly from activities such as trawling and mining, or indirectly from industrial or agricultural pollution, land clearance and cyclones, pose a significant threat. In the Arabian Gulf,

dugongs are particularly at risk from oil spills (Preen, 1989) and starvation and relocation of populations has been recorded in Australia following large-scale seagrass loss (Preen & Marsh, 1995).

Accidental drowning in shark and gillnets is also a major cause of dugong mortality throughout its range (Plate 1).

Due to their slow rates of reproduction, the sustainable level of human-induced mortality (hunting) is only 1-2% of females. Indigenous use and hunting play an important role in local culture and tradition in northern Australia, and in recent years, the take from hunting has exceeded 5% (Preen, 1998). The dugong is hunted primarily as a source of meat. In northern Australia, Aborigines and Torres Strait Islanders regard dugong meat and oil as among the most valuable traditional food, and dugong hunters are given high status in the community (Marsh et al., 2001). Other dugong parts are also utilized. In Bahrain for instance, dugong tusks are used in sword handles and the hide is used to make shoes (Preen, 1989) and in Kenya, oil, bones and tusks are used to cure a variety of ailments (Wamukoya et al., 1995).

To a lesser extent, dugongs are also threatened by vessel strikes from increased boat traffic, ecotourism (e.g. Australia, Philippines and Vanuatu), acoustic pollution and disease (Korrubel & Cockcroft, 1997; Marsh et al., 2001).



Plate 1. The carcass of a dugong caught in a gillnet in Mayotte (Source: Franck Charlier, Brigade Nature Mayotte)

6. Aims

The purpose of this study is to produce a regional overview of the historical and current conservation status of, and threats to, dugongs in the WIO.

Synthesizing information gathered by countries in the region, the specific aims are to:

- Identify key locations, critical habitats and threats to dugongs in the region;
- Identify emergency strategies and actions for dugong conservation at both national and regional levels;
- Produce a database of individuals and institutions active or interested in dugong conservation in the region and of ongoing conservation activities;
- Identify data gaps on a regional basis; and
- Increase awareness of the status of dugongs amongst national wildlife and marine agencies, as well amongst the public and donors.

The aims of the rapid country assessments were to:

- Develop a preliminary overview, using best available information, on the historical and current status of dugongs, including identification of key locations and pressures;
- Develop a contact list of individuals and institutions involved in dugong conservation and research; and
- Identify data gaps and priorities for dugong conservation.



7. Methods

In Kenya, Tanzania, Mozambique, Madagascar, Seychelles, Comoros and Mayotte/Reunion, data were gathered through a review of existing literature, questionnaire surveys and opportunistic sightings. Specific methodologies used in each country are detailed in the comprehensive country reports in Section 8 below.

7.1 Literature review and consultation

A review of available literature on dugong status and distribution was undertaken as well as consultation with researchers, conservation practitioners and other relevant contacts in each country. Contact details were obtained for individuals or groups involved in dugong research and conservation.

7.2 Questionnaire survey

Interviews were conducted with local communities, particularly fishers, government personnel, diving and aircraft operators (Mayotte) and organizations/institutions involved in marine mammal research and conservation. The questionnaire interviews used in each country (with the exception of Madagascar) are presented in Appendix I.



8. Results (National Dugong Assessments)

Detailed national assessments from Kenya, Tanzania, Mozambique, Seychelles, Comoros, Mayotte/Reunion are presented below. Each national account includes: a summary, general description, overview of the status (historical and current), distribution and threats to dugongs, recommendations for research and conservation.

A contact list of individuals/institutions involved in dugong conservation and research in each country is presented in Appendix II.

8.1 KENYA

S.Weru¹ and N. Muthiga²

8.1.1 Summary

In Kenya, large dugong herds were commonly reported before the 1960s and a group of 500 was seen in 1967 off the south coast. More recent estimates have been obtained from aerial surveys conducted in 1973, 1975, 1980, 1994 and 1996. Results from these surveys indicate a sharp downward population trend with 10 and 6 dugongs counted in the Lamu Archipelago, their former stronghold, in the north of the country in 1994 and 1996 respectively and 3 off the south coast. In 2002, there were anecdotal reports of between 5 and 8 animals including 2 calves at Siya Channel and Kiunga Muini in northern Kenya. More recently, the carcass of a dugong was reported on 15 April 2003 at Gazi near the border with Tanzania. This report was not verified and no information on the cause of death was available.

Information on dugong status, distribution and threats was also gathered from questionnaire interviews. Questionnaires were distributed to field workers in 14 villages. A field officer was designated in each village and either interviewed the respondents or asked them to complete and return the questionnaire. Of 311 questionnaires distributed, 222 questionnaires were returned duly filled.

31% of respondents claimed to have seen a dugong live at sea and 31% said they had seen a dead one either on the beach or trapped / entangled in a fishing net. Five per cent did not know what a dugong was.

The most important dugong habitats in Kenya are in the area of Kiunga Marine National Reserve (KMNR), Dodori and Mongoni Creeks and the Siyu Channel in the north of the country, and around Gazi on the south coast. The spatial separation between sightings in the north and south of the country suggests that there are two discrete and small populations in Kenya.

The main threats to dugongs are entanglement in gillnets, destruction of seagrass beds by prawn trawlers and harvesting for meat and medicine. In Kenya, dugongs are protected by both national and international legislation. However, the capacity of government authorities to monitor illegal activities and enforce the law is inadequate due to limited personnel and resources.

Recommended management actions include: establishment of dugong sanctuaries at the key dugong areas; initiation of a conservation and awareness programme; more detailed surveys on dugong population biology, ecology and levels of incidental captures in gillnets and trawl nets; initiation of a satellite-tagging programme; and improved capacity of government organisations to protect dugongs.

8.1.2 General background

The Kenyan coastline is 536 km long, from latitude 1°42' S to 4°40' S bordering Somalia in the north and Tanzania in the south (Figure 5). The continental shelf covers an estimated area of about 19,120 km². Well-developed fringing reef systems are present along the coastline except where major rivers (Tana and Athi/Sabaki) discharge into the Indian Ocean and north of the Tana River (Anon, 1998). Patch reefs occur around Malindi and Kiunga in the north and Shimoni in the south. Seagrass beds are usually associated with reef systems growing in

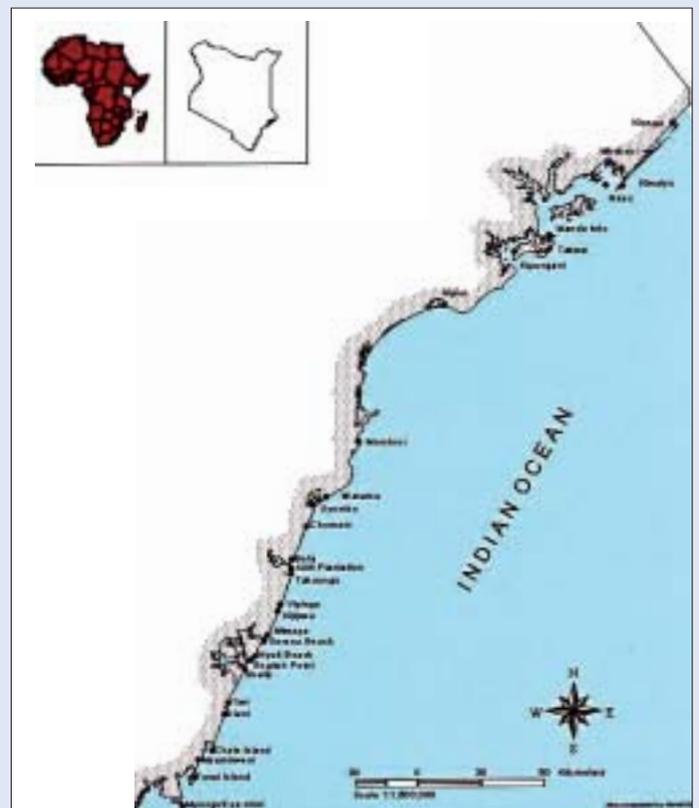


Figure 5: Map of the Kenyan coast

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shallow lagoons creeks and bays. Mangrove forests are well developed in the Lamu archipelago, where 70% of Kenya's mangrove occurs (UNEP, 1998). The main marine ecosystems of the Kenyan coast include beaches and dunes, inter-tidal mud flats, mangroves, seagrass beds and coral reef communities.

In 1992 about 1.64 million people lived in the coastal area and the population of Coast Province was expected to exceed 2 million by 2000. The population is not evenly distributed. Approximately 400,000 people are concentrated in the Mombasa area where the main East African port of Kilindini is situated. While the population density for the country as a whole is 44 persons / km², the density along the coast ranges from 10 persons / km² in Lamu to 280 persons / km² in Mombasa (UNEP, 1998)

The mainstay of the economy in the urban centres is maritime commerce and tourism. The latter depends heavily on the rich biological diversity and the health of the environment. Outside the urban centres, the main economic activities include food production, artisanal activities and small retail and service enterprises.

Coastal waters are characterised by semi-diurnal tides – approximately two cycles for every 24-hour period. Except for limited periods in the year, however, the levels of high and low water of each successive tide differ appreciably from the corresponding tide before and the tide following. The tides can therefore be classified as mixed semi-diurnal tides. Maximum tidal range at Kilindini does not usually exceed 3.8 m. The tidal range for Malindi is 2.0 m for neap tide and 2.9 m for spring tide.

Sea surface temperature reaches a high of 28-29°C following the northeast monsoon in March and April and a minimum of 24°C in August and September. Water temperature average about 27°C in the lagoons, but fall to 25°C between June and September.

8.1.3 Dugong status and distribution

(a) Literature review

Kenya has no reliable historical data on dugong populations (Wamukoya et.al.,1997). However, herds of dugongs were reported in the Gazi-Funzi area in the 1950s (Peter & Thorsell, 1980) and in the 1960's large groups of dugongs were reported to occur along the Kenyan coast, the largest of which comprised 500 animals seen off the south coast in 1967 (Husar, 1975).

More recent estimates have been obtained from aerial surveys conducted in 1973, 1975, 1980, 1994 and 1996. Results from these surveys indicate a sharp downward population trend with 10 and 6 dugongs counted in the Lamu Archipelago in the north of the country in 1994 and 1996 respectively (Wamukoya, et. al.,

1997). 3 dugongs were also sighted in the south of the country in 1996 and there have been isolated reports in the Msambweni and Chale area south to the Mpunguti Marine Research Centre near the border with Tanzania (Ochilo 1986; Sharlow 1996; Wamukoya, et. al., 1996). The spatial separation between sightings in the north and south of the country suggests that there are two discrete populations in Kenya.

Local fishers reported that 5 dugongs have been killed since 1994 in the Dodori creek area, mainly by gillnet fishers from Kizingitini (Figure 6). They also reported that only one female dugong is known still to be alive, currently located in the Dodori creek / Wange area (Wamkoya et al., 1996). In October 1999, the first recorded release of a live dugong from a gillnet took place in Kiunga (J Church, pers. comms.).

In 2002, between 5 and 8 animals, including 2 calves, were reported by fishermen at Siya Channel and Kiunga Muini in northern Kenya. This area was previously distinguished as the most important dugong habitat on the Kenyan coast (Mohammed et al., 2002).

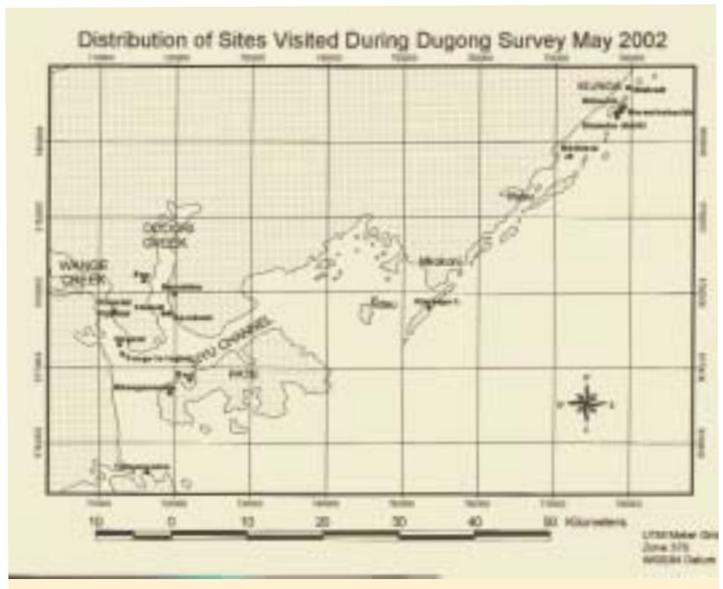


Figure 6. Important dugong areas north of Lamu in northern Kenya

The most recent report was of a dead animal, probably caught in a fishing net, at Gazi in southern Kenya on 15 April 2003. By the time the field worker had reached the site, the animal had already been butchered, the carcass disposed of and the report could not be verified.

The most important dugong habitats in Kenya are believed to be around Kiunga Marine National Reserve (KMNR), and in Dodori and Mongoni Creeks and the Siyu Channel in the north of the country, and around Gazi on the south coast.

(b) Questionnaire survey

The survey was conducted in 14 villages. Out of 311 questionnaires distributed during the survey, 222 (71%) were completed and returned (Table 1).

Table 1. Questionnaire returns from the Kenyan interview survey

Location	Issued	Returned	%
Kiunga, Mkokoni, Lamu	75	36	48
Kipini	50	24	48
Watamu, Gede, Uyombo	30	27	90
Vanga, Shirazi, Kidimu	60	60	100
Bofa	15	15	100
Msambweni	20	17	85
Malindi, Ngomeni, Mambrui	50	43	86
Mtwapa (Bardale)	11	0	0
Total	311	222	71

Most (67%) of the respondents were fishermen. Other occupations included private business people, cargo boat operators and fish vendors (Table 2). The male: female ratio was 96:4. Most respondents (93%) were in the 25 – 50 age group and 76% were long-term residents of their village suggesting that most respondents had a long history of local knowledge of the area and dugong distribution. The only site with a relatively low proportion of

long-term residents is Watamu as most residents are either foreigners or local immigrants from Lamu (Bajuni) District.

Table 2. Respondent profile in Kenya

Village	Sum	Age group								Sex		Residency		Occupation									
		<18	25	30	40	50	60	70	70+	M	F	Res	Vs	FM	FV	CS	Th	Bs	St	BC	Cx	Sc	O
Kinondo	7	0	3	2	1	0	0	1	0	7	0	5	2	4	0	1	0	0	1	0	0	0	1
Msambweni	10	1	1	1	1	1	1	0	1	10	0	10	0	8	2	0	0	0	0	0	0	0	0
Kipini	24	0	6	6	4	3	3	0	2	23	1	21	3	17	0	0	1	2	1	0	0	0	3
Malindi	43	11	7	6	8	7	4	0	0	39	4	34	9	16	3	0	0	10	0	4	0	0	10
Watamu	15	0	0	2	4	2	3	4	0	14	1	2	13	11	0	0	0	1	0	3	0	1	0
Uyombo	7	0	0	2	3	1	1	0	0	7	0	2	5	7	0	0	0	0	0	0	0	0	0
Gede	5	1	1	1	2	0	0	0	0	5	0	5	0	2	0	0	0	0	0	0	1	1	1
Kilifi/Bofa	15	3	3	7	2	0	0	0	0	14	1	14	1	11	2	0	0	1	0	0	0	0	1
Kizingitini	13	0	3	3	3	3	1	0	0	13	0	12	1	13	0	0	0	0	0	0	0	0	0
Kidimu	40	3	9	5	10	8	3	0	2	40	0	33	7	34	0	0	0	2	0	2	0	0	2
Shirazi	9	2	0	4	2	0	1	0	0	9	0	7	2	2	0	1	1	1	1	1	1	0	1
Vanga	11	1	1	2	3	2	1	1	0	11	0	6	5	8	0	0	0	1	0	0	0	0	2
Lamu	17	1	1	4	6	1	3	1	0	16	1	16	1	10	0	2	0	0	0	1	3	0	1
Kiunga	6	0	0	0	2	4	0	0	0	6	0	2	4	5	0	0	0	0	0	0	0	0	1
TOTAL	222	23	35	45	51	32	21	7	5	214	8	169	53	148	7	4	2	18	3	11	5	2	23

Legend

Fisherman	FM	Teacher	Th	Boat Crew	BC	Other	O
Fish Vendor	FV	Businessman	Bs	Coxswain	Cx		
Civil Servant	CS	Student	St	Scientist	Sc		

Table 3. Source of knowledge about dugongs in Kenya

Source of Knowledge / Where seen	Respondents	%
Alive at sea	70	44
Caught / trapped in net	42	27
Dead on the beach	26	17
Trawlers/boats	4	2.5
Seen/eaten meat	3	2
Photos and video	1	0.5
No idea	11	7
TOTAL	157	71

44% of respondents claimed to have seen a dugong live at sea and 44% said they had seen a dead one either on the beach or trapped / entangled in a fishing net (Table 3). 7% did not know what a dugong was. Few respondents (0.5%) had learned about dugongs at school or from awareness programmes.

8.1.4 Uses and myths

In Kenya dugongs are most valued as a source of meat. However, a survey of medicinal wildlife resources in 1986 revealed that the meat, oil, bones and tusks of dugongs are used to cure a variety of ailments including arthritis, labour pains, tonsillitis and

protection against evil spirits (Marshall, 1998). Dugongs also play an important cultural role and in Lamu are referred to as the "Queen of the Sea".

8.1.5 Threats

Fishing activities, habitat loss and degradation appear to pose the greatest threat to dugong survival in Kenya (Pertet & Thorsell, 1980). Dugongs are caught in nets set deliberately to catch them, or as incidental by-catch in gillnets targeting sharks and rays (Wamukoya, et. al., 1997).

Respondents identified a variety of threats to dugongs (Table 4). The most common perceived threats were habitat disturbance from anthropogenic activities, and harvesting for food and medicine.

Trawling was also cited as a major threat to dugongs in Kenya and most respondents attributed dugong carcasses washed ashore to trawling.

The issue of excessive levels of by-catch and seagrass bed destruction by prawn trawlers has led to controversy between conservation groups and trawler companies. Recently, the Department of Fisheries issued a short-term ban on trawling to allow for research. The findings indicated that levels of by-catch exceeded catches of the target fish (prawns) and that seagrasses are uprooted as nets are pulled across seagrass beds (Mueni & Mwangi, 2001). The main trawling areas are Ungwana and Malindi Bays and the Lamu Archipelago all of which are important dugong habitats.

Table 4. Perceived threats to dugongs in Kenya

Threat	No. Respondents
Destructive fishing methods/activities	
Destructive fishing practices (poison)	13
Trawling	42
Net fishing (gillnets/mesh nets)	38
Deliberate hunting for meat / medicinal purposes	54
Habitat disturbance / destruction	
Habitat destruction (feeding or breeding/nesting sites)	19
Anthropogenic activities	69
Natural environment changes / fluctuations	5
Pollution	8
Lack of food in habitats	1
Others	
Natural predators (whales, sharks etc.)	11
Injuries by fishing or recreational gear	13
Poaching and hunting	12
Oil tankers and ships	7
No idea or not aware	12
No threats	3
Rare to see	2

The majority of respondents claimed that conservation measures were necessary to protect dugongs and proposed law enforcement, improvement of conservation measures, the banning or regulation of gillnets and trawlers and increased education and awareness activities as key management actions

(Table 5). To a lesser extent, the establishment of dugong protection areas or sanctuaries was suggested. 13% of respondents advocated for the legalization of dugong harvesting for meat.

Table 5. Proposed management actions in Kenya

Proposed management actions	No. Respondents
Conserve/Protect and enhance laws & conservation measures or practices	74
Awareness/education campaigns on conservation of dugongs	57
Ban or regulate fishing methods (trawling, gill nets,)	55
Allow limited fishing and selling of meat in market	29
Create dugong protection areas (breeding, foraging, feeding areas)	20
Translocate them to confined or protected areas	17
Community participation in conservation and monitoring	11
Research and monitoring	9
Declare as endangered species	7
No idea / Unable to tell	6
Government should eliminate them to prevent accidents	1

Note: Some respondents suggested more than one management action

8.1.6 Policy and legislation

Dugongs are protected by both national and international legislation in Kenya. However, the capacity of government authorities to monitor illegal activities and enforce the law is low due to limited personnel and resources.

Under Section 51 of the Fisheries Industry Act CAP 378 of the Laws of Kenya, all marine mammals are protected from hunting or harassment (Govt of Kenya, 1989). This law is galvanized by Islamic beliefs (to which most marine fisher folk in Kenya ascribe), which prohibit the consumption of prohibited foods (haramu).

Kenya is a signatory to the Convention on the international trade in endangered species of fauna and flora (CITES). The Kenya Wildlife Authority (KWS) is the authority responsible for CITES management, according to the Wildlife (Conservation and Management) Act, CAP 376 of the Laws of Kenya.

The lack of effective monitoring and law enforcement pose a serious threat that needs to be addressed immediately.

8.1.7 On-going/proposed conservation and research activities

Kiunga Marine National Reserve in northern Kenya is managed by the Kenya Wildlife Service with support from WWF. Over the past 7 years, an on-going environmental education programme has been implemented in the area. This has included an annual Dugong Festival in Lamu town to raise awareness about the status of and threats to dugongs. It has proved highly popular. Through a process of local sensitization, two dugongs that drowned in nets were returned to the Reserve Headquarters by local fishers.

The Fisheries Department and Kenya Wildlife Service operate

along the Kenyan coast and have the capacity for involvement in dugong conservation activities.

8.1.8 Recommendations

(a) Research and monitoring

- More detailed surveys are required to determine the status of dugongs in Kenya, particularly focusing in the extreme north and south of the country where there is evidence that small discrete populations exist.
- Once individual animals are identified, initiate a satellite-tagging programme to monitor habitat preference and movements.

(b) Conservation and management

- Establish dugong sanctuaries at known dugong locations around Siyu channel south of Kiunga Marine Reserve and at Gazi on the south coast.
- Establish a national dugong conservation program in Kenya similar to the on-going turtle conservation programme, coordinated by KESCOM. Through such a program, advocacy on the use of By-Catch Reducing Devices (BRD) in trawl nets should be promoted.
- Initiate a national dugong education and awareness campaign targeting local coastal communities and tourist operators, to compliment the annual Dugong Festival held annually in Lamu which has proved highly successful in sensitizing local communities about the plight of dugongs. The Dugong Festival should be replicated in other coastal locations and the theme of dugong conservation should be incorporated fully in the annual Marine Environment Day.
- Improve institutional capacity, through training and human and logistical support, to enforce the law.

8.2 TANZANIA

C. E. Muir¹, A Sallema², O. Abdallah 1, D De Luca & T R B Davenport³

8.2.1 Summary

An investigative survey was carried out between April-June 2003 to determine the status, distribution, threats, uses and attitudes towards dugongs in Tanzania. Interviews were conducted with 420 fishermen from 57 villages along the coast.

Prior to the mid-1970s, dugongs were both abundant and widely distributed along the Tanzania coast. At this time they were actively hunted in some areas using deliberately fashioned "dugong nets" and occasionally dynamite. Over the past 25-30 years dugong numbers have declined dramatically and sightings are now rare. Interviews with fishermen yielded just 38 reported sightings since the start of 2000 (31 incidental captures and 7 live). Small resident populations are reported to exist in just two remaining areas: the Rufiji-Kilwa-Mafia area and at Moa in Tanga region, near the Kenyan border. That dugongs do still occur in Tanzania waters was confirmed on 14 January 2004 when a dugong drowned in a gillnet off the Rufiji Delta was handed over to government officials on Mafia Island.

In Rufiji-Kilwa, dugongs were reported to move into channels of the Rufiji delta, possibly to calf, during the southeast monsoon from May-August when sea temperatures are lower. During the inter-monsoon months (October & November) when the sea is calm and the water clear, dugongs can sometimes be seen in the shallow bays and seagrass beds in the southern part of the delta. Dugong meat is a prized source of protein, with a current market value of US\$ 1.00 per kg.

The main threat to dugongs in the past was deliberate hunting for meat. Today, the mammals having become so rare, accidental entanglement in both set and drift gillnets with a mesh size of >6' is the main cause of dugong mortality in Tanzania. Disturbance, both to dugongs directly and to critical seagrass feeding habitats, from commercial prawn trawling, oil and gas exploration and destructive fishing practices such as dynamite fishing is likely also to have contributed to the population decline. Villagers tend to recognise the need for conservation measures; proposals included awareness raising, establishment of dugong sanctuaries, law enforcement, control of trawling activities and further research.

Dugongs are critically endangered in Tanzania and without an immediate and concerted conservation effort they will almost certainly become nationally extinct in the near future. Detailed

surveys are urgently needed in the two remaining dugong areas to determine precise population sizes, movements and threats, and to map seagrass distribution and diversity. Other research priorities include aerial surveys, catch monitoring, assessing the impact of prawn trawling and initiation of satellite tracking.

Probably the only hope of protecting the two remnant dugong populations is the immediate establishment of dugong sanctuaries in one or both areas. Management of such sites will need to focus on regulating the use of gillnets, and prawn trawling. Success is likely to depend particularly on the provision of incentives and alternatives to gillnet fishers and awareness raising. A body such as a national dugong task force would assist in the development and implementation of a national dugong conservation action plan. Regional collaboration is also critical given the migratory nature of this species.



Figure 7. Map of the Tanzanian coast, showing sites where interviews were conducted

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8.2.2 General background

Tanzania's 900km mainland coastline, together with Zanzibar and numerous smaller offshore islands (from 4°40'S – 10°.22'S) supports a diverse array of habitats including fringing and patch reefs, seagrass beds, mangroves, sheltered bays and sand beaches (Figure 7). The tropical climate is subject to two monsoon seasons, the calmer NE monsoon from November to March and the stronger SE monsoon between June and September. The spring tidal range is 2-4m.

Tanzania has a population of 35.5 million people. The five coastal regions encompass about 15% of the country's land area and approximately 25% (8 million) of the population, which is expected to double by 2010 (TCMP, 2003). Most rural coastal communities are poor and depend directly on coastal and marine resources for their livelihoods. Pressures on coastal resources are increasing as demands from a growing population escalate. 95% of Tanzania's fishing industry is artisanal and occurs in inshore areas.

8.2.3 Dugong status and distribution

(a) Literature review

Tanzania's mainland coast (and offshore islands), which is characterized by a shallow and relatively narrow coastal shelf less than 100 m deep and 10 km wide (Frazier, 1975; Richmond, 1997), supports extensive seagrass pastures which occur from the high inter-tidal to shallow sub-tidal areas off the coast of Mtwara, Kilwa, Rufiji, Bagamoyo and Tanga (Moa) and the west side of Pemba, Unguja and Mafia Islands (Richmond, 1997; Muhando et al. 1999; UNEP, 2001; Ochieng & Erftemeijer, 2002). 12 species of seagrasses have been identified in Tanzania including genera preferred by dugongs such as *Halophila*, *Halodule*, *Cymodocea* and *Syringodium* (Semesi, 1987; Howell, 1998; Ochieng & Erftemeijer, 2002).

Information on dugong distribution and abundance in Tanzania is mostly from anecdotal reports and incidental sightings. Until recently, dugongs were thought to have already disappeared from northern Tanzania (their former stronghold), their presence in the south was unknown and the entire Tanzania coast was highlighted as a priority area for research (Marsh et al., 2001).

No aerial dugong surveys have been conducted in Tanzania and few confirmed data exist on numbers. The first documented photographic records were of 3 animals netted by local fishermen from Mafia Island in 1930 (Dollman, 1933). In 1968, Ray identified Rufiji and Kilwa as the last remaining refuges for dugongs along the Tanzania coast. The Pemba-Zanzibar channel in northern Tanzania has also been recognized as an important dugong habitat (Bryceson, 1981; Howell, 1988; Korrubel & Cockcroft, 1997; UNEP, 2001), but in this area they are already believed to be locally extinct and the last report was in 1990 (Chande et al., 1994; Cockcroft et al., 1994; Marsh et al., 2001). Populations have declined significantly in recent decades possibly to the point where they cannot recover and their numbers are estimated to be no more than 100 individuals (Ngusaru et al., 2001).

The most recent information on dugongs in Tanzania is from interviews by the Mafia Island Sea Turtle & Dugong Conservation Programme, conducted between 2000 and 2003 at Mafia Island (Muir & Abdallah, 2002; Muir & Abdallah, 2003). The findings suggest that dugongs still exist in the area between Mafia and Rufiji, south to Somanga. Since January 2000, 11 dugong sightings were reported (2 live and 9 caught in gillnets) in the Mafia-Rufiji-Kilwa area. The preserved tail of a dugong caught in 2001, the ribs of two other animals and a photo of a dead dugong, were also collected from local fishers. The major threat was reported to be accidental drowning of dugongs in gillnets set to catch rays, sharks and other pelagic species.

Table 6. Respondent Profile

	No. villages	No QIs	Sex		Residency		Occupation				Age Classes					
			M	F	Res	Vis	Fish	F/F	Farm	Others	>70	60-69	50-59	40-49	30-39	20-29
Tanga	8	27	26	1	25	2	24	0	1	2	0	4	6	8	7	2
Pemba	6	33	33	0	33	0	31	0	0	2	0	4	2	8	15	4
Unguja	2	18	18	0	15	3	18	0	0	0	1	0	0	1	5	11
B'moyo	5	32	32	0	29	3	31	1	0	0	3	6	6	8	7	2
DSM	4	15	15	0	11	4	15	0	0	0	1	3	1	4	3	3
Mafia	10	100	99	1	81	19	81	0	9	10	9	17	10	19	23	22
Rufiji	5	52	40	12	52	0	27	10	13	2	2	3	8	23	9	7
Kilwa	4	38	38	0	34	4	35	2	0	1	7	1	9	8	8	5
Lindi	3	31	31	0	31	0	29	0	1	1	6	2	5	9	6	3
Mtwara	10	74	71	3	71	3	37	22	10	5	13	6	5	15	22	13
TOTAL	57	420	403	17	382	38	328	35	34	23	42	46	52	103	105	72

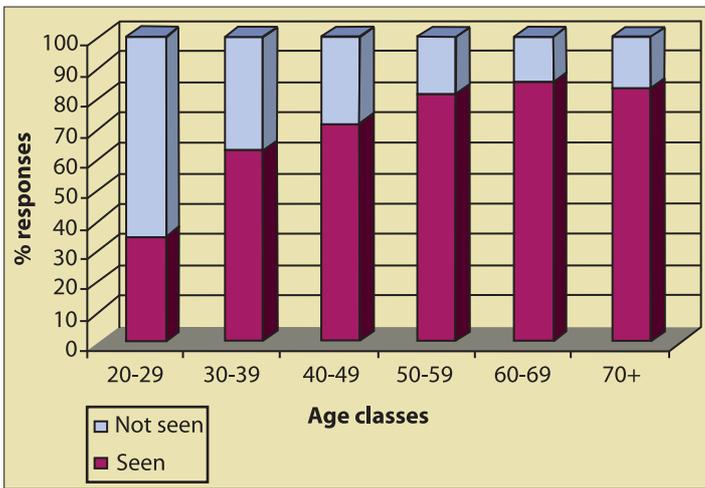


Figure 8. Proportion of respondents in different age classes who had seen a dugong

(b) Questionnaire survey

420 interviews were conducted in 57 villages along the coast of Tanzania, including the offshore islands of Pemba and Unguja (Zanzibar) and Mafia.

96% of respondents were fishermen and 94% were long-term residents of the village in which they were interviewed, therefore it is assumed that a significant proportion of information gathered was local knowledge (Table 6).

The general level of awareness of dugongs amongst respondents was high and nearly 70% recognised the dugong on the identification card. However, the level of awareness and understanding about their life history, biology and threats was generally poor. Dugongs were typically reported to be just like

"fish" which give birth to live young. The local Kiswahili word for dugong is "nguva".

Amongst the younger respondents, 33% between the age of 20 – 29 years had seen a dugong compared to 83% of respondents over 70 years confirming that dugongs were more abundant in the past (Figure 8).

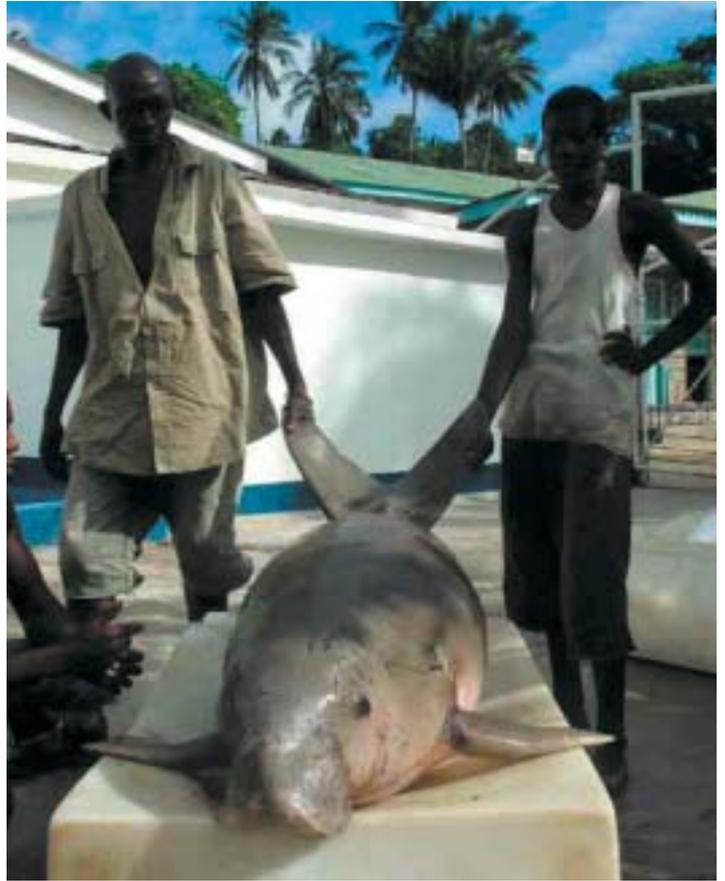


Plate 2. Male & female dugongs caught in Rufiji Delta, in January & March 2004. (Source: J. Rubens & C. Muir)



(c) Status

Prior to the mid 1970s, dugongs were reported to be relatively abundant in Tanzanian waters when herds of 20 – 30 animals were not uncommon and it was possible for gillnet fishers to capture 3 - 5 animals per day. 67% of respondents (281) claimed personally to have seen a dugong; of which 272 respondents had sighted dugongs in Tanzanian waters, 3 in southern Kenya and 6 in northern Mozambique. 41% of these respondents (115) had themselves captured a dugong in gillnets (jarife),

Table 7. Records of dugong observations in United Republic of Tanzania, 2000 - 2004

Reporter	Date seen	Location	No.	Sex/size	Circumstance
2004 Bakari Juma Abdul Latif Saidi	30.03.04	Dima, Rufiji	1	M / 1.73m	Caught in drift gillnet – p'graphed
	14.01.04	Simba Uranga, Rufiji	1	F / 2.57m	Caught in drift gillnet – p'graphed
2003 Isihaka Kilumbi Juma Mohammed Nasorro Saidi S Mangondo Bakari Mwani Abdul Latif Saidi	01.11.03	Boza, Kisiju	1	?	Caught in gillnet
	May '03	Mombasa, Kenya	2	?	Live
	30 Feb '03	Twana, Rufiji	2	Sub-adults	Caught in gillnet.
	22 Feb '03	Ukambara, Rufiji	1	?	Live
	Feb '03	Kichinja ya Mbuzi, Rufiji	1	Adult	Caught in gillnet.
	Jan '03	Simba Uranga, Rufiji	1	calf	Caught in gillnet
TOTAL NO. DUGONGS CAUGHT IN NETS: 5					
2002 Mohammed Rambaso Bakari Mkunga Haji Abdallah Bakari Mwani Philip Mason Juma Kombo Saidi Issa Mzee Mohammed Ali Mgeni Ibrahim Kichapwa Issa Mohammed	Dec '02	Mbayae, Moa	1	Adult	Live
	Nov '02	Somanga, Kilwa	1	?	Caught in gillnet.
	7 July '02	Somanga, Kilwa	1	?	Caught in gillnet.
	June ' 02	Kichinja ya Mbuzi, Rufiji	1	F / 3m	Caught in gillnet.
	March '02	Njao gap, Pemba	1	Adult	Live
	15 Jan '02	Mafia	1	Calf	Caught in gillnet.
	2002	Utigiti, Rufiji	1	Adult	Caught in gillnet.
	2002	Mohoro Bay, Rufiji	1	Adult	Live
	2002	Somanga, Kilwa	2	Adult	Caught in gillnet.
	2002	Somanga, Kilwa	1	F / 3m	Caught in gillnet.
	2002	Fungu Mbwamba, B'moyo	?	?	Live
	TOTAL NO. DUGONGS CAUGHT IN NETS: 8				
2001 Mzee Kijonjo Juma Hemedi Juma Hemedi Mzee Chapwe Hamili Ali Mzee Mohammed Ali Mgeni	04 Oct '01	Somanga, Kilwa	1	Adult	Caught in gillnet.
	Sep ' 01	Somanga, Kilwa	1	F / 1m	Bought dugong for TSh 9,000/-
	Apr '01	Matula, Rufiji	1	F / 1.5m	Bought for 16,000/-, sold 34,000/-
	Feb '01	Bwejuu Is., Mafia	1	?	Caught in gillnet.
	2001	Jaja, Rufiji	1	?	Caught in gillnet.
	2001	Somanga, Kilwa	1	Calf	Caught in gillnet.
	2001	Somanga, Kilwa	1	M / 3m	Caught in gillnet.
	TOTAL NO. DUGONGS CAUGHT IN NETS: 7				
2000 Moh'd Saidi Kahema Juma Hemedi Hemedi Zaharan Salum Mohammed Athamani Kigonge Moh'd Omar Mchimikya Hamisi Hawadhi Machano Ahmadi Abdallah Mohammed	20 Aug '00	Kilwa	3	Adults	Caught in gillnet.
	June '00	Somanga, Kilwa	1	F / Adult	Caught in gillnet.
	Apr '00	Buyuni, Pangani	1	F / 2.5m	Caught in gillnet
	2000	Bwejuu, Mafia	1	?	Caught in gillnet.
	2000	Ngolwe, Mohoro Bay, Rufiji	1	F / 3m	Caught in gillnet.
	2000	Somanga, Kilwa	1	?	Live
	2000	Somanga, Kilwa	1	?	Caught in gillnet.
	2000	Mafia	1	M / adult	Caught in gillnet.
	2000	Somanga, Kilwa	1	Adult	Caught in gillnet
TOTAL NO. DUGONGS CAUGHT IN NETS: 10					



Figure 9. Map showing recent dugong sightings in the United Republic of Tanzania

with a mesh size of between 8 – 12 inches (sinia). Others reported seeing a carcass at a landing site or meat sold in a local market. 8% of respondents reported having seen live, free-swimming dugongs (i.e. not caught in gillnets).

Since January 2000, 31 dugongs were reportedly caught in gillnets while live, free-swimming animals were sighted on 7 occasions (Table 7). The most recent incidents were of two animals (male & female) that accidentally drowned in drift gillnets (12-18" mesh size) on 14 January and 30 March 2004 off the Rufiji Delta (Plate 2). Both carcasses were taken to District officials in Mafia. These represent the first photographic records of dugongs in Tanzania since 1930 and provide the first specimens for Tanzania.

Most sightings were of single animals in the Rufiji-Kilwa area, indicating that the largest remaining concentration of dugongs occurs there. A sighting of a live individual from Moa in Tanga supported the general opinion of fishers there that a small number of dugongs persist close to the northern border with Kenya where they were previously thought to have disappeared.

Other isolated sightings were reported from Pangani and Pemba but there was little indication to support the view that there are resident populations in these areas (Fig 9).

Significantly, 79% reported a dramatic decline in dugong numbers since the mid to late 1970s. In some areas of their former range, such as Unguja (Zanzibar), Lindi and Mtwara, they were said to have become locally extinct. The capture records since 2000 suggest that 8-10 dugongs are killed annually in Tanzania. The general perception in all areas, including Rufiji-Kilwa, is that it may already be too late for dugong numbers to recover.

(d) Distribution

The most frequent dugongs records, from the 1950s to the present day, were in the waters off the Rufiji Delta (Pombwe & Utigiti) and Kilwa (Somanga & Matapatapa) (Figure 10).

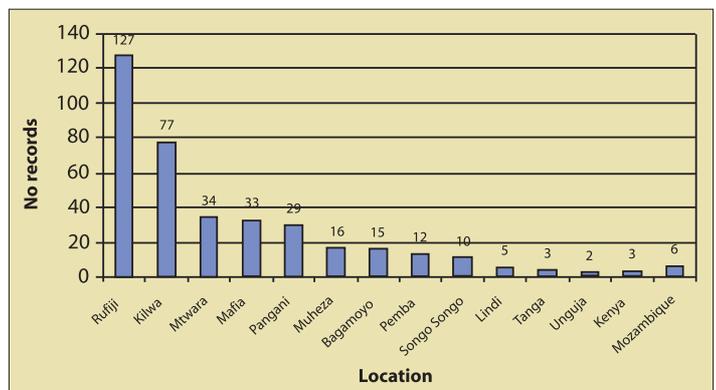


Figure 10. Locations of dugong sightings in the United Republic of Tanzania

(i) Kilwa – Rufiji

Over half of all the respondents (55%) identified the most important remaining dugong area as the shallow seagrass meadows and sheltered bays in the southern section of the Rufiji Delta. Specific locations included Mohoro Bay, Kichinja cha Mbuzi, Pombwe, Jaja and Somanga. Also cited were Twana, Mbwera and Dima, a little further to the north. The incidental capture of two immature dugongs on 30 February 2003 at Twana was verified by several different witnesses, including the Village Chairman, from Bwejuu Island in Mafia District where the meat was sold.

7 respondents from Mbwera, Jaja, Pombwe and Somanga villages concurred that dugongs still occur at Utigiti, Bacha Mbao, Lokotonazi and Ngolwe in Mohoro Bay, between Pombwe and Somanga. In the shallow bay, it is possible to see 3 - 4 animals during the months of July and August. The ideal time to see them is early in the morning during spring tides before they return to deeper waters. Bakari Mwani from Somanga also reported that it was possible to see dugong feeding trails during low spring tides. It was not possible to verify these claims as rough sea conditions prevented attempts to snorkel in the bay. A detailed map of Mohoro Bay is shown in Figure 5.

(ii) Bagamoyo - Pangani - Muheza

3 out of 5 fishers interviewed at Moa, and several from Kwale village, claimed that dugongs were abundant up until the late 1970s, and that a small population of dugongs still exists close by at Mbayae / Kigomeni (approximately 15km south of the Kenya border) where it is possible to observe them early in the morning between the months of August and October. The reported accidental capture of a dugong in southern Kenya in 1994 was confirmed by several different respondents.

Most records of dugong off the coast of Pangani District (to the south) were reported to be before the 1980s. However, an adult male was allegedly caught in a gillnet at Sima (Madete) in March 1999 and a 2.5m long adult cow at Buyuni in April 2000.

(iii) Mtwara

Most dugong reports from Mtwara (Mnazi Bay and Ruvuma River on the border with Mozambique) were prior to the 1980s. The last confirmed sighting was at Msimbati in 1992. This was verified by the District Fisheries Officer from Mtwara who had personally seen the animal which was caught in a gillnet by local fishers. Recent unconfirmed observations include that of a dugong feeding trail in Mnazi Bay in 2000, and a live dugong also in Mnazi Bay in January 2003. These claims are being followed up by staff of the Mnazi Bay – Ruvuma Estuary Marine Park.

(iv) Mafia

Respondents from Mafia reported herds of 70-100 individuals in Chole Bay prior to the mid 1970s (Muir & Abdallah, 2003). Recent sightings were rare and confined to waters on the west coast between Mafia and the Rufiji Delta (e.g. Twana and Dima).

(v) Zanzibar (Unguja and Pemba)

One dugong was reported at Kizimkazi in the southeast of Unguja Island in 1982.

In Pemba Island, 13 reports of dugongs (several of a stranding) were made prior to the early 1990s. The most recent observation was in March 2002 by a dive instructor from Pemba Afloat who claimed to have seen a live dugong at Njao gap off the west coast.

(vi) Lindi

Only 4 dugong observations were reported in Lindi, all of which were prior to the 1980s. 3 respondents interviewed in Lindi claimed to have seen dugongs in Mtwara but by far the majority (26 respondents) reported observations from the Mafia-Rufiji-Kilwa area.

(e) Ecology and movements

56% of respondents (180) identified seagrasses as the main dugong feeding and breeding grounds. River mouths and estuaries were also cited (11%), as were coral reefs (4%) and deep seas.

Several fishers from Kilwa and Somanga identified "dugong grass" as *Halophila ovalis*, *Halodule uninervis*, *Zostera capensis* and *Syringodium isoetifolium*. During a recent survey in the southern Rufiji Delta, 8 seagrass species were identified: *Cymodocea rotundata*, *Cymodocea serrulata*, *Enhalus acoroides*, *Halodule uninervis*, *Halodule wrightii*, *Halophila ovalis*, *Syringodium isoetifolium*, *Thalasia hemprichii* and *Thalassodendron ciliatum* (Muir, 2003).

8.2.4 Uses and myths

The main use of dugongs is for meat (Figure 11), a prized source of protein. Although fishers were generally aware that killing dugongs is illegal, many admitted that if a live dugong is caught accidentally, it will invariably be killed and eaten. Several respondents claimed that dugong meat has special qualities, giving strength and good eyesight. 47% of respondents had tasted the meat which they likened to prime beef. A fisher from Rufiji believed the meat was more similar in taste to giraffe.

Few respondents, mostly elders, reported that in the past, dugongs were deliberately hunted for their meat using locally crafted "dugong" nets (msadaka) with a large mesh size of >15

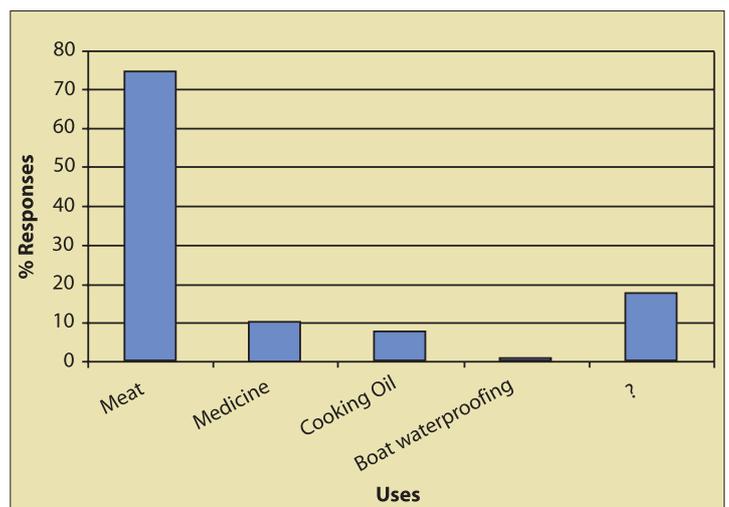


Figure 11. Uses of dugongs by respondents in the United Republic of Tanzania

inches. The nets were set in shallow, seagrass meadows on known dugong routes to a depth of about 3m. Homemade bottom-set msadaka nets are still used today to catch rays and sharks because they are considerably cheaper to make than the manufactured 6" jarife (gill) nets. However, they are no longer used intentionally to hunt dugongs because dugongs are now so rare and because it is illegal.

Depending on the village, dugong meat was either shared out or sold locally within the community. If a calf is caught, the meat is normally shared out. However, if a large animal is netted, the meat is usually cut up into pieces sold for UD\$ 1.00 per kg. The whole animal was said to be worth anything from US\$ 9 – 80). The price

was said to vary according to size, the amount buyers could afford and to freshness of the meat.

Reported uses, other than meat, were few. Several respondents said that dugong oil is used as a fat for cooking fish, eggs or bread and occasionally as waterproofing for boats (sifa). It is also used rarely as a cure for a range of illnesses including asthma, burns, skin ulcers, muscle pain, ear ache and breast pain. Traditional healing properties of bones were only mentioned by 3 respondents during the survey. The dense, swollen bones were said to ward off evil spirits, as a cure for skin rashes or rubbed on the legs of young children to help them walk. Tusks were not mentioned.

Dugong myths were uncommon. Of the minority who held beliefs about dugongs, the most commonly cited was that describing dugongs as mermaids with "a face like a pig", a "torso like a woman" and a tail "like a shark or dolphin". Dugong cows were said to give birth to live young, which they nurse from breasts positioned between their flippers or "hands". The skin has hairs, also like humans. Some said that when a dugong is caught and killed, it cries like a baby or wails like a woman. Several fishers believed that female dugongs menstruate. 19 elaborated further saying that in the past, fishers were obliged to make an oath before they went out fishing, promising not to have sexual intercourse with a cow if they caught one in their net. Doing so would bring bad luck to the fisher and anyone who ate the meat.

5 fishers reported a dugong spirit or ghost living in the area of Pombwe and Mohoro Bay (Rufiji district) where it is commonly seen swimming in shallow waters especially during spring tides. Being a spirit, it was not possible to catch it in a net. Seeing this ghost was neither a good nor bad omen.

In Pangani, a fisherman told a story about Sirenian creation. According to legend, in ancient times two humans, a brother and sister, had an incestuous relationship. God became angry and as punishment replaced their legs with fish tails and banished them to the sea where they remain to this day as dugongs.

Other tales included the belief that: by eating dugong meat, it is possible to live to be 1025 years old; dugongs come ashore during the night and return to the sea in the morning; dugongs come out of the sea in the day to warm up in the sun; and that a dugong sighting forecasts a good harvest.

8.2.5 Threats

The main threats to dugongs in Tanzania are accidental capture in gillnets, seagrass damage from trawlers and seine nets, disturbance from boat traffic, dynamite fishing and offshore gas and oil extraction activities, and coastal development (Figure 12).

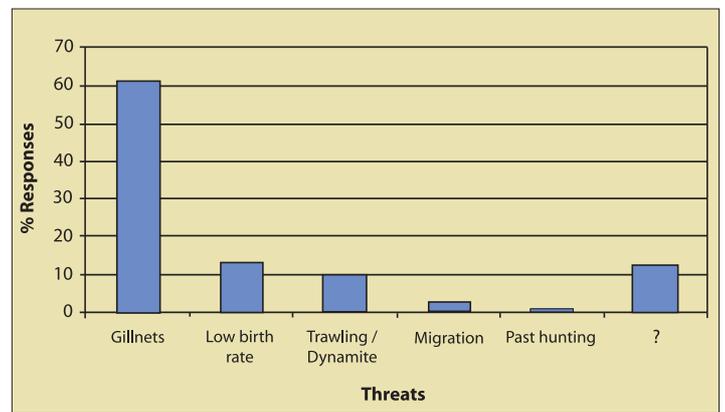


Figure 12. Claimed threats to dugongs in the United Republic of Tanzania

(a) Hunting and gillnet fishing

Prior to the 1970s (and before dugongs were officially protected) dugongs were actively hunted and this has probably had the biggest impact on their current population status.

Nylon filament gillnets were introduced in Tanzania in the late 1960s (Amir et al., 2002) and pose the greatest threat to dugongs in Tanzania today. 85 fishers had personally caught a dugong in their net, 98% of which were gillnets with mesh sizes ranging from 5 – 16". Gillnets are typically set in the evening where they remain for 12 - 24 hours before being pulled. Respondents who had netted a dugong said that animals were normally dead or very weak when the net was pulled. However, if a dugong was still alive, it would invariably be slaughtered for the meat. Of respondents who had not caught a dugong in their net, 45% (190) cited gillnets as the major threat. In this survey, In Kwale (Muheza District) dugongs were actively hunted using dynamite until the 1970s.

(b) Prawn trawling

Damage to seagrass beds and disturbance to dugongs from prawn trawling was cited as a threat, mostly by fishers from Rufiji and Bagamoyo (48% and 44% of respondents respectively). Commercial trawling started in Tanzania in the late 1960s and 22 vessels currently operate along the coast in 3 zones. The prawn trawling season is open for 9 months of the year between March and November (inclusive) (Richmond et al., 2002). Apart from several exclusion areas in the north of Zone 1, trawling is unrestricted. Prawn hotspots exist at Mchungu and Jaja off the Rufiji delta, a prime dugong area in Tanzania. At times when good prawn concentrations are found, a maximum of 14 vessels might be fishing along the shores of the Rufiji District. Most trawling occurs at depths between 4-10m.

(c) Habitat Destruction and Pollution

Coastal communities depend on local resources such as artisanal fishing, small-holder farming, subsistence forestry and lime and salt production for their livelihoods. Population growth, rapid urban expansion and industrial development are resulting in a

reduction in water quality from industrial and domestic effluents, siltation of inshore waters, which include important dugong feeding grounds, from land clearance and deforestation and increased pressure on marine resources (Pratap, 1988). As a result, estuarine and coastal habitats are being degraded and are threatening the future survival of dugongs (Cockcroft et al., 1994). Gas & oil exploration in the Songo Songo archipelago, off the southern Rufiji delta may also pose a potential threat from general disturbance (e.g. pipe laying) and oil / gas leaks.

Population declines were also attributed to low reproduction rates of dugongs.

The general consensus among respondents (71%) was that conservation measures are necessary because dugong populations have been decimated and are now very rare. As part of Tanzania's natural heritage, respondents thought it was important that dugongs be protected for future generations to see and use. Only 1 individual did not think conservation was important and 28% did not know. Villagers tended to recognise the need for conservation measures; proposals included awareness raising, establishment of dugong sanctuaries, law enforcement, control of trawling activities and further research (Figure 13).

8.2.6 Policy and legislation

In Tanzania, turtles are officially protected under Section 7 of the Fisheries Act, No. 6 1970. Under this law, anyone found guilty of a first offence is liable to a fine of TSh 300,000 (USD 300) or a jail sentence of 3 years. The fine for a second offence is TSh 500,000 (USD 500) and 4 years imprisonment. However, capacity of district Fisheries Officers to enforce national legislation is lacking due to limited resources and awareness.

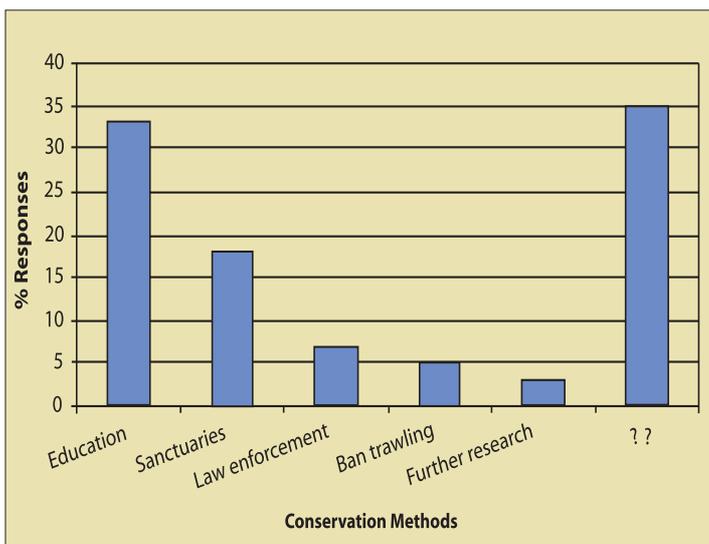


Figure 13. Proposed methods of conservation (%) in the United Republic of Tanzania

Tanzania is a signatory to the Convention on International Trade in Endangered Species of Fauna and Flora (CITES) of 1973. Dugong are listed on Appendix I of CITES which prohibits any international trade in dugong meat or parts as well as the entire animal. Tanzania is also a signatory to the Convention on Biological Diversity of 1982 and the Nairobi Convention of 1985.

8.2.7 On-going / proposed education, research and management activities

(a) National Integrated Coastal Environment Management

The Government of Tanzania has recently launched the National Integrated Coastal Environment Management Strategy. The goal is to implement the National Environment Policy and other related policies in conserving, protecting and developing the resources of Tanzania's coast for use by present and future generations. The ICM strategy will be implemented through activities of the Marine Parks & Reserves Unit, National Environment Management Council and the Tanzania Coastal Management Partnership.

(i) Tanga Coastal Zone Conservation & Development Programme (TCZCDP)

TCZCDP covers Muheza, Tanga and Pangani districts in northern Tanzania and was initiated in 1994. The overall goal is to develop sustainable use of coastal resources in Tanga Region through improvement of institutional capacity to undertake integrated coastal management and to assist coastal communities to use coastal resources in a sustainable way.

(b) Protected areas

(i) Mafia Island Marine Park (MIMP)

MIMP was established in 1995 under the Marine Parks & Reserves Act No. 29 of 1994 and covers an area of 822 km² which includes estuarine, mangrove, coral reef and seagrass ecosystems as well as critical habitats for turtles and dugongs. MIMP is responsible for: protecting ecosystem processes and areas of high species and genetic diversity; stimulating the rational development of non-utilised natural resources and tourism; promoting sustainable use of resources; and promoting involvement of marine park users in planning, development and management of the park.

(ii) Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP)

MBREMP, on the border with Mozambique in southern Tanzania, was established in June 2000. Mnazi Bay and Ruvuma Estuary have extensive mangrove forests, coral reefs and seagrass meadows, providing important dugong habitat. The biological diversity is considered to be the highest in southern Tanzania.

(c) Non-governmental Organisations (NGOs)

(i) World Wide Fund, Tanzania

WWF has been involved in marine conservation in Tanzania since 1990. In recent years, WWF has developed a new conservation approach and defined 238 "eco-regions" worldwide, based on their outstanding biological features. The Eastern Africa Marine Ecoregion (EAME), which extends along the coast from southern Somalia to northern South Africa, is one of these eco-regions. Within EAME, the Rufiji – Mafia – Kilwa Seascape is one of 8 sites identified as globally important and covers an area of approximately 9,500km² which includes one of perhaps only two remaining dugong populations in Tanzania. The objectives of the programme are to: develop a sustainable resources management plan for the seascape; stabilize household livelihoods and improve sustainability of natural resource-use in pilot communities; strengthen capacity of District authorities to develop collaborative management at village level; and strengthen the EAME process by highlighting policy issues.

(ii) Tanzania Turtle and Dugong Conservation Programme

The on-going Community-based Turtle and Dugong Conservation Programme based on Mafia Island, Tanzania, has been involved in protection, awareness raising and research since January 2001. Programme activities are expected to expand in April 2004 to include the whole Tanzanian coast.

(iii) Wildlife Conservation Society (WCS)

Since January 2003 the Wildlife Conservation Society (Tanzania) has focused attention on the plight of dugongs in Tanzania. Plans are underway to initiate more detailed research, based on these preliminary findings, such as quantitative population, and seagrass, surveys.

8.2.8 Recommendations

(a) Research and Monitoring

- Conduct aerial surveys in the area of Rufiji Delta and at Moa (in collaboration with KWS) to determine population status and abundance.
- Initiate a community-based dugong monitoring programme. Identify willing and honest resident fishers, and local village government members, to record sightings and incidental captures. Provide underwater cameras to fishers to obtain photographic evidence (live or dead animals).
- Conduct detailed studies on: the effect of trawling and natural

gas/oil extraction on seagrass habitat and dugong movements/behaviour; seagrass diversity and distribution; and dugong biology, ecology and movements. Encourage participation by researchers from the University of Dar es Salaam and Institute of Marine Sciences, Zanzibar, as well as foreign students.

- Initiate a dugong satellite-tracking programme.
- Assess the practicalities & appropriate incentive levels of introducing a dugong release incentive scheme.

(b) Conservation and Management

(i) Sensitisation and public awareness

- A nation-wide sensitization and public awareness campaign on the plight of dugongs in Tanzania and the region must be initiated. There are many ways this could be achieved at regional, national and local levels. For example, the development of a comprehensive and realistic regional environmental education strategy together with guidelines for conservation practitioners. At a national level, information should be disseminated through district authorities and the existing network of marine protected areas and conservation initiatives along the coast and via the media. At the local level, especially in key fishing villages, education activities should be enhanced with the support of village councils and district authorities via public meetings and slide and video shows. These activities would be greatly facilitated by the establishment of a Tanzania "Dugong Day", along similar lines to the Dugong Festival held annually in Kenya.

(ii) Dugong Sanctuaries

- Establish dugong sanctuaries or community-managed areas in one or both of the key dugong areas. Management of these sanctuaries will need to focus on regulating the use of gillnets, and possibly also prawn trawling in Rufiji-Kilwa, and halting dynamite fishing. Success is likely to depend particularly on an effective programme raising awareness and providing incentives and alternatives to gillnet fishers.

(iii) National dugong conservation body

- A body such as a "national dugong task force", along similar lines to the recently convened Tanzania Turtle Committee would greatly assist in the development of a national dugong conservation strategy, including the establishment of one or more sanctuaries and national awareness campaigns.

8.3 MOZAMBIQUE A T Guissamulo ¹

8.3.1 Summary

A national assessment of dugong status and distribution conducted by Hughes (1971) recorded that dugongs were common, occurring along the coast at Maputo Bay, Chidenguele, Inhambane Bay, Bazaruto Bay, Angoche, Mozambique Island, Pemba Bay and the Quirimba Archipelago.

More recently, boat and aerial surveys have been conducted in Bazaruto Bay, Inhambane Bay and Maputo Bay. The results suggest that populations have fallen steeply and the only remaining viable population is in Bazaruto Bay area where there are estimated to be approximately 100 animals. Dugongs have also been sighted in the southern part of the Quirimba Archipelago in the north of the country.

Results from 84 questionnaire interviews conducted in Inhambane and Cabo Delgado provinces, mostly with fishermen, suggest that dugongs may still be present around Inhambane Bay and Mozambique Island. They confirmed results from aerial and boat surveys that dugong populations have suffered greatly over the past 20 – 30 years.

The main threats to dugongs include: incidental capture in gillnets, and to a lesser extent trawlers, seine nets and palisade fish traps, which have increased in number along the coast since the end of the civil war in 1992; habitat degradation as a result of erosion and sedimentation caused by flooding and cyclones; direct mortality by cyclones; disturbance from boat traffic and divers; and pollution, particularly around the capital city, Maputo. The most recent net captures were in August and November 2003 off Vilanculos and in Quirimba National Park respectively. National and international laws exist for the protection of dugongs. However, capacity by relevant government institutions to implement legislation is limited. Two national parks have been established in Bazaruto Bay and the Quirimbas, both of which are important dugong areas. A private conservation area has also been created on the southern boundary of Bazaruto National Park. However, these protected areas represent only approximately 30% of the known dugong range.

The Ministry for the Coordinator of Environmental Affairs and the University of Eduardo Mondlane are planning a dugong research project in 2004. A Dugong Trust has been established to raise funds for dugong conservation through the tourist industry.

Recommendations include: monitoring dugong status, distribution and threats through annual aerial surveys; satellite tracking; incidental catch monitoring; and research into population biology, ecology and extent and health of seagrass habitat. The creation of new dugong conservation areas at four key sites (Inhaca Island; north of the Bazaruto National Park; Primeiras and Segundas Archipelago; and north of Quirimba

National Park) is recommended. Activities contributing to dugong mortality should be controlled in these areas and alternative livelihoods for local residents developed. Education and public awareness is critical and it is suggested that dugongs are promoted as Mozambique's flagship marine species. Finally, creation of a national dugong conservation group is recommended to coordinate activities and raise funds necessary to protect and manage dugongs.

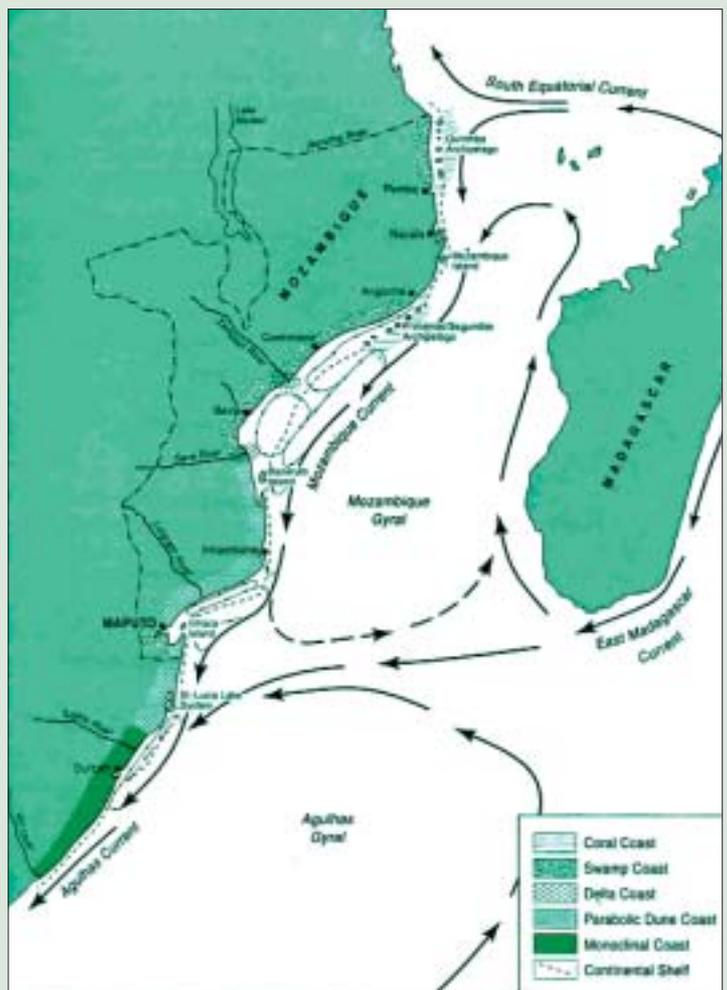


Figure 14. Map of Mozambique coast

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8.3.2 General background

The Mozambique coast is 2,770 km long, from 10°20'S to 26°50'S (Figure 14). Along the coast there are 3 distinct ecological zones (Tinley, 1971):

- The coral coast in the north, which extends from the Ruvuma River on the border with Tanzania to Angoche. The zone is dominated by scleractinian coral communities and includes seagrass beds, mangrove forests and sandy and rocky shores.
- The swamp coast is confined to central Mozambique and extends from Angoche southwards to Bazaruto. Sandy beaches, coastal swamps and estuaries with extensive mangrove forests characterize the coastline.
- The parabolic dune coast is the most southerly zone extending for 850 km from the Bazaruto Archipelago to Ponto do Ouro at the border with South Africa. The coast has high parabolic dunes, capes and headlands with coastal barrier lakes behind.

The climate in Mozambique is humid to sub-humid tropical with mean yearly temperatures of 26°C in the north and 22.1°C in the south. Mozambique is affected by both the Indian Ocean monsoon and the temperate South Africa climates. The interaction of the two systems can cause cyclones as well as upwelling along the coast which give rise to productive fisheries areas around Sofala, Maputo and Beira (Kemp, 2000).

34% (6.6 million people) of Mozambique's population lives along the coast, concentrated in the urban centers of Maputo, Xai Xai, Inhambane, Beira, Quelimane, Nacala and Pemba (Sosovele, 2000). The coastline is characterized by poor soil fertility and irregular rainfall and artisanal fisheries contribute significantly to coastal community livelihoods. About 60% of the population lives in extreme poverty and in an effort to reduce poverty levels, the government is supporting small-scale fisheries which currently employ about 80,000 people. Industrial and semi-industrial fisheries are exclusively limited to commercial shrimp catches.

8.3.3 Dugong status and distribution

(a) Literature review

The earliest documented reports of dugongs along the Mozambique coast were in 1936 by Lopes (Lopes, 1936). Walker et al. (1964) mentioned that dugongs occur in in-shore shallow

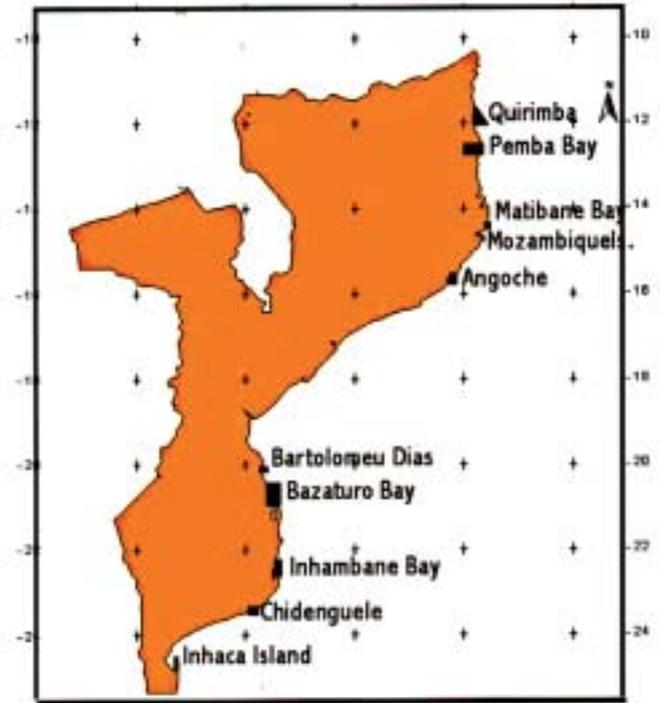


Figure 15. Dugong distribution in Mozambique from early records

warm waters, rarely ranging into deeper waters. In 1969, Hughes conducted a dugong (and turtle) survey along the Mozambican coast and reported that dugongs were common at Maputo Bay, Chidenguele, Inhambane Bay, Bazaruto Bay, Mozambique Island and Pemba Bay (Hughes, 1971). At Angoche estuary in northern Mozambique, 27 dugongs, including a herd of 12 animals, were counted during an aerial survey, although local fishers identified Mafemedede Island, approximately 10 km offshore as the most important site for dugongs in the area (Hughes & Oxley-Oxland, 1971). Hughes also speculated that dugongs may occur in the Quirimba Archipelago in the north of the country, based on the existence of suitable habitat, but their status in this area was unknown (Hughes, 1971; Smithers & Lobão Tello, 1976).

Later, Smithers & Lobão Tello (1976) observed dugongs in Maputo Bay (8 - 10 animals), Inhambane Bay (2 - 4 animals), Ponta Bartolomeu Dias (20 animals seen in 1974) and along the coast between Bazaruto Bay and Save River where they were reported to be common. Elsewhere, smaller groups were observed at Angoche, Mozambique Island, Matimbane Bay and Pemba where they were said to be abundant until 1970. The distribution of dugongs along the Mozambican coast from early records is presented in Figure 15.

(b) Boat and Aerial Surveys

Over the past decade, boat and aerial dugong surveys have been

Table 8. Dugong observations during boat surveys carried out in Maputo Bay

Year	No surveys	Time (h)	No. of days	No. sightings	Alone	with <i>S. chinensis</i>
1992	46	180.74	46	7	6	1
1996	57	127.1	41	2	2	0
1997	99	170.8	81	2	2	0
2001	76	233	69	4	1	3

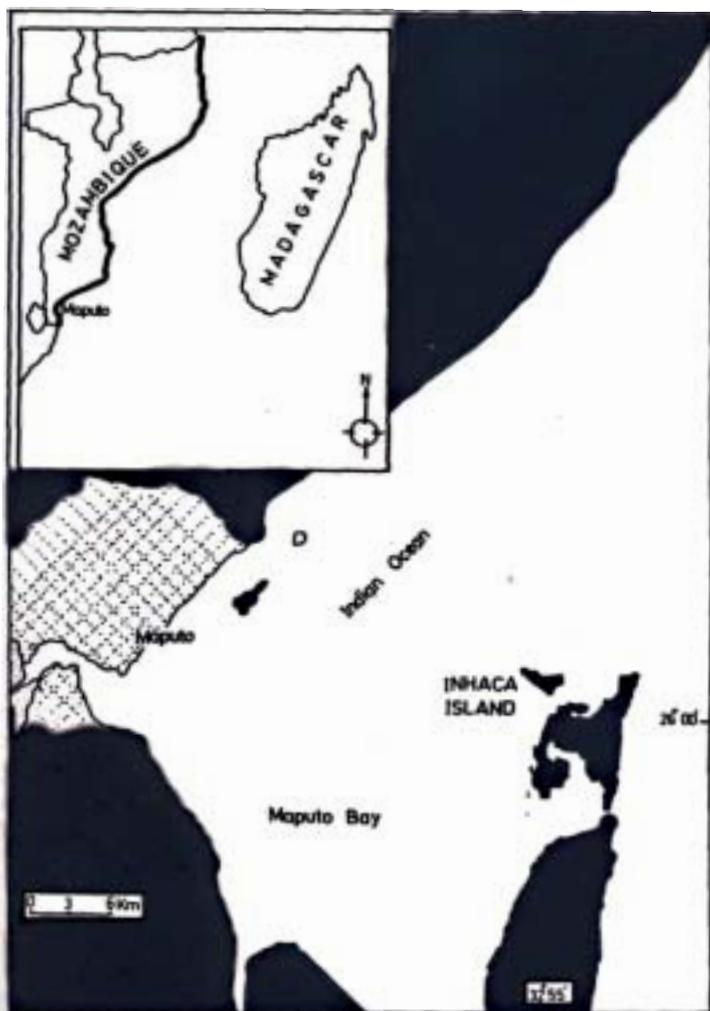


Figure 16. Map of Maputo Bay

carried out in just three areas along the coast: Maputo Bay, Inhambane Bay and Bazaruto Bay. No other recent surveys have been undertaken and the current national status of dugongs is unknown.

(i) Maputo Bay

Dugongs were once plentiful in Maputo Bay (Guissamulo & Cockcroft, 1997). However the area is now thought to support only 2 or 3 individuals (Cockcroft & Young, 1998). Boat surveys have been conducted in Maputo Bay on 4 occasions between 1992 and 2001 (Table 8). Only single animals have been observed, possibly due to disturbance from boat engines causing dugongs to submerge and swim away quickly. On 4 occasions dugongs were sighted in association with Indo-Pacific hump-backed dolphins (*Sousa chinensis*). Due to the infrequency of sightings, it has not been possible to estimate their abundance or density (Fig 16).

(ii) Bazaruto Bay and neighbouring areas

The waters around the Bazaruto Archipelago are reported to support the largest dugong population along the eastern Africa coast (Dutton, 1994). Population figures, obtained from sample aerial counts carried out in Bazaruto Bay in 1990, 1992, 1995, 1999, 2001 and 2002, are estimated to be between 25 and 130 and declining (Mackie, 1999) (Table 9). The latest estimate

Table 9. Data from aerial surveys conducted in Bazaruto Bay between 1990 & 2002

Year	Counts	Estimates	No. of surveys	Duration (min)
1990	80	110	1	
1992	75	130	2	228.67
1995	2	25	1	172
1999	9	72	1	
2001	13	104	1	202
2002	19	?	1	

suggests that there may only be 100 individuals left in the area.

Later, Smithers & Lobão Tello (1976) observed dugongs in Maputo Bay (8 -10 animals), Inhambane Bay (2 - 4 animals), Ponta Bartolomeu Dias (20 animals seen in 1974) and along the coast between Bazaruto Bay and Save River where they were reported to be common. Elsewhere, smaller groups were observed at Angoche, Mozambique Island, Matimbane Bay and Pemba where they were said to be abundant until 1970. The distribution of dugongs along the Mozambican coast from early records is presented in Figure 15.

Most sightings were of single animals. However, larger groups were observed south of Santa Carolina Island where 34 individuals were recorded in 1992, 3 in 1999 and 6 in 2001. Another large herd is believed to occur south of the Bay, near San Sebastian Peninsula (Paul Dutton, pers. comms. Aug. 2003). In August 2003, a dugong was caught in a net at Vilanculos, on the southern border of the park. Details of group size and distribution from aerial surveys conducted in 1990 and 2002 in Bazaruto Bay are shown in Figures 18 and 19. They indicate a significant decline in dugong numbers.

30 km north of the bay, off Bartolomeu Dias Point, a mother-calf pair were sighted during a survey conducted in May 2001. Anecdotal information also indicates that dugongs are caught in

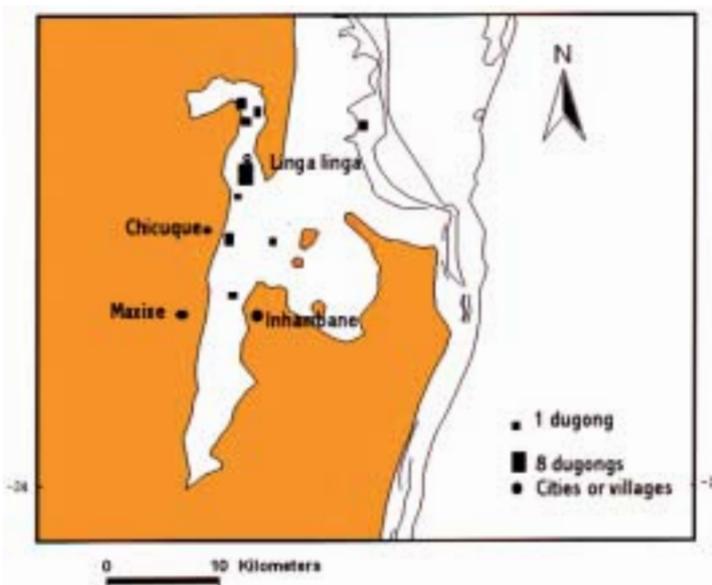


Figure 17. Dugong sightings at Inhambane Bay (1994 & 2001)

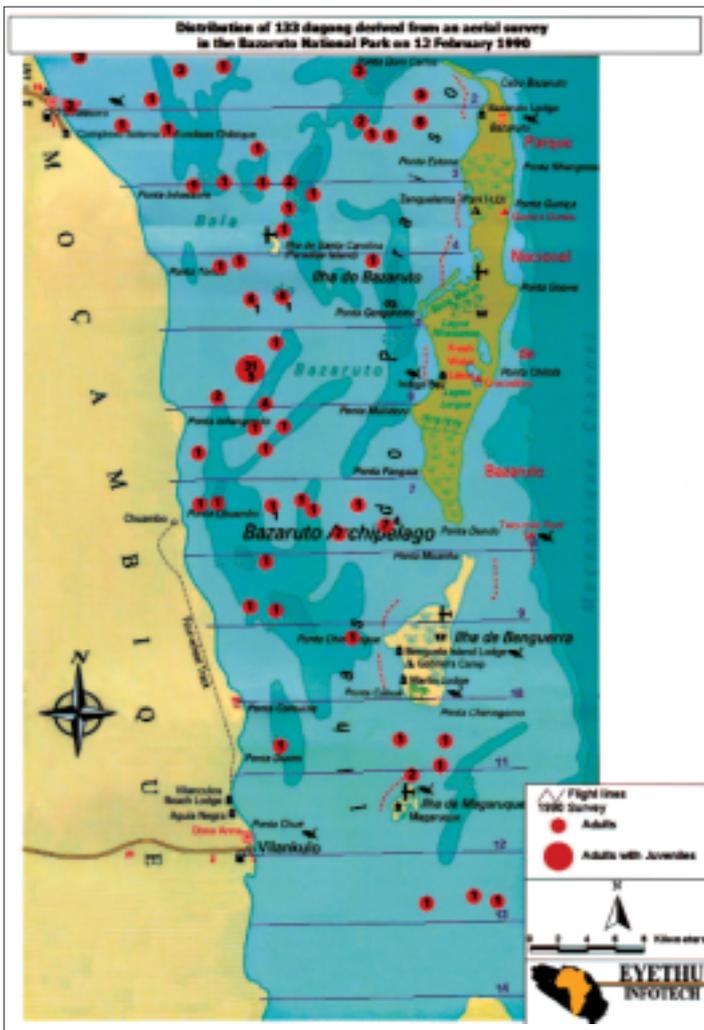


Figure 18. Numbers & distribution of dugongs in Bazaruto Bay in Feb 1990 (Source: P Dutton)

palisade fish traps in this area.

Seagrass species recorded in Bazaruto Bay include: *Halophila ovalis*, *Halodule uninervis*, *Cymodocea rotundata*, *C. serrulata*, *Thalassia hemprichii*, *Thalassodendron ciliatum* and *Zostera capensis* (A Guissamulo, unpublished).

(ii) Inhambane Bay

During a boat survey in Inhambane Bay in October 1994, dugongs were observed throughout the bay and were reported to be common at the Nhanombe River estuary where 8 animals were observed on one occasion at Linga Linga point (Guissamulo, unpublished data) (Figure 17).

A more recent aerial survey was conducted in 2001 during which a single dugong was observed outside the bay, during a low spring tide (Mackie, 2001).

(c) Questionnaire survey

In total 84 interviews were conducted along the Mozambique coast; 54 were held in 5 districts in Inhambane Province and 30 in 5 villages in the Quirimba Archipelago in Cabo Delgado Province (Table 10). Most of the respondents were fishers. Other

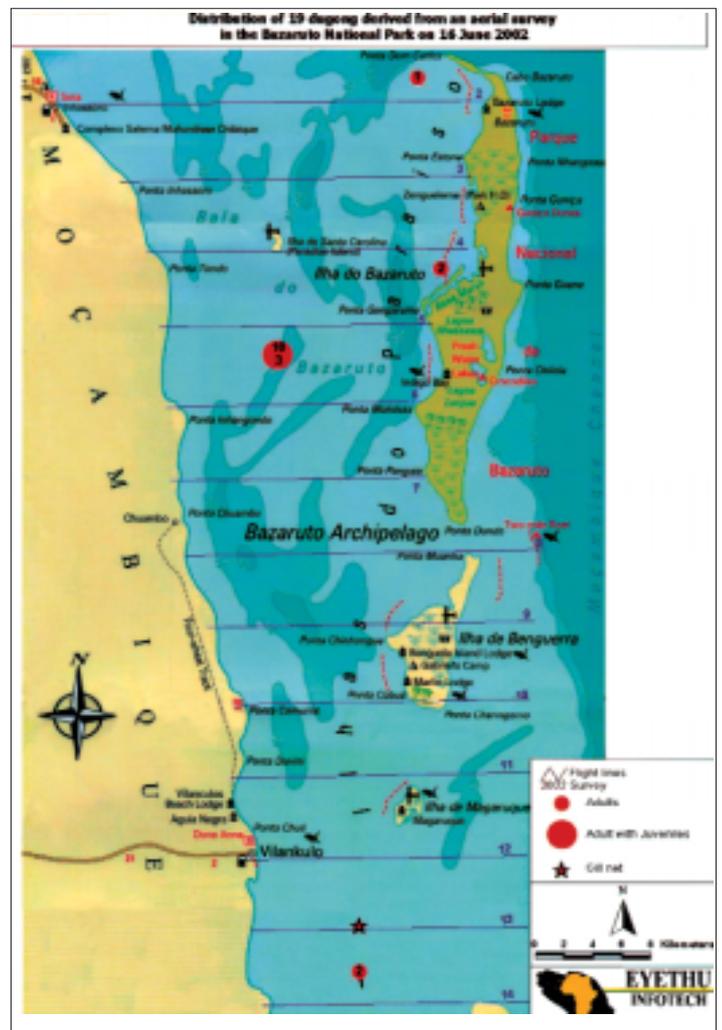


Figure 19. Numbers & distribution of dugongs in Bazaruto Bay in June 2002 (Source: P Dutton)

Table 10. Occupations of respondents

Location	Maritime authority	Sailor	Fishers	Other	Total
Inhassoro	1	2	14	1	18
Vilanculos	1	0	7	4	12
Morrumbene	0	0	5	0	5
Chicucue	0	0	10	0	10
Maxixe	0	0	7	0	7
Inhambane	0	0	2	0	2
Cabo Delgado	0	0	30	0	30
Total	2	2	71	9	84

professions included maritime officers, sailors, fishery extension workers, representatives of fisher associations, a camp owner and a conservationist. Fishers ranged in age from 18 to 70 years old.

Later, Smithers & Lobão Tello (1976) observed dugongs in Maputo Bay (8 - 10 animals), Inhambane Bay (2 - 4 animals), Ponta Bartolomeu Dias (20 animals seen in 1974) and along the coast between Bazaruto Bay and Save River where they were reported to be common. Elsewhere, smaller groups were observed at Angoche, Mozambique Island, Matimbane Bay and Pemba where they were said to be abundant until 1970. The distribution of dugongs along the Mozambican coast from early records is

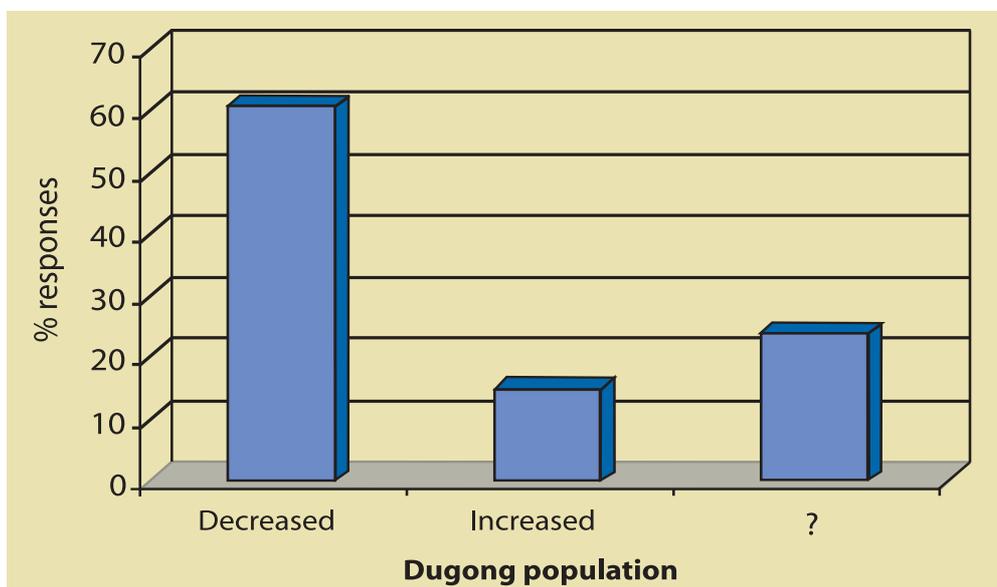


Figure 20. Perceived dugong population trends

Sites where dugongs have been reported by respondents along the Mozambique coast are presented in Table 11.

Table 11. Locations where dugongs have been recorded since 1992

Province	Location	Locations where dugongs reported / observed
Cabo Delgado	Northern Quirimba Archipelago	No records for past 15 years
	Southern Quirimba Archipelago	Mucojo area (Macomia), Quissanga coast, Islands of Ibo, Quirimba, Matemo, Quilaluia and Macaloe
Nampula	Nacala	Open sea, Quissimajulo Creek,
	Mossuril	Matibane Bay & Mocambo Bay
	Angoche	No recent records. Last reported in river channels in 1971
Inhambane	Govuro	Bartolomeu Dias & Mambone
	Inhassoro	Bazaruto Island, Chibwe, Mapandzene, Ponta Inhassoro
	Vilanculos	Open sea, Benguerua Island, Chibwe, San Sebastean Penninsula (Kewene)
	Morrumbene	Outside bay
	Chicuque	Both inside & outside bay
	Maxixe	Both inside & outside bay
	Inhambane	Linga Linga point (river mouth), Praia da Barra
	Jangamo and Zavora	Open sea
Maputo	Inhaca Island	North & south of the bay and on west coast

presented in Figure 15.

(d) Status and distribution

The majority of respondents (61%) claimed that dugong populations have decreased in their lifetime (Figure 20).

Table 12. Distribution and relative abundance of dugongs along the coast of Inhambane Province (from interview survey)

Location	Common	Rare
Inhassoro	6	12
Vilanculos	7	5
Morrumbene	4	1
Chicuque	0	10
Maxixe	3	4
Inhambane	0	2
Total	20	34

Population declines were attributed to rarity of this species. 15%

of respondents believed that populations have increased due to a reduction in the use of gillnets and because they are naturally abundant.

In Inhambane Province, respondents claimed that dugongs occur in Maputo Bay, Inhambane Bay, Bazaruto Bay, Bartolomeu Dias and Zavora (about 80 km offshore, south of Inhambane Bay) (Figure 13).

The presence of dugongs in Inhambane Province in the Nacala – Mossuril area (encompassing Mozambique Island, Matibane Bay and Quissimajulo Creek) was confirmed in January 1999 (Telford et al. 1999).

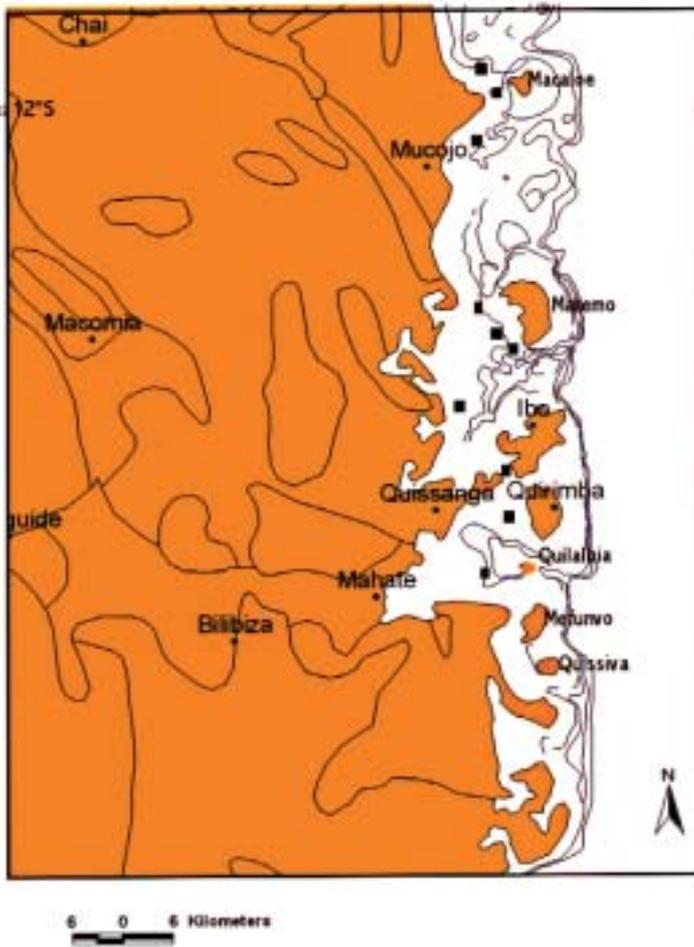


Figure 21. Map of dugong sighting records in the Quirimba Archipelago (A. Guissamulo, unpubl. data)

Further north in the Quirimba Archipelago, dugongs were reported to occur in the shallow areas between the mainland coast and the islands of Matemo, Quirimba, Ibo, Quilalea and Macaloe (Figure 21). Respondents claimed that dugongs used to be common in the northern Quirimba Archipelago but the last sightings in this area were more than 15 years ago. The main reason for the population decline was said to be increased capture in drift gill nets and disturbance by boat traffic.

Baseline biological studies carried out between 1996 and 1997 by Frontier Mozambique confirmed the existence of dugongs at Quilalea, Matemo and Mucojo Islands (Whittington et al. 1997; Stanwell-Smith et al. 1997).

The most recent sighting was of a dugong drowned in a net in the Quirimba National Park in November 2003 (H. Motta, pers. comms). Prior to this a local fisherman reported seeing a lone dugong in 2001 near Quilalea Island (Motta, 2001).

Table 14. Seasonality of dugong sightings in Inhambane Province

Location	Winter	Summer	All year
Inhassoro	1	9	8
Vilanculos	1	10	1
Morrumbene	1	1	3
Chicuque	1	9	0
Maxixe	3	4	0
Inhambane	2	0	0
Total	9	33	12

(e) Ecology and movements

Fishers claimed that dugongs feed on seagrasses and are most commonly sighted in shallow waters, bays, channels and in the open sea (Table 13). Fishers from the Quirimba Archipelago recognized several species of seagrasses as "dugong grass" including: *Cymodocea*, *Enhalus*, *Thalassia*, *Halodule*, *Zostera* and *Halophila*. The shallow waters around the islands of the Primeiras and Segundas Archipelago supports dense beds of *Halodule uninervis* and *Cymodocea ciliata* (Hughes & Oxley-Oxland, 1971).

At Inhambane, Vilanculos, Inhassoro and Bazaruto, respondents noted that dugongs also feed on seaweed. Others claimed that dugongs eat fish, as they are often caught in palisade (fence) traps which are between 500 – 1,000 m long enclosing shallow areas which are exposed on the low tide.

Respondents were unable to provide details on dugong reproduction or important breeding and calving areas.

With regard to seasonal movements, the majority of respondents claimed that dugongs are seen more frequently during summer months (November – March) (Table 14). Hughes & Oxley-Oxland (1971) also noted that dugongs entered the Angoche estuary in greater numbers during the rainy season between November and January and moved back to the shallow waters around the offshore islands between March and April.

Table 13. Perceived status of dugongs and habitat types (interview survey)

Location	Inhassoro		Vilanculos		Morrumbene		Chicuque		Maxixe		Inhambane	
	common	rare	common	rare	common	rare	common	rare	common	rare	common	rare
Open sea		5	3	5	4	1		5	1	3		1
Bay								1	2			
Channels	1		2					4		1		1
Beach	3	1										
River mouth	2											
Shallow areas	6	2										

8.3.4 Uses and myths

Throughout the Mozambique coast, dugongs are most highly valued as a source of protein and many respondents said they had eaten dugong meat. The meat is sometimes sold for between US\$ 0.6 – 2 per kg (Mt 15 – 45,000). However, it is more commonly distributed free among the local community.

Dugong meat is served to traditional chiefs. At Vilanculos and Bazaruto, it is believed that a dugong can only be butchered after a traditional chief has removed the head for his own consumption.

In October 1994, dugong bones were recovered from dumping sites after an appeal to fishers for research purposes (A. Guissamulo, pers. obs.). Respondents from Inhassoro said that some fishers sell dugong skulls to tourists. In June 2003, the author purchased the skull of a dugong which had apparently died in a cyclone in March 2003.

Fishers from the Quirimba Archipelago claimed that when a dugong is caught, a prayer must be said at the mosque or church before it can be butchered because dugongs are believed to be like humans (Whittington et al. 1998). However, many fishers cut the meat up into pieces at sea to avoid being detected and penalized.

Others said that dugongs, like dolphins, protect fishers and sailors from drowning at sea.

Local communities along the Inhambane coast appeared to be aware that hunting and killing dugongs is illegal. However they said that if a dugong is caught in a net it is invariably killed for its meat. At Govuro, Morrumbene, Vilanculos and Inhassoro secret trade routes have been established to prevent discovery by local authorities.

8.3.5 Threats

The main threats to dugongs in Mozambique are:

(a) Capture in fishing nets

Entanglement in gillnets appears to be the major cause of dugong mortality along the whole coast of Mozambique and it is likely that the level of threat from this fishing gear has increased since the end of the civil war in 1992 when use of gillnets increased. Fishermen have historically caught dugongs using large mesh gillnets and in some areas dugongs were deliberately hunted as fishers learned more about their ecology and movements. In Angoche in the late 1960s a dedicated dugong fisher claimed that he regularly caught 2 animals a month in his gillnet (Hughes & Oxley-Oxland, 1971). Large mesh gillnets (up to 30cm) are still in

use in the Quirimba Archipelago, Mozambique Island area (Quissimajulo, Moçambo Bay, and Matibane Bay) Angoche, Bartolomeu Dias and Bazaruto bays, Inhambane Bay and Maputo Bay (off the western coast of Inhaca Island).

Seine nets also pose a threat. In August 2003 a dugong was caught live in a seine net off Vilanculos (Plate 3). The animal was slaughtered at the landing site where the fishers were arrested by local authorities and their fishing gears seized. They are currently awaiting trial (A Guissamulo, pers. obs, 2003).

Similarly, trawling gears and large palisade (fence) fish traps, set in extensive inter-tidal areas, have proliferated along the coast. An aerial survey in 2001 indicated that Inhambane Bay has the highest density of fence traps. In Maputo bay fishing intensity is high and commercial bottom trawl fishing, artisanal gillnet fishing and large mesh set gill nets are in use.

(b) Habitat disturbance

Disturbance of dugong habitats, particularly seagrass beds, may pose a significant threat to dugongs along the Mozambique coast. For example, increased levels of sedimentation and changes in river courses caused by extensive flooding in 1999 and 2000 have altered the extent and species composition of seagrass beds in the Maputo area and at Bazaruto Bay (Baliday, pers. comms.).



Plate 3. Dugong caught off Vilanculos Town in a seine net in August 2003 (E Videira)

Cyclones may also have a significant impact on benthic habitats, altering the bottom profile and water turbidity (Spain & Heinsohn, 1973). In Mozambique, approximately 70% of the coast where dugongs occur is affected by cyclones at a rate of 2 a year at Mozambique Island and Nacala and 1 every 3 years at Bazaruto Bay.

(c) Mortality from natural events (cyclones and floods)

The only documented account of dugong mortality resulting from cyclones in Mozambique was reported in the Bazaruto area during a cyclone in March 2003 when 4 - 5 dugongs were stranded along the north coast of Inhassoro and Govuro areas (A. Guissamulo, pers. obs., 2003).

(d) Anthropogenic Disturbance

Increased use of motorised boats over seagrass meadows by tourist operators, particularly in Bazaruto Bay and around Inhaca Island may be denying dugongs access to important feeding grounds. Similarly, diving by lobster and sea cucumber fishers may also pose a threat. Spear fishing, commonly practiced in the Quirimba Archipelago, is also thought to disturb dugongs (A Guissamulo, pers. obs.)

(e) Illegal offshore trawling

An increase in the number of illegal off-shore trawling operators may pose a threat to dugongs from incidental captures. Illegal trawling takes place off Bazaruto, Benguerua Island, Praia da Barra, Linga Linga and Pomene as well as to the east of the Quirimba Archipelago. Dugongs have learned to leave the shallow water to take refuge in deeper waters during the day and at low tides and therefore may be threatened by these trawling activities. However, no data is available on catches.

8.3.6 Policy and legislation

(a) National Legislation

The Hunting Law of 1978 forbade the hunting or fishing of dugongs. This was replaced by in July 1999 by the Forestry & Wildlife Law No. 10/99, and its regulation of 6 June 2003, which include dugongs in the list of protected species. Fishers who are found guilty of hunting or killing a dugong are obliged to pay a fine of Mt 50 million (US\$ 2,000) and the fishing gear and license are confiscated.

The 1990 Fisheries Law (No. 30/90 of 26 November 1990) and 1996 Regulation of Maritime Fisheries (Decree No. 16/96 of 28 May 1996) state that fishing licenses must detail a list of species whose catch is forbidden. In the case of gillnet fishing licenses, protected species include dugongs, dolphins and turtles.

The 1997 Land Law provides a legal basis for the creation of

protected areas for the protection, conservation and management of riparian and coastal habitats and associated species. Article 4 also notes that activities which threaten the conservation, reproduction, quality and quantity of biological resources, especially those that are threatened with extinction, are prohibited, and that the government will ensure adequate measures are taken for the maintenance and regeneration of animal species, rehabilitation of degraded habitats and creation of new habitats, through control of activities and substances that may impact upon faunal species and their habitats.

Enforcement of regulations relating to artisanal and commercial fishing activities is the responsibility of the National Services for Maritime Administration and Control (SAFMAR) and the Fisheries Administration Services respectively.

The Forestry and Wildlife Services (DNFFB) is responsible for regulating international trade in dugong products through CITES. Scouts from DNFFB have the authority to penalize dugong poachers outside protected areas whereas the National Directorate for Conservation Areas has jurisdiction within national parks.

In practice however, enforcement of national and international legislation is hampered by limited personnel, particularly in rural areas, and lack of resources. As such, the law is rarely applied.

(b) International Conventions ratified by Mozambique

- Convention on the international trade in endangered species of fauna and flora (CITES) of 1973 – ratified by resolution 20/81 of 30 December 1981.
- African Convention for Nature and Wildlife Resources Conservation (1968) – ratified by resolution 18/81, 30 December 1981.
- Convention on the Biological Diversity, of 1982, ratified by resolution 2/94 of 24 August 1994.

As part of the convention, Mozambique has prepared the National Strategy for Conservation of Biodiversity. Within this the dugong is among the species of special concern and which require protection.

- The Nairobi Convention of 1985, ratified by resolution 17/96 of 26 November 1996.

8.3.7 On-going and proposed conservation and research activities

(a) Protected areas

As part of effort to protect dugongs, two national parks have

been gazetted in Mozambique and a private conservation area established. These protected areas cover approximately 30% of the known area of dugong distribution.

Bazaruto National Park was created in 1971 and in 2001 the area under protection was extended by 600 km². The park now covers an area of 1,400 km².

Quirimba National Park was established in 2001. The park covers an area of 7,000 km², of which approximately 2,500 km² is marine, including the islands of the archipelago. The park was created to protect coastal and marine resources as well as marine mammals such as dugongs, dolphins and whales.

Vilanculos Coastal & Wildlife Sanctuary, a private conservation area, of which 50 km² is marine, has been created on the southern boundary with the Bazaruto National Park and provides further protection to dugongs in the area.

As a result of escalating tourism development along the coast of Cabo Delgado Province, tourist operators located outside the Quirimba National Park are collaborating in an effort to manage and protect marine habitats. They are also promoting awareness and employing local game scouts to assist with conservation activities (Chrystopher Cox & Julie Garnier, pers. comms., 2003).

(b) Local conservation initiatives

(i) Inhambane Province

In Inhambane Province, a moratorium on the use of gillnets has been agreed between the Provincial Governor and the Fishermen Associations.

(ii) The Dugong Trust

The Dugong Trust was formed in 2003 in South Africa and is supported by tourist operators in the Bazaruto Archipelago. The Trust aims to provide funds for dugong protection, research, monitoring, education and awareness in the Bazaruto area.

(iii) WWF Multiple Resource Use Project – Bazaruto Archipelago

This project was initiated in 1991 by WWF and has contributed to a greater level of awareness about the status of dugongs in the Bazaruto area. Activities have subsequently been extended to the mainland, through establishment of an office and a conservation group, as well as training of community game scouts. WWF has supported dugong monitoring since 1990 through aerial surveys and is supporting projects managed by the Forum Natureza em Perigo (FNP).

(iv) Research, management and conservation initiatives

The Department of Coastal Zone Management of the Ministry for Coordination of Environmental Affairs, and the Centre for

Sustainable Development are preparing a short-term intervention programme for dugong conservation in Mozambique. The aims of the programme are to conduct intensive research on dugong ecology and threats as well as to draft a national dugong protect plan. The programme will run between October 2003 and December 2004.

At a regional level, the WWF Eastern Africa Marine Eco-Region Programme (EAME) plans to facilitate dugong conservation activities in the region.

8.3.8 Recommendations

(a) Research and monitoring

The role of research and monitoring is very important in the protection and management of vulnerable or endangered species. Information on population biology and trends, movements, threats and habitat requirements / quality are critical in prioritising conservation and management efforts and resources.

The following research and monitoring activities are therefore recommended in order of priority:

- Annual or bi-annual aerial dugong surveys in Bazaruto Bay, southern Quirimba Archipelago and Maputo Bay to determine population status, distribution and trends.
- Initiate a catch monitoring programme, focusing on gillnets, palisade fence traps and trawlers to quantify the level of threat from incidental captures. Data can be collected by trained local "dugong monitors" who would also be responsible for raising awareness within the community.
- Map seagrass habitats to determine extent, health and therefore carrying capacity. Also, monitor changes in seagrass habitat in important dugong sites as a result of erosion, sedimentation from cyclones and floods using ground surveys and remote sensing.
- Initiate a dugong satellite-tracking programme in Bazaruto National Park to track fine-scale and long distance movements.
- Monitor the impact of education and awareness activities and techniques and perceptions of local communities to dugongs and the marine environment.
- Conduct genetic studies to investigate the threat from in-breeding, determine patterns of paternity / maternity and assess the viability of the population.
- Assess the viability and effectiveness of potential dugong sanctuaries of MPAs as well as the potential benefits and losses to local communities.

- Assess and monitor potential sources of pollution along the coast, such as levels of industrial effluents and fertilizers as well as acoustic pollution caused by increased boat engine use by tourist operators and fishermen.
- Assess the breeding success of the dugongs. Mortality of young animals (new born) can impair the continuity of the population. Dugongs live up to 70 years and females can only give birth to about 12 calves throughout their live span. However, their ability to reproduce successfully depends on availability of mates during oestrus and on the calf survival rate. These parameters require investigation.

(b) Conservation & management

The following conservation and management initiatives are recommended:

(i) Restrict or ban use of threatening fishing gears

- Restrict or ban the use of gillnets and other potentially threatening fishing gears such as fence traps and trawlers in areas where dugongs are known to occur.

A programme to purchase banned fishing gears should be initiated to prevent further illegal use. The effect of other fishing gears such as seine nets and long lines on benthic habitats such as seagrass beds and level of by-catch requires further study.

(ii) Create new sanctuaries or marine / community protected areas

- The existing marine protected area network covers approximately 30% of the area where dugongs occur. Establishment of dugong sanctuaries or buffer zones in areas currently unprotected or unmanaged is recommended. Important areas include: Inhaca Island, north of the Bazaruto National Park, the Primeiras and Segundas Archipelago (between Moebase and Angoche) and north of Quirimba National Park (between Matemo and Macaloe Islands). Activities contributing to dugong mortality should be controlled in these areas and alternative livelihoods for local residents promoted.

(iii) Strengthen capacity of government conservation authorities

- Currently government institutions responsible for enforcement of laws relating to endangered species, including dugongs, have limited capacity to control activities along the 2,700km coastline. Training is required as is the provision of transport (boats, vehicles) and communication equipment (radios).

Surveillance and monitoring of illegal activities by tourist operators, NGOs and local conservation organizations should be encouraged and developed.

(iv) Public awareness & Education

- Proclaim the dugong a flagship species for marine conservation in Mozambique. Initiate a comprehensive nation-wide public awareness campaign targeting decision-makers, fishers, women, students, children, religions leaders, and community associations.

The programme should highlight the role of dugongs in the environment, its status, and the benefits of its conservation (e.g. tourism).

(v) National dugong conservation body

- Establish a national dugong conservation body. Such a body could operate under the umbrella either of the government inter-institutional technical committee for Coastal Zone Management (CTIIGC), or the EAME National Committee which was convened in May 2003.

This dugong conservation committee could include research institutions, conservation practitioners, the business sector and government institutions (fisheries, maritime authorities, tourism and wildlife managers) dealing with dugong and marine protected areas.

Restrict or ban the use of gillnets and other potentially threatening fishing gears such as fence traps and trawlers in areas where dugongs are known to occur.



8.4 MADAGASCAR

G Rafomanana¹,
H Rasolojantovo²

8.4.1 Summary

A literature survey was carried out in April 2003 and an interview survey conducted between July and December 2003 to determine the status, distribution, threats and values of dugongs in Madagascar. This is the first preliminary national assessment of dugongs ever undertaken. A total of 113 sites were visited and 195 people interviewed.

In Madagascar, dugongs, locally called *Lambwara* or *Lambohara* on the west coast, and *Lambondriaka* on the east coast, were reported to be relatively common prior to the 1980s when they were heavily exploited in certain areas, most notably around the islets of Vohémar in Antsiranana Province. Over the past 10-15 years however, anecdotal information indicates that populations have declined.

The most important dugong areas are: around the islets of Andavadoaka - Morombe; Ambararata - Courier and Diego bay; the bays and estuaries of Sakoany - Bombetoka; Ambavarano - Vohémar; and Sainte-Marie Island. In general, respondents claimed that the highest dugong encounter rate is from October to March (austral summer), during the monsoon rains.

In the north of the country, incidental dugong catches were reported in 2002 in Nosy Hara bay. Off the northeast (e.g. Antongil bay and Saint Marie Island) and northwest coasts (e.g. Diégo, Baie de la Dune, de Maxime, d'Ambavanibe, d'Amponkarana, de Befotaka, d'Amparenty, d'Ampasindava), regular dugong sightings, including pairs of animals, were reported. Respondents confirmed the presence of dugongs along the west coast, with high concentrations at Atrema and Katsepy, near Mahajanga, during the months of September and October. In the southwest, dugongs are believed to occur in seagrass beds in the area of Andavadoaka / Morombe. Other sites where dugongs were mentioned included the reefs of Taolagnaro and the area between Farafangana and Mananjary. Dugongs appear to be absent along the southeast coast of Madagascar, although this may be due to lack of reliable data.

The dugong has considerable social and cultural value for Malagasy communities. However, direct exploitation of dugongs appears to be low and incidental catches occasional.

The recent introduction of new and more destructive fishing gears and techniques around the Malagasy coast is a significant threat to dugongs. A general lack of awareness about their status and threats may also be having a negative impact.

Recommendations include development of a comprehensive national coastal and marine resource management and conservation strategy as well as involvement of local communities in dugong management and conservation practices. Raising the level of awareness about their status and threats through a national education campaign.

8.4.2 General background

The island of Madagascar is situated in the Indian Ocean and is separated from Mozambique by the 400 km Mozambique

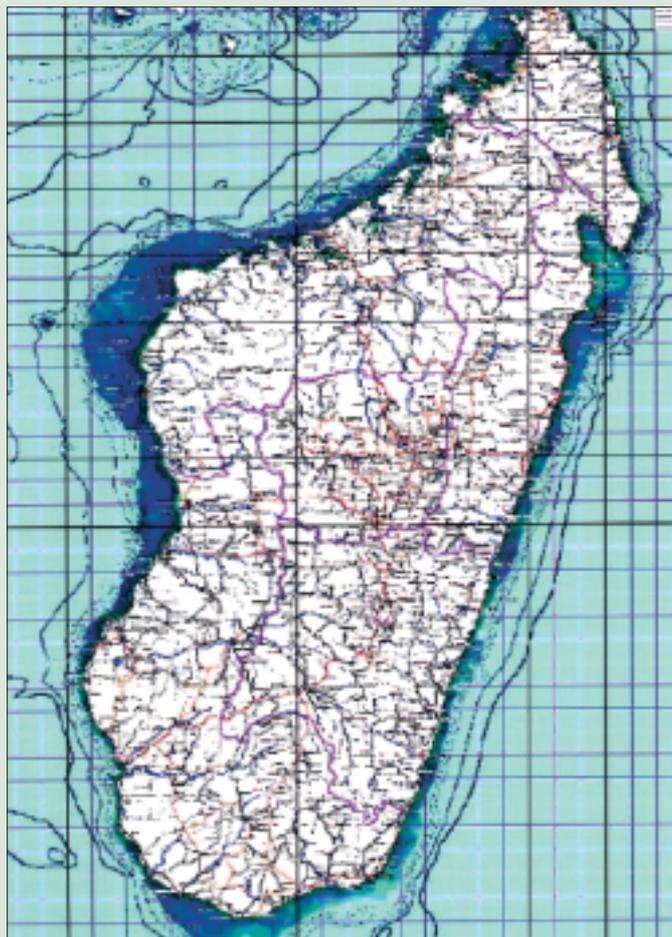


Figure 22. Map of Madagascar (source: CSP, 2003).

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²Les association et Groupements des Pêcheurs Traditionnels des cinq provinces Autonomes : Antsiranana, Mahajanga, Toliara, Fianarantsoa et Toamasina

Channel. It is the 4th largest island in the world covering an area of 587,040 km², from latitude 12°17'S to 23°21'S, with a coastline of 4,848 km (Figure 22). Unlike its volcanic neighbours of Mauritius, Reunion and Comoros, Madagascar was formed by continental drift, separated from the rest of Africa around 2 million years ago.

Due to its geographic isolation and diverse climatic regimes, Madagascar is characterised by rich biological diversity and a high rate of endemism.

Madagascar's climate is influenced by the wet northeast monsoon from November to April (tropical) and the dry southeast trade winds from May to September. The average temperature is 23°C with fluctuating humidity. The west and south coasts are very dry (temperate) while the east and far north are characterised by regular rains that are prolonged until April (tropical). Between January and March the east coast, far north and far south are subject to cyclones.

The strong Mozambique Current influences the west, north, and south coasts which are characterised by a large barrier reef complex (from Cap d'Ambre to Cap Saint Vincent), extensive mangrove forests, large inter-tidal areas, seagrass beds and numerous estuaries and deltas. These hydrological and biological systems are highly productive providing a rich resource for coastal communities (traditional fishing) and commercial activities (e.g. shrimp trawlers, aquaculture).

8.4.3 Dugong status and distribution

(a) Questionnaire survey

The study was undertaken between June and December 2003. A total of 113 sites were visited during the survey (Table 15) and 195 people were interviewed (Table 16). Group and one-to-one interviews were conducted with local fishermen and coastal peoples to obtain a preliminary assessment of dugong status,

Table 15. Madagascar interview sites (June – December 2003)

Dates	Areas	Villages	Number of sites
July-August	Five provinces	Various	20
July	Mahajanga	Mahajanga to Antsalova	15
August	Mahajanga-Toliar	Antsalova-Faux-Cap	9
August-Sept	South-east	Mananjary-Farafangan	5
September	Toamasina/Sainte-Marie	Mahanoro to Mananara	10
September	Antsiranana/Nosy Be	Ambanja-Vohémar	12
October	Taolagnaro/Toliara	Faux-Cap à Ste Luce	5
November	Mahajanga-Antsiranana	Antsohihy to Cap Diego	15
November	SAVA/Antalaha/Sambava	Antalaha to Cap Est	7
December	Antsiranana/Ambanja	Villages/fishermen	15
Total	-	-	113

Table 16. Occupations of respondents

Location	Artisanal fishers	Traditional fishers	Scientists Fishery	Police	Others	Total
S/Marie/Toa.	1	10	-	2	5	18
AntongilCEst	2	6	3	1	2	14
Vohémar	-	4	-	1	4	9
Baie Diego	3	16	4	1	2	26
Ambararata	2	20	-	2	4	28
Bombetoka	2	4	3	2	8	19
Morombe	1	3	2	-	2	8
Taolagnaro	-	2	1	1	3	7
Farafangana	1	4	-	1	-	6
Mozambique	-	8	-	-	1	9
Nosy Ve	1	4	1	2	4	12
Manompana	-	6	2	-	-	8
Baie Sakalava	2	5	3	1	5	17
Baie/Baly	1	10	1	-	2	14
Total	17	102	20	14	42	195

distribution and threats and to identify local perceptions about dugong value and myths. The informants provided information on important dugong areas and catches (deliberate/incidental), and provided dugong bone samples and photographs. Respondents were contacted initially and an interview date set. However, many fishers were unavailable on the set date, due to the fact that the study period coincided with the months of highest fishing intensity.

(b) Status and Distribution

The local Malagasy name for dugong Lambwara or Lambohara on the west coast and Lambondriaka on the east coast.

Dugongs were reported to be relatively abundant until the 1980s, prior to which they were actively hunted in some areas along the coast. Populations have declined significantly over the past 10 – 15 years due to threats from artisanal and commercial fishing activities, coastal pollution and development.

Along the Malagasy coast, the following areas were identified as potentially important dugong habitats:

- Sakalava and Diégo Bays;
- The bays of Ambararata, Courrier, Ampokarana, and the islets of Nosy Hara;
- The bays of Bombetoka, Sokoany, and the bay of Baly;
- The bays and barrier reef systems of Morombe and Andavadoaka;
- Vohémar area;
- Sainte Marie Island;
- Baie d'Antongil, and the northeast coast.

Other sites were also mentioned included Farafangana and Mananjary on the southeast coast, and the reef area of Taolagnaro. In addition,

dugongs were reported to occur between the bays of Marombitsy and Baly, and between the bays of Mozambique and Masoarivo-Antsalova.

No dugong sightings were reported from the southeast region.

(i) Bays of Sakalava and Diégo (northwest)

The extensive seagrass beds in these bays are particularly well developed and provide suitable dugong habitat. In February 2003, a group of two dugongs were recorded in the Bay of Diégo.



Figure 23. Bay of Sakalava and Diégo

(ii) Bays of Ambararata, Courier, Ampokarana and the islets of Nosy Hara (northwest)

The northwest coast of Madagascar is characterised by a large complex of coral reefs, with a very wide continental shelf and is an area recognised locally as an important site for dugongs. Incidental dugong catches were recorded in the area in 2000 and 2003.

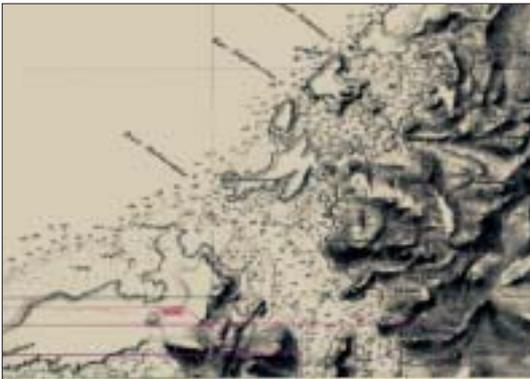


Figure 24. Bays of Ambararata and Ampokarana

(iii) Bays of Mahajamba, Bombetoka, Sokoany, and the bay of Baly

This area is characterised by extensive and well-developed coral reefs. Several respondents reported sighting dugongs in the area. The most recent incident was in 2003 when several observations were made near Bombetoka and Sokoany. Dugongs are most commonly observed between the months of March and November.

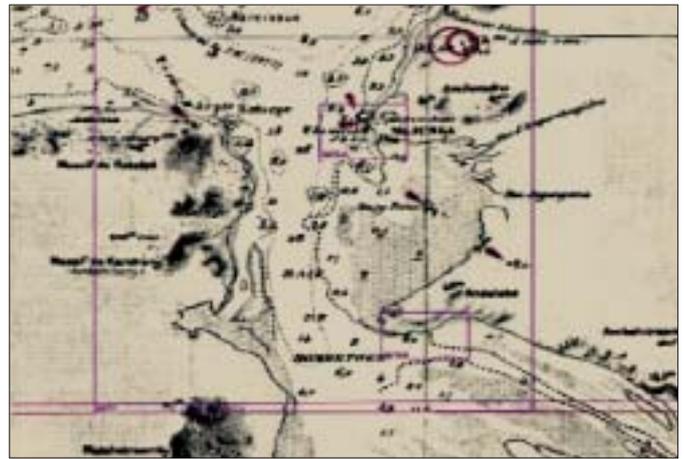


Figure 25. The bay of Bombetoka



Figure 26. The bay of Baly

(iv) The bays and barrier reef systems of Morombe and Andavadoaka (southwest)

In this area, the continental shelf is very narrow, and fringing and barrier coral reef systems alternate and many islets occur. The physical characteristics of the coastline restrict fishing activities.

During 2003, dugongs were sighted off Andavadoaka and Morombe. Two incidental dugong catches were also reported in 2003 at Ampasindava and Ramena (Plates 4 & 5) and two were seen by fishermen at Ramena during the same period. No precise dates were given for these records. When dugongs are caught, both intentionally and incidentally, the meat is sold in the closest market.

Other nearby sites at Taolagnaro, Manantenina, Farafangana, and Nosy Varika were also visited, but the local respondents only mentioned the regular presence of cetaceans.

(v) The islets of Vohémar

In the early 1980's, dugongs were heavily exploited in this area. However, hunting ceased in the 1990s as dugong numbers declined. This is the only area of the study where dugongs were regularly killed. The ecological characteristics of the Vohémar islets are suitable for dugongs.



Plate 4. Dugong caught in August 2003 (Helene)



Plate 5. Head of dugong caught at Ramena in March 2003

(vi) Sainte-Marie Island and adjacent waters (northeast)

The island is characterised by coral reef and lagoon ecosystems. Sea-grass beds are well developed, providing potentially important dugong feeding and breeding grounds. Local fishermen claimed to observe dugongs regularly around the island. However, confusion between dugongs and small cetaceans was common among respondents from this area. As such, the information provided may not be reliable.

(vii) Baie d'Antongil and the eastern Cape (northeast)

Dugongs have been recorded by fishermen in the area of Mananara marine park and off the eastern Cape and were said to be seen alive regularly, often in pairs. The shallow waters and extensive seagrass beds in this area provide potential habitat for dugongs.



Figure 27. The islets of Vohémar

8.4.4 Uses and myths

The economical value of dugongs is relatively low in Madagascar compared to other marine resources such as demersal fishes, shrimps, and sea cucumbers. This is due to their low numbers and rarity. However, when a dugong is caught, respondents admitted that the meat is sold in the local market. The price is fixed on site, and fluctuates according to availability and demand.



Figure 28. The island of Sainte-Marie (or Nosy Borah)



Figure 29. Baie d'Antongil and the eastern Cape

Dugong myths were relatively common. The morphology of the animal is regularly associated with the siren or mermaid myth due to the position of the teats. Dugongs appeared to be relatively respected by local communities, even if they are occasionally caught. According to some respondents, such as fishers from Bombetoka Bay, the sighting of a dugong is interpreted as a gift or as a good omen for fishing. In other areas, particularly the Bay

of Baly, sighting a dugong was perceived to be a bad omen. In the village of Ampapamena, some fishermen mentioned that it is necessary to consult sorcerers before killing a dugong to avoid bad luck.

8.4.5 Threats

The main threats to dugongs in Madagascar are mainly anthropogenic, including over-exploitation of near-shore marine resources and destructive fishing practices, together with limited awareness about their status. However, habitat destruction from cyclones may also pose a significant threat.

(a) Traditional fishery

Sailing pirogues are most commonly used and fishing effort is concentrated very close to the shore. The main fishing gears used are rudimentary gillnets, beach-seine nets and hand lines.

Gill and seine nets are considered unselective, and many untargeted species such as marine turtles and occasionally dugongs, are sometimes caught.

Table 17 below presents details of fishing effort, represented by the numbers of boats and fishermen, for each of the regions.

Over the past 20 – 30 years, the number of traditional fishing vessels around Madagascar has declined significantly. However, more destructive fishing methods have been introduced which have had a negative impact on coastal ecosystems. There are currently no plans to reduce the impact of fishing activities in the marine and coastal environment.

Table 17. Number of traditional fishing boats and fishermen along the Malagasy coast.

Region	Number of boats		Number of fishermen		
	Pirogue	Small boat	With pirogues	Walking	Total
Antsiranana	4,023	41	5,818	1,426	7,244
Fianarantsoa	1,139	139	2,112	1,348	3,460
Mahajanga	4,720	64	6,690	4,903	11,593
Toamasina	5,427	-	3,509	1,491	5,000
Toliara	8,359	-	12,601	2,668	15,269
Total	23,726	244	30,720	11,836	42,566

(b) Artisanal shrimp fishery

Small trawlers are permitted to operate in the inshore stratum (2 nautical miles and less), including areas of mangrove forest and estuaries. Trawling occurs along both the west and east coasts but is most developed in the northwest. Conflict exists between traditional fishers and artisanal fishers, with the latter being accused of damage to coastal and marine resources. The maximum authorised power of trawling vessels (approximately 8 - 9 meters long) is 50 kph. The main target species are pelagic and demersal fish and shrimps. Non-selectivity of these trawlers impacts negatively on juvenile fish and shrimp populations.

Table 18 presents data on catch effort for the Malagasy artisanal shrimp fishery from 1990 to 2001.

Table 18: Effort and catches from the artisanal shrimp fishery.

Year	No. of vessels	Catch (t)	Ratio (t/boat/year)
1990	19	228	12
1991	19	230	12
1992	21	276	13
1993	30	371	12
1994	19	188	10
1995	24	284	12
1996	27	?	?
1997	37	786	21
1998	37	623	17
1999	36	480	13
2001	36	503	14

(c) Industrial fishery

This fishery operates in offshore waters (further than 2 nm from shore) and targets mainly shrimp and tuna. The impact of this fishery on dugongs is probably less significant than the near-shore traditional and artisanal fisheries.

(i) Shrimp fishery

This is mainly an offshore fishery, concentrated off the west coast. With a production of 126-165 tons/boat/year, this fishery is probably one of the most important worldwide and invaluable to the national economy.

(ii) Tuna fishery

Exploitation of the tuna fishery requires large boats and the use of sophisticated oceanographic technology dedicated to detecting concentrations of tuna. Each year more than 40 European and 30 Asian vessels operate in offshore Malagasy waters.

8.4.6 Policy and legislation

Madagascar has signed and ratified many international conventions related to the conservation of endangered species, such as CITES and the Washington Convention.

8.4.7 Recommendations

In Madagascar, new paradigms have recently been developed, especially those related to sustainable development. The country faces many economical hardships and is suffering environmental degradation, notably in coastal areas. The development of a comprehensive national coastal and marine resource management and conservation strategy is needed if Madagascar's rich and diverse flora and fauna is to be protected.

Involvement of local communities in dugong management and conservation practices is considered essential as is increasing the level of awareness about their status and threats through a national education campaign.

8.5 SEYCHELLES M Loustau-Lalanne ¹

8.5.1 Summary

Data on the status, distribution and threats to dugongs in the Seychelles were gathered from questionnaires and opportunistic sightings. 28 questionnaire interview sheets were circulated to organizations and individuals in the Seychelles. 16 of these were completed.

Since the early 20th century until 2001, dugongs have been sighted in the Seychelles on only 3 or 4 occasions.

However, between August and October 2001, dugongs were observed 4 times in the shallow lagoon waters of Aldabra Atoll which is located half way between the Comoros and the other Seychelles islands, in the open Indian Ocean. Two further sightings were made in April 2002, and May and December 2003, also at Aldabra. This is the first time that multiple sightings have been recorded over such a short period of time.

These recent sightings indicate that dugongs in the Seychelles occur only in Aldabra. The minimum number of dugongs in the area is 3: two adults and one juvenile.

Aldabra Atoll is a world heritage site and is fully protected. The dugongs present in Aldabra are under no threat or pressure from exploitation and traditionally Seychellois do not hunt dugongs for meat or oil.

The Seychelles Islands Foundation has conducted aerial surveys around Aldabra Atoll and is currently seeking funding to initiate a satellite-tagging programme. Recommendations include: implementation of a tagging programme to track dugong movements and habitat use; and annual aerial surveys to determine population status and distribution.



Plate 6. First sighting of a dugong on 02.08.01 in Aldabra (SIF)

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Plate 7. Dugong in the lagoon of Aldabra April 2002 (C. Pavard)

8.5 2 General background

The Seychelles archipelago is comprised of 115 islands (76 coralline and 39 granite) and lies 1,593 km east of Kenya and 925 km north east of Madagascar (Figure 30). The islands were discovered by Europeans in 1609 and later settled in 1770. The population is about 80,000 (1998 census). The wet season is from November to April, and the dry months are between May and October.

Aldabra Atoll is located half way between the Comoros and the

other Seychelles islands, in the open Indian Ocean, over 1,000km from Mahe, and approximately 680km east of the East African mainland and 400km northeast of Madagascar. The atoll is 35,000 ha, of which 18,800 ha are terrestrial, 2,000 ha are mangroves and 14,200 ha are marine. It is comprised of 4 large coral islands, which enclose a shallow lagoon (34km long and 14.5km wide). The group of islands is itself surrounded by a coral reef. Aldabra is almost uninhabited and is home to 150,000 giant tortoises, among other species. The atoll was designated a World Heritage Site in 1982 and is administered by the Seychelles Island Foundation.



Plate 7. Dugong in the lagoon of Aldabra April 2002 (C. Pavard)

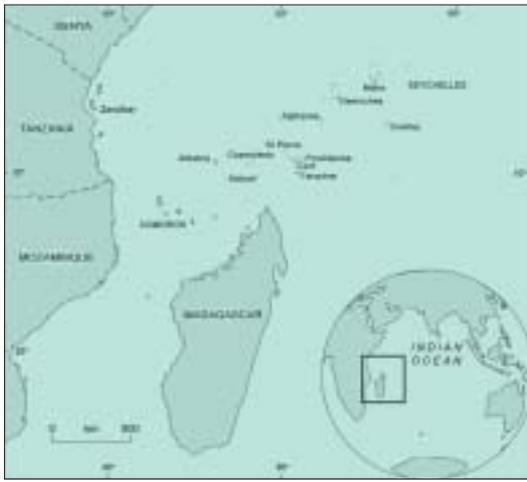


Figure 30. Map showing the Seychelles archipelago (including Aldabra Atoll)

8.5.3 Dugong status & distribution

(a) Literature review

It is believed that early explorers saw dugongs off Bird Island in the 18th century and a dugong was reported in the Seychelles around 1908 (Cockcroft et al., 1994).

In the early 1970s, a single adult dugong was sighted by a Seychellois called Antonio Constance (also known as Mazarin) on the island of Cosmoledo.

Several sightings were reported during a Royal Society research trip to Aldabra Atoll in 1975 and again in 1976. The animals were seen in calm waters in the western part of the lagoon (Sirenews, 2001).

In 1988, a dugong was seen by Richard Spies, the captain of a private research yacht called Gaia Quest, in the lagoon of Desroches.

(b) Questionnaire survey

28 questionnaires were electronically circulated to NGO's, private islands, individuals both local and overseas, the Seychelles Fishing Authority and the Ministry of Environment. 16 were completed.

1 respondent had seen dugongs in 1975 and 1976 at Aldabra Atoll, typically in pairs or in groups, and generally during the calmer months outside the monsoon season. No respondents claimed to have caught a dugong in a net or knew of anyone else who had. All respondents had heard of the recent sightings at Aldabra Atoll.

(c) Opportunistic sightings

Since August 2001, dugongs have been sighted on 7 occasions at Aldabra Atoll (Table 19). 4 observations were made within 3 months in 2001. The most recent sightings, made in December 2003, confirm a minimum dugong population of 3, comprised of 2 adults and 1 juvenile (Loustau-Lalanne, pers. comms.). Dugongs were also observed on 21 May 2003 by Guy Esparon, Warden of

the Seychelles Islands Foundation (SIF). The animals were photographed by research staff of the SIF based on Aldabra in shallow lagoon waters near the mangroves of Bras Monsieur Clairemont (Plate 6 & 7). This is the first time that multiple sightings have been recorded over such a short period of time. Based on recent evidence, it appears that dugongs in the Seychelles occur only in Aldabra.

Table 19. Details of recent opportunistic dugong sightings at Aldabra Atoll

Date	Location	No. in gp	Photo
02.08.01	Aldabra Atoll	1	Yes
03.08.01	Aldabra Atoll	1	
01.10.01	Aldabra Atoll	2	
12.10.01	Aldabra Atoll	1	
April 02	Aldabra Atoll	1	Yes
21.05.03	Aldabra Atoll	1	

8.5.4 Threats

Aldabra Atoll is a world heritage site and is fully protected. The dugongs present in Aldabra are

under no threat or pressure from exploitation and traditionally Seychellois do not hunt dugongs for meat or oil.

8.5.5 Policy and legislation

The dugong is afforded protection under the Fisheries Act of 1986. There is provision for amendment of the Wild Animals and Birds Protection Act of 1991 to include the dugong.

8.5.6 On-going and proposed conservation and management activities

Since the sighting of dugongs in Aldabra lagoon in August 2001, the Seychelles Islands Foundation has initiated a monitoring programme.

The SIF has a flying inflatable boat (FIB) which has been used in aerial surveys of dugongs. A tagging programme has also been proposed, in collaboration with experts from James Cook University in Queensland, Australia.

8.5.7 Recommendations

Recommendations include:

- Initiation of a satellite tagging programme of dugongs in the Aldabra lagoon and monitoring of tagged animals for a minimum period of one year to determine whether these animals migrate to the Comoros archipelago, Madagascar or elsewhere in the WIO region.
- Annual aerial surveys in the vicinity of Aldabra Atoll to determine population status and distribution.

8.6 UNION OF THE COMOROS

Ali Abdallah Fatouma¹

8.6.1 Summary

Prior to the 1970s, dugongs were reported to range in all 3 islands of the Comoros (Grand Comoro, Anjouan and Moheli). However, they are now believed to be very rare and only occur in the southeastern island of Moheli.

In Grand Comoro, there were 2 reports from the 1970s of a dugong caught in a net and in 1988, the incidental capture of two dugongs was recorded in the north of the island at Mitsamiouli where seagrass beds occur.

All respondents from Anjouan Island had heard of a dugong but none had ever seen one. It may be that the species has disappeared from Anjouan waters.

Dugongs are most well known on Moheli Island. 30% of the respondents claimed to have seen one and 10% had eaten dugong meat. Up until the 1980s, dugong "hunters" used to catch at least one dugong per month, using specially crafted nets made with local materials. The most recent dugong sighting in Moheli was in May 2002 of a live animal at Itsamia, and prior to this in July 1993 at Nioumachoi. In this area, fishermen confirmed that dugongs are still present in small numbers as they occasionally observe feeding trails and faeces in the seagrass meadows.

In the past, deliberate hunting threatened this species but sightings are now so rare that it is no longer an issue. The main contemporary threat to dugongs around Grand Comoros, Anjouan and Moheli Islands is accidental captures in fishing nets.

Dugongs are protected under the national environment legislation and further protection is afforded by the establishment in early 2003 of Moheli Marine Park, which incorporates the small islands off southern Moheli.

Currently no research, monitoring or awareness raising activities is being conducted in the Comoros. Therefore, initiation of a research and monitoring programme is required to determine dugong abundance and movements and assess seagrass habitat. Improved management of threatening coastal activities associated with population expansion such as urbanization, pollution, over-fishing and coral mining is necessary to reduce the threat to marine ecosystems. A WIO regional dugong action plan, including an awareness and sensitization component needs to be developed and key sites (around Moheli Island) need greater protection.

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8.6.2 General description

The Comoros Archipelago is comprised of four islands: Grand Comoro (1,147 km²); Anjouan (424 km²); Moheli (290 km²); and Mayotte (388 km²). Although the country acceded to international sovereignty in 1975, Mayotte is still under French administration. The other three independent islands constitute the Union of the Comoros. As such, the status and conservation of the dugong in Mayotte is detailed in Section 8.6.

The archipelago is located in the Indian Ocean, about 300 km equidistance from Mozambique and Madagascar at the entrance to the northern part of the Mozambique Channel between 11_ 20' and 13_ 14' south and 43_ 11 and 45_ 19' east (Figure 31).

The population of the Union of the Comoros is 527,000 and it is estimated that 75% of the inhabitants live in coastal areas. The islands were inhabited by successive waves of migrants from the Persian Gulf and eastern Africa, and have recently been enriched through exchanges with the Malagasy people. Although the inhabitants are of various origins, they are characterized by a great homogeneity and a religious (Moslem), linguistic and cultural unity.

The Islands are of volcanic origin and are mountainous with steep slopes and gullies. Moheli Island has a coral plateau which is 10 - 60 m deep and is composed of eight small and mountainous islands in the south. The climate is humid and tropical. The cooler drier southeast trade winds occur from May to October and the hotter, wetter north-south monsoon occurs between November and April.

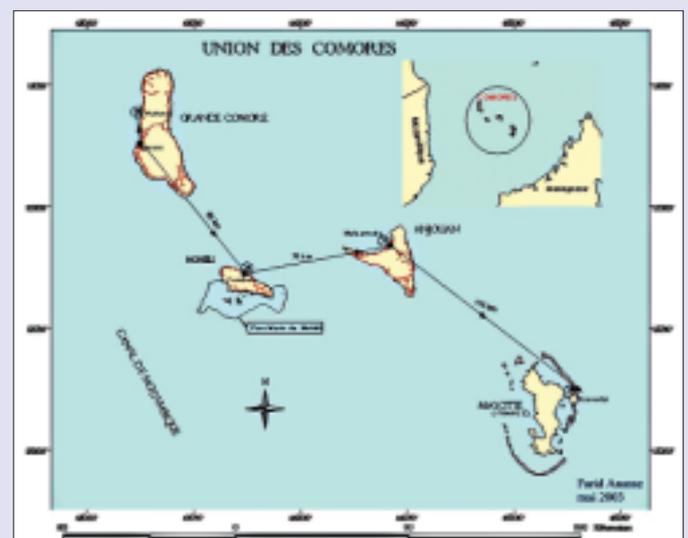


Figure 31. Map of the Comoros Union

8.6.3 Dugong status and distribution

(a) Literature review

Prior to the 1970s, dugongs were reported to range in all 4 islands of the Comoros. However, they are now believed to be very rare and only occur in the southeastern islands of Moheli and Mayotte.

(b) Questionnaire survey

During the survey, 41 interviews were conducted: 27 from Grand Comoros, 4 from Anjouan, 9 from Moheli and 1 from France.

The Comorian name for dugong is N'gouva, similar to the Kiswahili name Nguva

Results from the interview survey show that dugongs are known by communities in all three islands, but to differing degrees.

In Grand Comoro, all respondents had heard of a dugong but few (3) had ever seen one. Two reports were from the 1970s of a dugong caught in a net at Itsandra and taken to the north of the island for consumption. More recently in 1988, during a coastal survey of the Grand Comoro, the incidental capture of two dugongs were recorded also in the north of the island at Mitsamiouli where seagrass beds occur. No further sightings were noted.

All respondents from Anjouan Island had heard of a dugong but none had ever seen one. It seems that the species has disappeared from Anjouan coasts (Brutton et al, 1987).

Dugongs are most well known on Moheli Island. 30% of the respondents claimed to have seen one and 10% had eaten dugong meat. Up until the 1980s, dugong "hunters" used to catch at least one dugong per month, using specially crafted nets made with local materials. A fisherman called Boina Amani claimed to have already caught several dugongs and noted that they are found in the southern part of the island where large Potamogetonaceae and Hydrocharitacea seagrass beds occur. Dugongs feed mostly at night.

In July 1993, a dugong was seen in Nioumachoi by a FAO consultant (J Roseline) and several fishermen testified that the animal is often seen in Ouellah and Itsamia.

In May 2002, a trainee from the Reunion Center of Discovery of Marine Turtles saw a dugong in Itsamia. In this area, fishermen confirmed that dugongs are still present as they continue to observe feeding trails and faeces in the seagrass meadows.

These small islands off southern Moheli are included in the Moheli Marine Park, which was established by the Biodiversity Project and inaugurated in early 2003. Furthermore, the marine reserve located opposite Galawa and Maloudja beaches could protect the rare dugongs.

8.6.4 Threats

In the past, deliberate hunting threatened this species but sightings are now so rare that it is no longer an issue. The main contemporary threat to dugongs around Grand Comoros, Anjouan and Moheli Islands is accidental captures in fishing nets.

8.6.5 Policy and Legislation

In the Comoros, dugongs are included in List 1 under Article 40 of the Environment Law. As such, the dugong is a protected species and the following acts are strictly banned:

- the capture, detention and killing of the specimen;
- the transport, purchase, selling and export or re-export of living or dead specimen, even if they are stuffed, as well as of derived products;
- any act that may disturb the species during their reproduction or dependence period;
- the destruction, collecting or detention of eggs, even if they are empty, and of nests.

Article 6 also bans any form of destruction or disturbance of the feeding or breeding habitats of endangered or endemic species.

Any breach or attempt to breach the above provisions shall be punished in accordance with the rules stipulated by the framework law pertaining to the Environment.

8.6.6 On-going and proposed conservation and management activities

Currently no research, monitoring or awareness raising activities is being conducted in the Union of the Comoros.

8.6.7 Recommendations

(a) Research and monitoring

- Establish a research and monitoring programme (in collaboration with Mayotte), centred at Moheli Island, to: determine dugong abundance and movements (tagging, aerial and underwater surveys); and assess seagrass habitat.

(b) Conservation and management

- Improve integrated management of the coastal areas of Grand Comoro, Anjouan and Moheli in order to better control and monitor potentially damaging activities such as urban growth and discharge of commercial, agricultural and domestic pollutants as well as regulate use of natural resources such as sand and coral mining and fishing through destructive means.
- Develop a WIO regional action plan and use this to seek funding for dugong research and protection.
- Initiate a dugong information and sensitization campaign.
- Protect key dugong sites (outside Moheli Marine Park) and improve enforcement of existing laws.

8.7 MAYOTTE AND RÉUNION

J J Kiszka^{1,2}, M Vely¹, N Bertrand¹, O Breyse¹, J Wickel² and N Maleck-Bertrand¹

8.7.1 Summary

Information from la Réunion indicates that dugongs never occurred there. Their absence is believed to be due to the lack of potential habitats for dugongs. In Mayotte, data on the status, distribution and threats to dugongs was gathered from opportunistic sightings and interviews with local fishers (n = 35), ultra-light aircraft (n = 1) and dive operators (n = 6).

The results indicate that dugongs are present in small numbers within the lagoon waters of Mayotte. Since Mayotte is surrounded by deep water and is 115km from Anjouan, the nearest Comorian Island, it is likely that these animals are resident or semi-resident. The most important habitats for dugongs are the shallow waters of the lagoon and the seagrass beds in the bay of Bouéni, at Passe en S, off the southern coast of Petite Terre and at Saziley.

Between 1999 and 2003, 12 opportunistic dugong sightings were recorded by the Service des Pêches et de l'Environnement Marin (SPEM) and the association MEGAPTERA Océan Indien. The largest group size was 3 individuals. Dugongs were observed associating with Indo-Pacific bottlenose dolphins in 1999 and a mother-calf pair was observed in April 2000. The most recent incident was on 21 September 2003 when a dugong was caught accidentally in a bottom set gillnet.

74% of fishermen interviewed had observed a dugong at least once, 3% had heard but had never seen one and 23% had never heard of a dugong. Respondents claimed that dugongs have become increasingly rare since the 1980s. Observations were made most frequently inside the 5 km lagoon. Other important areas include: Tsingoni; the bay of Bouéni; areas adjacent to Petite Terre; and the southern barrier reef area. Respondents cited incidental net captures as the greatest threat to this species.

Aerial surveys (focusing on turtles) were conducted during 2002 and 2003 from a micro-light aircraft. In 2002, dugongs were observed on 12 occasions between August and September. These included a group of 5-7 individuals and two mother-calf pairs which were observed off the west coast near

the bay of Bouéni and Tsingoni. In 2003, dugongs were seen on 4 occasions off the east coast of the island at Pamandzi. Between 2000 and 2003, divers observed dugongs on 8 occasions. All sightings were of single animals on the east of the island, where the main dive sites are located.

The main threats to dugongs in Mayotte are incidental catches in fishing gears, habitat destruction, pollution, disturbance and boat collisions. Systematic aerial surveys and initiation of an intensive research programme are needed to determine population dynamics, and movements, assess extent of habitat and threats. Conservation measures include creation of protected areas for dugongs (and turtles) where use of gillnets is regulated, awareness raising among the general public, establishment of a WIO dugong research and conservation network and development of an integrated land use and management plan for Mayotte.

8.7.2 General description

The island of Mayotte, the most oriental of the Comoros archipelago, is a 388km² departmental territory under French administration with a population of 160,000. The island is characterized by the presence of a barrier reef system, forming a 5km wide lagoon of 1,100 km² which reaches a maximum depth of 80m (Maggiarani & Maggiarani, 1991). The tidal regime of Mayotte is macro-tidal, and characterises the coral reef system. To the west, the barrier reef is partially sub-soiled, and a double barrier reef is present in the south (Maggiarani &

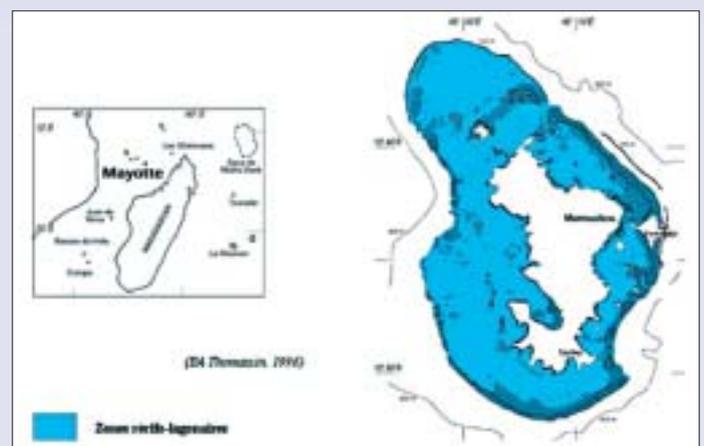


Figure 32. Location of Mayotte and presentation of its coral reef system (Thomassin, 1996).

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Maggiarani, 1991 Seitre et al., 1998). A map of Mayotte is shown in Figure 32.

Seagrass beds are distributed homogeneously around the island. These are well developed in some sandy bays and over the internal slope of the barrier and fringing reefs. The dominant seagrass species are: *Halophila ovalis*, *Halodule uninervis*, *Cymodocea rotundata*, *Cymodocea serrulata*, *Thalassodendron ciliatum*, *Syringodium isoetifolium*, and more rarely, *Thalassia hemprichii* and *Enhalus acoroides* (Guerniou & Nicet, 2001).

8.7.3 Dugong status and distribution

(a) Literature review

The survey in Mayotte was originally to include Reunion. However, preliminary investigations indicated that dugongs have never occurred here. Their absence is believed to be due to the lack of potential habitats for dugongs (e.g. seagrass beds and large areas of shallow waters). During boat surveys (focusing on marine turtles and cetaceans) performed by the association GLOBICE and the Centre d'Etude et de Découverte des Tortues Marines de la Réunion in the 1990s, no dugongs were recorded (J Kiszka, pers. comm. 2003).

In Mayotte, dugongs are locally known as *Doutzi* (Mayotte language) or *Lambwara*, which is Malagasy for large sea-pig.

There appears to be no documented reference to dugongs in Mayotte before the late 1990s. However, fishermen, especially elders, confirmed that dugongs have occurred around the island, particularly in the mangrove and barrier and fringing reefs areas where seagrass beds are abundant, for many years. Respondents reported that, before the early 1980's, one or two dugongs were sold at the market of Mamoudzou every week and they were relatively abundant at this time. These estimates do not include animals which were taken for domestic consumption. At Petite Terre and the bay of Bouéni, fishers reported that dugongs were observed on a daily basis in the surrounding seagrass meadows.

(b) Questionnaire survey

35 questionnaire interviews were conducted, by the Service des Pêches et de l'Environnement Marin in August 2003, with local fishers from six villages on Mayotte located in the north, on Petite Terre and in the west (Figure 24).

All age classes were represented in the sample and respondents ranged in age from 32 to 75 years. No relationship was observed between age and number of dugong sightings made during their career (Pearson: $p=0,19$).

74% (26) of respondents had observed a dugong at least once, 3% (1) had heard but had never seen one and 23% (8) had never

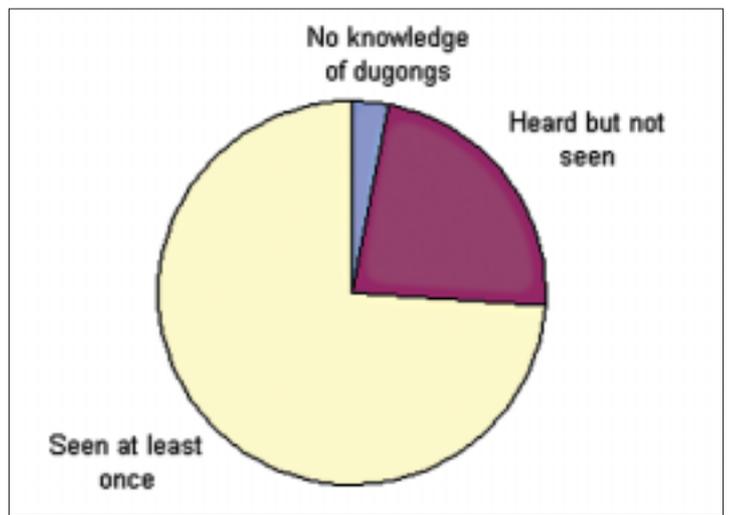


Figure 33. Knowledge of the dugong by artisanal fishermen of Mayotte

heard of a dugong (Figure 33). Of those who had seen a dugong, the number of sightings made during their lifetime varied from one to seven ($\mu = 2,2$; Mode = 1; $\pm 1,74$).

Respondents observed dugongs most frequently inside the lagoon. Four important areas were cited: Tsingoni; the bay of Bouéni; areas adjacent to Petite Terre; and the southern barrier reef area (Figure 34). Dugongs were also sighted in mangrove habitat, notably in Bouéni bay. Although mangrove areas do not constitute major feeding grounds, dugongs have been known to feed on mangrove leaves, although this is relatively rare (Lawler & André, 2000).

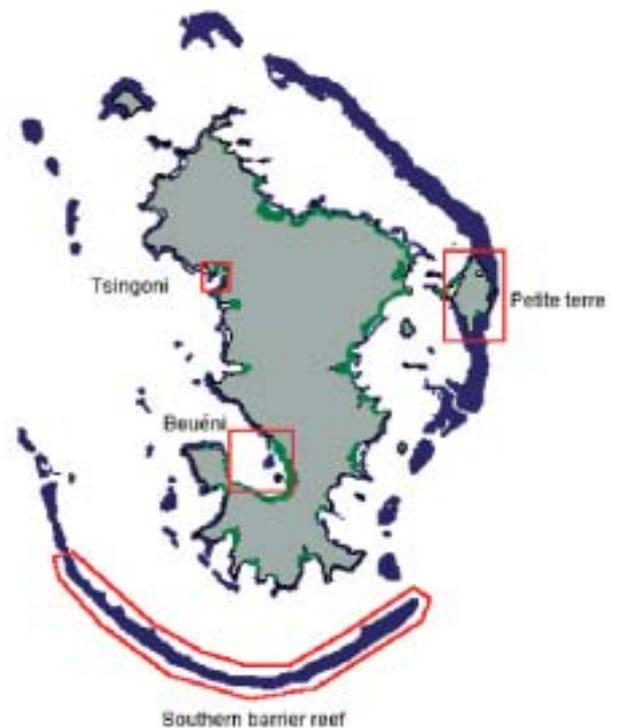


Figure 34. Location of main dugong sighting sites reported by artisanal fishermen of Mayotte

100% claimed that they had caught a dugong at least once in their net. The gear is a bottom set gillnet with a mesh size of 12 inches, usually placed above shallow coral reefs and bays. The nets are used during the low or ebb tide and target coral reef species and to a lesser extent pelagic fish (Fouquet, 2001). When a fisherman catches a dugong in his net, the meat is consumed locally or sold directly on the beach or at the nearby market. The price for a kg of meat is between US\$ 2.5 – 6.5.

Respondents claimed that dugongs have become increasingly rare since the 1980s and incidental net captures pose the greatest threat to this species.

(c) Opportunistic sightings

Between 1999 and 2003, 12 dugong sightings were recorded by the Service des Pêches et de l'Environnement Marin (SPEM) and

the association MEGAPTERA Océan Indien. The largest group size was 3 individuals, last sighted in 2000 (Table 20). A calf was observed in April 2000, and on one occasion in 1999, dugongs were observed associating with Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) (Kiszka, in prep).

The most recent sighting was of a dead dugong on 21 September 2003 by staff of Brigade Nature de l'Océan Indien which is conducting regular patrols against poachers in the lagoon. The sighting was of a male dugong (1.98m) caught in a fishing net in the south of the island. The animal had already been cut into pieces but the post-mortem indicated that the dugong was still alive when caught and had been slaughtered (Plate 8). This was reported to be the third net capture in 2003 (G Rocamora, pers. comms).



Plate 8. Male dugong caught in fishing net in Mayotte, September 2003. (Franck Charlier, Brigade Nature, Mayotte).

Table 20. Details of opportunistic dugong sightings in Mayotte by the Service des Pêches et de l'Environnement Marin, Megaptera Océan Indien & Bridage Nature

Date	Location	No. in gp	Notes	Photos/film	Observer
13/04/99	South-east lagoon	1	-	?	Megaptera OI
01/11/99	South-east lagoon	3	Travelling	?	SPEM, OMM
17/11/99	South-east lagoon	2	-	?	SPEM, OMM
11-12/99	Between Petite Terre and Grande Terre	2	Travelling with 2 Tursiops aduncus (Plate 9)	Yes	Megaptera OI
11/03/00	South-east lagoon	1	-	No	Megaptera OI
04/00	Passe en S	3	Presence of a calf	Yes	Megaptera OI
15/08/00	South-east lagoon	1	-	?	Megaptera OI
12/2001	Passe en S	1	-	No	Megaptera OI
12/2001	Passe en S	1	May be same individual as previous sighting	No	Megaptera OI
07/04/02	South of Petite Terre	1	-	No	Megaptera OI
05-06/03	West of the southern barrier reef	1	-	No	Megaptera OI
23/08/03	Ilot Bouzi	1	Travelling	No	SPEM, OMM
21/09/03	lagoon	1	Caught in net	Yes	Brigade Nature

All of the observations were made along the east and southeast coast of Mayotte, inside the lagoon (Figure 36). However, it is important to note that activities by SPEM and Megaptera OI are concentrated in this area throughout the year and thus spatial distribution may be a reflection of higher observation effort in this area.

The opportunistic observations indicate year round distribution (Figure 35)

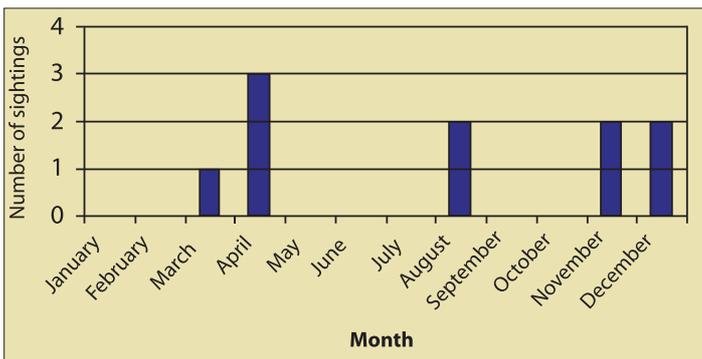


Figure 35. Seasonality of opportunistic dugong sightings around Mayotte between 1999-2003 (n=10)

(d) Interviews with dive and ultralight aircraft operators

Interviews with ultralight aircraft (n = 1) and dive (n = 6) operators were conducted in August 2003. In total, dugongs were sighted on 24 occasions between 2000 and 2003 (16 from the air and 8 by divers). A map of sightings is shown in Figure 37.

Several aerial surveys were conducted during 2002 and 2003 for the purpose of assessing marine turtle populations and distribution.

During the 2002 surveys, dugongs were observed on 12 occasions between August and September. These included a group of 5-7 individuals and two mother-calf pairs which were

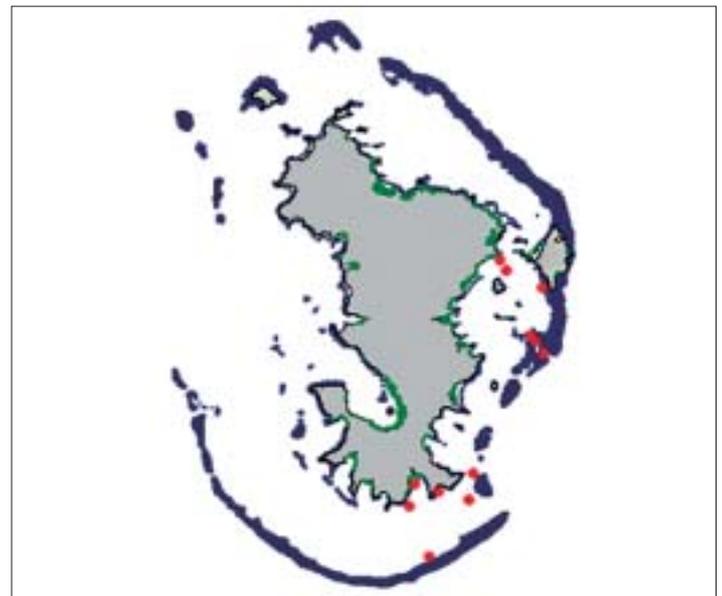


Figure 36. Map showing distribution of dugong sightings in Mayotte (1999 – 2003)

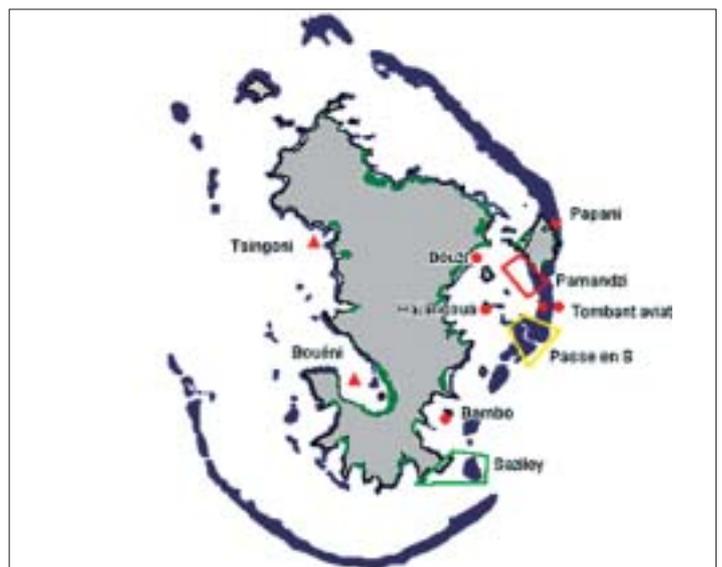


Figure 37. Map of dugong sightings reported by diving and ultra-light aircraft operators in 2002 and 2003 (red spots: sighting; Green, yellow and red sectors: multiple sighting sectors; red triangles: sighting involving a mother-calf pair)

observed off the west coast near the bay of Bouéni and Tsingoni (red triangles). Multiple sightings were recorded around Pamandzi, Saziley and Passe en S (red, yellow and green). Other sightings are presented as red spots at Papani and Bambo and off Bouzi and Hajangoua

In 2003, dugongs were seen on four occasions between January and April off the eastern coast of the island at Pamandzi.

Dive operations in Mayotte are concentrated in the east of the island, particularly around Passe en S and this is reflected in the sighting records which were concentrated in this location (Table 21).

Table 21. Opportunistic sightings from 2000 – 2003 in Mayotte

Date	Location	No. in gp	Notes
2000	Tombant des aviateurs	1	
2002	Passe en S	1	
2002	Passe en S	1	Spring tide
2002	Tombant des aviateurs	1	
2002	Passe en S	1	
2002	Passe en S	1	
02/03	Passe en S	1	
06/03	Passe en S	1	

The combined results indicate that dugongs are present in small numbers within the lagoon waters of Mayotte. Since Mayotte is surrounded by deep water and is 115km from Anjouan, the nearest Comorian island, it is likely that these animals are resident or semi-resident (see Figure 23). The most important

habitats for dugongs in Mayotte are the shallow waters of the lagoon and the seagrass beds in the bay of Bouéni, at Passe en S, off the southern coast of Petite Terre and at Saziley.

8.7.4 Threats

(a) Incidental catches in fishing gears and hunting

Intentional hunting of dugongs took place in the past but is now uncommon because dugongs are so rare. However, from the late 1970s, the increased use of fishing nets and corresponding increase in incidental captures has contributed to the decline in dugong numbers in Mayotte. 73% of respondents claimed to have caught a dugong in their net at least once during their lifetime. These nets are bottom set small mesh (3cm) gillnets. Although dugong captures were now said to be rare, the threat is likely still to be significant in view of the small size of the population.

Several fishermen admitted that when a dugong is caught live, it is usually killed for its meat. Incidental captures of turtles were also reported to be common.

(b) Habitat destruction

Damage to seagrass beds as a result of the development and growth of coastal villages leading to higher levels of pollution, erosion and sedimentation, may have impacted on the local dugong population.

(c) Pollution

Domestic and industrial effluents contribute to coastal degradation and are a potential threat to seagrass beds (Cockcroft et al., 1994). Mayotte's urban areas are expanding and



Plate 9. Dugongs with two Indo-Pacific bottlenose dolphins (*Tursiops aduncus*) in Nov/Dec 1999 (Megaptera Ocean Indien)

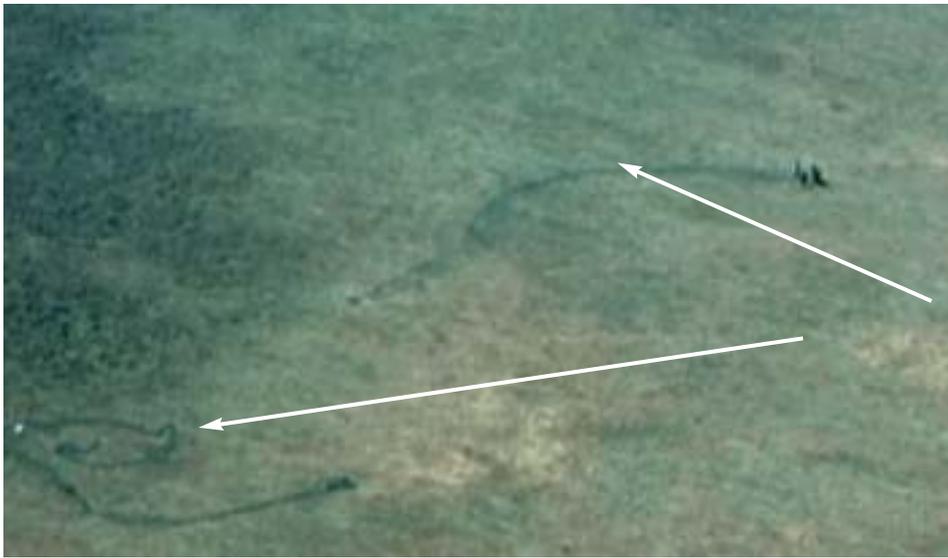


Plate 10. Aerial view of set nets above a seagrass bed on the barrier reef of Mayotte. (SPEM)

the population is expected to double to 300,000 by 2010 (INSEE, 2002). The level of pollution is expected to rise accordingly. However, no quantitative data are available and no long-term monitoring is being conducted to investigate contamination by pollutants in the coastal waters of Mayotte..

(d) Disturbance and collisions

Tourism is expanding in Mayotte. The main tourist interests in the lagoon are diving, whale-watching and boating which occur throughout the year. Boat speed in the lagoon is unrestricted and marine turtles are regular victims of boat collisions. Disturbance to dugongs from divers, engine noise and boat collision is an increasing threat. An assessment of the nautical traffic is also important to monitor its impact on the entire marine ecosystem.

8.7.5 Policy and legislation

The dugong is protected in Mayotte under French law (1995) which prohibits the purchase, killing or harassment of dugongs in French coastal waters. France is also a signatory to CITES, the Convention on Migratory Species and the Nairobi Convention.

The penalty for killing a dugong is 6 months imprisonment or a fine of US\$13,500.

8.7.6 On-going and proposed dugong conservation and research activities

Two organizations on Mayotte have been involved in marine mammal conservation: the Service des Pêches et de l'Environnement Marin ("Marine Environment and Fisheries Service", under the French administration) and the NGO "MEGAPTERA Océan Indien". With the assistance of local fishermen, whale-watching operators, dive operators and yachtsmen, these organisations have been collecting sighting data on dugongs in Mayotte waters since 1999. However, neither are now involved in marine mammal studies.

The establishment of a Marine Mammal Observatory is planned for September / October 2004 which will implement and oversee research and conservation activities (J Kiszka, pers. comms. 2004).

8.7.7 Recommendations

(a) Research and monitoring

- Establish a dugong research programme, in close collaboration with turtle research activities, to:
 - Collect information on dugong biology, ecology and behaviour (genetic relations between territories, habitat preferences, movements, feeding ecology, effects of pollutants)
- Quantify and monitor the level of threat from incidental captures in gillnets.
- Assess the extent of seagrass beds around Mayotte.
- Conduct regular aerial surveys (combined with turtle surveys), using ultra light aircraft, to determine dugong abundance, distribution and habitat utilisation in the lagoon of Mayotte.

(b) Conservation and management

- Regulate use of fishing nets that catch dugongs (gillnets) particularly inside the lagoon and monitor incidental catches.
- Create and manage marine protected areas in key habitats particularly seagrass beds and mangroves.
- Initiate a public awareness programme on the dugong, using videos and school fact sheets, in order to promote release of dugongs caught accidentally in fishing nets and reduce the level of dugong meat consumption. This should run alongside a more general awareness raising campaign on conservation of the marine environment.
- Produce a Mayotte Dugong Management and Action Plan in collaboration with marine turtle researchers and experts.
- At the regional scale, establish a WIO dugong research and conservation network to encourage exchange of information and ideas useful for management, conservation and research.
- Develop an integrated land use and management plan for coastal and inland zones (with the local French administration) to control urban development, discharge of domestic and industrial effluents and monitor levels of siltation and pollution.

9. Western Indian Ocean (WIO) Regional Synthesis

Amalgamating information presented in the country reports, this section provides a regional overview of the status, distribution and threats to the dugong in the Western Indian Ocean. Priority actions for conservation are presented in Section 10.

9.1 Dugong status and distribution

Existing information across the WIO region indicates that dugong populations have been declining sharply since the 1960s and 70s. In Kenya, large herds were reported in the 1950s and '60s and a 500-strong group was seen in 1967. In Tanzania fishers stated that dugongs were abundant along the coast prior to the 1960s and groups of up to 20-30 animals were commonly seen in the Mafia – Rufiji area at this time. Further south in Mozambique the decline may have been more recent, escalating since the end of the civil war in 1992. Fishers from Madagascar and Mayotte also claimed to have witnessed a more recent decline since the early 1980s.

The map in Figure 38 shows the estimated relative population size and distribution of dugongs in the region.

Data from the last aerial survey in Kenya, in 1996, combined with more recent anecdotal reports, indicates the presence of two very small populations



Figure 38. Distribution of dugong populations in the WIO region

near the borders with Somalia and Tanzania (Wamukoya et al., 1997). The size of these populations, possibly 8-10 in the north and 3 in the south, is almost certainly unviable, assuming they are resident and isolated. However, there does appear to be some evidence of trans-boundary movements, which would improve genetic flow and reproductive viability. Given that dugongs are reported to occur around the Bajuni archipelago in the south of Somalia and large groups have also been sighted allegedly moving across the border, it seems likely that the population in the Lamu-Kiunga area extends into southern Somalia (Cockcroft & Young, 1998). Likewise, interviews conducted in villages north of Tanga, Tanzania, near the border with Kenya, indicate the existence of a small population which may form part of a slightly larger population from southern Kenya. Aerial surveys extending beyond Kenya's northern and southern geopolitical boundaries would help to clarify this.

In terms of the national population characteristics, it is unknown whether any interaction occurs between the northern and southern populations since there have been no recent sightings along the central Kenyan coast. However, in the absence of large-scale aerial surveys and satellite tracking, the extent, if any, of trans-boundary or national connectivity cannot be confirmed.

The survey in Tanzania indicates that the most important dugong habitat is off the Rufiji Delta east to Mafia Island and south to Kilwa, an area characterized by extensive shallow seagrass meadows and sheltered bays and channels. In 1930, Dollman (1933) photographed three dugongs caught in nets off Mafia Island. 74 years later in 2004, two dugongs drowned in gillnets off the Rufiji delta, and were delivered to Mafia by local fishers for research purposes. This is the first concrete (non-anecdotal) evidence that dugongs do still occur in the area. However, the exact size and distribution of the population is not known. Apart from Moa near the Kenyan border, dugongs have probably been extirpated from other areas along the coast including the islands of Unguja and Pemba, and Mtwara near the border with Mozambique.

Aerial and boat surveys in Mozambique support previous claims that the Bazaruto Archipelago is home to the largest dugong population in the WIO (Kemp, 2000; Mackie, 2001), although the latest estimates indicate that there may only be 50-100 animals. Dugongs have also been reported in other areas in Inhambane province but it is not clear if these outlying animals are associated with established local breeding populations or vagrants from the resident population in the Archipelago. Dugongs may still persist in the relatively undisturbed waters of the Quirimba Archipelago but there are growing fears that they have already disappeared from the heavily polluted and disturbed waters off the capital, Maputo. As in Kenya and Tanzania, unless standardized extensive aerial surveys are conducted along the entire coastline, it will not

be possible to estimate national population size and distribution with any degree of accuracy.

In Madagascar, dugongs are believed still to occur in small numbers along the central, northwestern, northeastern and southwestern coasts. Local fishers confirmed their presence in these areas and recovery of dugong photographs from 2002 and 2003 supported this. Populations in Madagascar are believed to be sparse although their exact status remains unknown given that no quantitative surveys have yet been undertaken in the country.

The largest dugong population in the Comoros Archipelago occurs in the waters off the southernmost island of Mayotte. Anecdotal reports suggest that they still occur around Moheli Island, which is approximately 160km northwest of Mayotte, but no longer occur at Grand Comore and Anjouan. In Mayotte, although opportunistic sightings by ultra-light aircraft and divers have only been made since 1999, interviews with local fishers revealed that dugongs have been present off Mayotte for decades and only started to decline in the 1980s. Their long-term occupancy, coupled with the fact that Mayotte is surrounded by deep water and is 115km from its nearest neighbour, indicates that the population is resident or semi-resident.

Conversely, recent sightings at Aldabra Atoll (estimated to support a minimum population of just 3 individuals), after a long period of absence, imply that these animals are long-distance immigrants, possibly from Madagascar some 450km to the southeast.

Prior to this exercise, dugongs were thought to be extinct in northern Tanzania and their status in the south of the country was unknown. Similarly, small numbers were believed to occur around Moheli Island in the Comoros Archipelago, but no data were available for Grand Comoro, Anjouan and Mayotte. Information gathered from anecdotal reports, opportunistic sightings and quantitative aerial surveys during this regional assessment have confirmed the existence of dugongs in Tanzania and Mayotte and established the regional significance of the Bazaruto Archipelago (Mozambique) as an important dugong habitat.

While confirmation of their occurrence in areas where they were formally believed to have disappeared gives rise for renewed optimism concerning their current status in the region, the data indicates that populations are extremely small and fragmented and their situation remains critical.

Most of the available data is qualitative, and there are still extensive gaps in knowledge of dugong status, distribution and behavioural characteristics. Quantitative aerial surveys have only been conducted in two countries in the region (Kenya and Mozambique), but even these data have not been sufficiently

comprehensive to establish population trends given that densities are low, distribution of animals uneven and information on their movements is lacking. It is also unclear whether the apparently discrete populations identified in the region are resident, semi-resident or migratory. If individuals or groups are moving, what distances are they covering, are they return trips and are movements associated with disturbance and stress, or governed by climatic regimes or availability of food and mates?

At both regional and local levels, there is a clear need for regular aerial surveys to be conducted, at least in the main locations where dugongs are known to occur. Understanding both site-based daily movements and determining to what extent dugongs migrate, through initiation of a regionally-coordinated satellite tagging programme, will determine what management strategy is most appropriate (marine protected area or generic management of marine and coastal waters) and what human and financial resources will be required.

With regard to dugong habitat, there have been few marine botanical studies on seagrasses in the Western Indian Ocean and

countries, is sorely lacking with efforts hampered by limited personnel and lack of resources, and dugongs are still widely netted and the meat sold.

Within the WIO region, the most commonly cited contemporary threat to dugongs is entanglement in inshore artisanal gill and shark nets (Table 22). Similarly in eastern Australia mesh-net deaths are now also widely accepted as being largely responsible for the significant decline in dugong numbers since 1987 (Preen, 1998). Along the eastern Africa coast, weighted or bottom set large mesh nets of 12-18 inches pose the greatest threat, while in Mayotte, dugong captures were reported in smaller 3 cm bottom set gillnets. In all countries, the decline in dugong numbers appears to be related to the introduction, or increased use of, nylon filament gillnets. The level of threat posed by this fishing gear however has never been quantified.

Dynamite fishing was eradicated in Tanzania in the mid 1990s but there are increasing reports that this illegal and destructive fishing practice is re-emerging along the coast, particularly in the area between Dar es Salaam and Kilwa. Dynamite blasting is likely

Table 22. Summary of current threats to dugongs in the Western Indian Ocean

Country	Fishing			Habitat loss / disturbance				Hunting (meat, oil)	Boat traffic / ecotourism
	Gill/shark nets	Explosives	Other	Fishing	Pollution	Coastal development	Cyclones		
Kenya	-		-	-	-	-		-	
Tanzania	-	-	-	-	-	-		-	
Mozambique	-		-	-	-	-	-	-	-
Madagascar	-		-	-	-	-	-		
Seychelles	-								
Comoros	-			-		-		-	
Mayotte	-			-	-	-		-	-

information on distribution and taxonomy is scarce and insufficient (Ochieng & Erftemeijer, 2002). Most seagrass studies have been carried out in Kenya and to a lesser extent in Mozambique and Tanzania. Virtually nothing is known about seagrasses in Comoros, Mauritius, Reunion, Seychelles and Somalia (Erftemeijer et al., in press). This information, together with details of abundance and movements, is important when planning the most effective, economical and appropriate strategies for their conservation.

9.2 Threats

In all the countries cited in this report, dugongs are afforded protection under international and/or national legislation. However, the capacity of government departments responsible for enforcement of such laws, at least in the eastern African

to affect dugong behaviour and movements, either directly from the physical impact of the explosion or by forcing them to migrate to safer waters. In Kenya the use of poison as a fishing method was cited as a threat. Other threatening fishing methods included trawling and seine nets, and to a lesser extent fence traps which were reported sometimes to ensnare dugongs with

Table 23. Known current value of dugong meat in the Western Indian Ocean region

Country	Value of meat (US\$)
Kenya	?
Tanzania	0.50 – 1.00 per kg
Mozambique	0.60 – 2.00 per kg
Mayotte	2.50 – 6.50 per kg
Madagascar	?
Comoros	?
Seychelles	?

the outgoing tide, most notably in Tanzania (Rufiji delta) and in Mozambique (Bazaruto).

Unplanned coastal development, land clearance and land-based pollution are believed to be impacting the condition and extent of seagrass habitats in all countries. The exception is Aldabra Atoll where the only human habitation is the research station of the Seychelles Island Foundation.

Habitat loss was also attributed to near-shore prawn trawling in Kenya, Tanzania, Mozambique and Madagascar as research has shown that dragging nets through seagrass beds uproots plants and increases water turbidity (Mueni & Mwangi, 2001; Ochieng & Erftemeijer, 2002). Studies in these countries have highlighted the negative impacts of trawling on the environment, fisheries production and artisanal fishers and the excessive levels of wasteful by-catch including turtles (Tanzania Fisheries Division 1999; Gove et al., 2001; Mueni & Mwangni, 2001). The main trawling areas in Kenya (Lamu Archipelago, Ungwana and Malindi), Tanzania (Rufiji delta) and Mozambique (Sofala Bank and Maputo Bay) are all important habitats for dugongs. Further investigation is required to determine the impact of prawn trawling on dugong habitat and behaviour and should be incorporated into any future

dugong conservation strategy.

The impact of cyclones and flooding on seagrass habitats and dugongs along the Mozambican and Malagasy coasts is unquantified but may pose a significant threat and in Mozambique at least one animal died as a result of the flooding in 2003. Flooding and a cyclone in Australia in 1992 destroyed over 1,000km² of seagrass leading to the death of 40% of the dugong population from starvation 6-8 months after the floods, and relocation of some animals in search of food (Preen & Marsh, 1995).

While over hunting is a major threat to dugongs in Torres Strait between Australia and Papua New Guinea where the take represents approximately 5% of the population (Preen, 1998), in the WIO region, hunting has declined over recent decades due to low capture rates and perhaps to some extent because coastal communities are aware that to do so is illegal (Wamukoya et al., 1995). Nonetheless, dugong meat is still valued highly as a source of protein, ranging in value from US\$ 0.50 – 6.50 per kg (Table 23).

In Mozambique and Mayotte, disturbance to dugongs from boat traffic and tourism activities, such as eco-tourism in Bazaruto National Park and diving in Mayotte, were cited as threats.



Dugong in the lagoon of Aldabra April 2002 (C. Pavard)

10. Priority Conservation Actions

Most governments in the region have neither the capacity nor the resources to control and monitor all activities in the marine and coastal zone. Prioritising actions for conservation is therefore essential if limited human and financial resources are to be effective. The conservation priorities listed below require commitment at all levels and some, such as large-scale aerial surveys, require considerable long-term financial input. The challenge for the region as a whole lies in working together to find realistic and sustainable mechanisms for achieving conservation goals and in ensuring the future survival of dugongs in the WIO region.

(a) Improve the level of protection for dugongs inside and outside marine protected areas

- Throughout the region, improve protection of dugongs in existing marine protected areas where dugongs occur, by promoting co-management and co-ownership of marine and coastal resources, including endangered species, among all stakeholders.
- Establish dugong sanctuaries or community-protected areas in sites currently unprotected and unmanaged. Proposed areas are listed in Table 24 below.
- Gill and mesh nets are undeniably a major threat to this species, and trawling is probably also significant with regard to destruction of seagrass habitat. It is therefore essential that measures be strengthened or imposed to reduce the threat

from these fishing gears both inside and outside marine protected areas in places where dugongs are known to exist. These could include: complete banning of gillnets and in-shore trawling activities; "open" and "closed" seasons for various fishing gears; or multi-user zoning.

In Bazaruto National Park in Mozambique, regulations banning gillnet fishing, as well as long lines and spear guns, have already been implemented and are proving effective (H Motta, pers. comm. 2003). Adopting similar regulations in Lamu-Kiunga, Gazi, Moa, Rufiji Delta, the Quirimbas Archipelago, Maputo Bay, Madagascar, Moheli and Mayotte should also be considered.

- Success is likely to depend on providing incentives and alternatives to gillnet fishers as well as the capacity of government authorities to review existing policy and enforce regulations. Associated costs (incentives, alternative gears) should be included in national and site-specific management strategies and plans.

Table 24. Proposed areas for dugong protection

Country	Sanctuaries / Community- protected areas
Kenya	Siyu Channel/Dodori Creek; Gazi, south of Kisite Marine Park
Tanzania	Moa, north of Tanga
Mozambique	Northern Quirimba Archipelago (btn Matemo & Macaloe Islands)
	Primeiras & Segundas Archipelago (btn Moebase & Angoche)
	Area north of Bazaruto NP, Inhaca Island
Madagascar	Northeast, northwest, central and southwest
Mayotte	East coast

- Promote trans-boundary conservation collaboration and partnership initiatives (e.g. Somalia - Kenya and Kenya - Tanzania).
- Where opportunities exist, integrate dugong conservation activities and actions with existing or proposed coastal management and development initiatives and the tourism sector. For example, there is scope for dugong conservation actions to be incorporated into national Integrated Coastal Environment Management Strategies recently launched in Tanzania and being developed in Mozambique.

Conservation actions can also be implemented in partnership with local NGOs or CBOs working in coastal areas (e.g. WWF Rufiji-Mafia-Kilwa Seascape Project (Tanzania), MEGAPTERA Ocean Indien (Mayotte)).

There are further opportunities to promote conservation and monitoring activities over a wider area through collaboration with the tourism sector, as has proved successful along the Mozambique coast.

(b) Adopt the dugong as a regional flagship species and initiate a public awareness campaign

- Due to their highly endangered status and rarity in the WIO region, all countries should be encouraged to adopt the dugong as their marine "flagship" species. Elevating their public status can be used to raise awareness and essential funds.
- There is a need to initiate national education and awareness campaigns targeting all stakeholders within the region. Information can be disseminated through national and local media and promotion of culturally sensitive educational activities (drama groups, posters, videos, competitions). It is recommended that the successful annual Dugong Festival held in Kenya be replicated in other countries within the region. Information should be disseminated through relevant government authorities and the existing network of marine protected areas and conservation initiatives. The impact of a marine / dugong education campaign on local perceptions and behaviour should be monitored and evaluated. Sharing of educational materials across the region is also recommended.

(c) Strengthen capacity of relevant government authorities to enforce legislation

- Provide technical training and resources (boats/engines, vehicles, radios, fuel, maintenance) necessary for relevant government authorities to enforce the law, monitor illegal activities and raise awareness at key sites in the region.

- To maximize effectiveness along the coast, surveillance and monitoring of illegal activities by tourist operators, commercial and private air passenger services, NGOs and local communities should be promoted and developed.

(d) Determine and monitor dugong population characteristics (status, distribution, movements) and the level of threats in the region

- Conduct large-scale quantitative aerial surveys in the region, using methods developed for remote areas in Australia.
- Carry out annual site-based aerial surveys in priority dugong areas to determine abundance and establish population trends. These surveys could be combined with surveys of other marine species (e.g. turtles, cetaceans) to maximize efficiency and share resources and costs.
- Initiate catch-monitoring programmes, focusing on gillnets, trawlers and fence traps, in collaboration with government institutions, academic & research institutes and local communities. Promote participation of local fishers to become "community monitors".
- Initiate dugong satellite-tagging programmes to track fine scale and long distance movements. Liaise with experts in Australia on methods of capture and re-capture and the most appropriate tagging equipment. This should be coordinated regionally.
- Map seagrass habitats and monitor health and carrying capacity in key dugong areas.

(e) Establish a regional network for dugong and general conservation practitioners and researchers

- The existing international Sirenian list server (sirenian@listserv.tamu.edu) could provide a useful forum for regional scientists and conservation practitioners and other interested parties to exchange ideas and experiences and disseminate information on dugongs.
- Encourage the establishment of national dugong conservation task forces in each country in the region to facilitate the development and implementation of dugong action plans and conservation strategies.

11. Conclusion

Marine and coastal conservation and sustainable resource use are among today's most important global environmental issues. Pressures on the marine environment are particularly acute in the WIO region which is characterized by a large and expanding human population and rich biodiversity. In response to the growing pressures and threats, initiatives to mitigate damage and ensure sustainability are escalating worldwide, through establishment of marine protected area networks, initiation of an eco-region approach to biodiversity management, and the development and implementation of integrated marine and coastal management strategies.

Within this context, through the network of existing and planned government and non-government coastal and marine initiatives in the WIO region, reduction or elimination of the main threats to dugongs should be possible and the survival of the highly endangered dugong assured.

While much more is still to be learned and discovered, this preliminary overview serves as an important first step in assessing the known conservation status and distribution of dugongs in the WIO region. It calls for urgent action and long-term commitment in the protection of this species and sets the scene for greater future collaboration in the region.



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Towards a Western Indian Ocean



DUGONG

Conservation Strategy

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