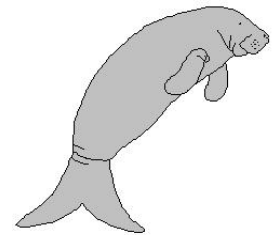


The dugong (*Dugong dugon*) in Tanzania:
A national assessment of status, distribution and threat



Catharine E. Muir, Adelaide Sallema, Omari Abdallah,
Daniela De Luca & Tim R.B. Davenport

Wildlife Conservation Society (WCS)



With additional support from the
Worldwide Fund for Nature (WWF)
and the
Mafia Island Turtle & Dugong
Conservation Programme

July, 2003

Contents

Acknowledgements	Page iv
Summary	Page 1
1. Introduction	Page 2
2. Background	Page 2
2.1 Taxonomy and description	Page 2
2.2 Distribution	Page 2
2.3 Conservation status and threats	Page 3
2.4 Life history and reproductive ecology	Page 3
2.5 Habitat and diet	Page 3
2.6 Movements	Page 3
3. Study justification	Page 3
4. Study aims	Page 4
5. Study area and timetable	Page 5
6. Methods	Page 5
6.1 Literature review	Page 5
6.2 Interview survey	Page 5
6.3 Opportunistic observations	Page 6
7. Results	Page 7
7.1 Summary	Page 7
7.2 Respondent profile	Page 7
7.3 Dugong status	Page 8
7.4 Dugong distribution	Page 9
7.5 Ecology	Page 11
7.6 Dugong uses and myths	Page 11
7.7 Threats and conservation	Page 13
8. Discussion	Page 14
8.1 Status	Page 14
8.2 Threats	Page 15
8.3 Ecology	Page 17
8.4 Utilisation	Page 17
8.5 Conservation measures	Page 17
9. Conclusions	Page 18
10. Recommendations	Page 18
10.1 Research and monitoring	Page 18
10.2 Conservation measures	Page 19
11. References	Page 20

List of Figures

Figure 1.	Adult dugong (Photo © Doug Perrine/Seapics.com)	Page 2
Figure 2.	Map showing sites surveyed	Page 5
Figure 3.	Proportion of respondents who had seen a dugong	Page 8
Figure 4.	Map of dugong sightings since 2000	Page 8
Figure 5.	Respondents who have seen dugongs by location (%)	Page 10
Figure 6.	Uses of dugongs by respondents	Page 12
Figure 7.	Claimed threats to dugongs (%)	Page 13
Figure 8.	Proposed methods of conservation (%)	Page 14
Figure 9.	Dugong being butchered for meat (Photo by P Dutton)	Page 15

List of Tables

Table 1.	Timetable of activities	Page 5
Table 2.	Respondent profile	Page 7
Table 3.	Records of dugong observations: 2000 – 2003	Page 9

Appendices

Appendix I	Questionnaire interview	Page 23
Appendix II	Dugong sighting sheet	Page 25
Appendix III	List of contacts	Page 26

Suggested citation:

Muir¹, C.E., Sallema², A., Abdallah¹, O., De Luca³, D.W. & Davenport³, T.R.B. (2003). The dugong (*Dugong dugon*) in Tanzania: A national assessment of status, distribution and threat. *Wildlife Conservation Society*. pp 31.

¹ Mafia Island Turtle & Dugong Conservation Programme, PO Box 23, Mafia, Tanzania. cmuir@africaonline.co.tz

² PO Box 32686, Dar-es-Salaam, Tanzania. adelaide5mon@yahoo.co.uk

³ Wildlife Conservation Society (WCS), PO Box 1475, Mbeya, Tanzania. dwdl@atma.co.tz or trbd@atma.co.tz

Acknowledgements

This work was funded by the *Wildlife Conservation Society* (WCS), Bronx Zoo, New York. Additional financial support was also provided by the *Worldwide Fund for Nature* (WWF), through its Eastern Africa Marine Ecoregion (EAME) initiative and the *Mafia Island Turtle and Dugong Conservation Programme*.

The following institutes and organizations are acknowledged for making available relevant literature and for facilitating this study: The Tanzania Fisheries Division, Marine Parks & Reserves Unit, University of Dar es Salaam, Institute of Marine Science, Tanzania Coastal Management Partnership, National Environment Management Council, IUCN, WWF and WCS.

More specifically, we greatly appreciate the assistance provided by the following individuals during the course of the work: Barnabus Mgweno, Rose Sallema, Gratian Luhikula, Dr G Wagner, Dr M Richmond, Prof K Howell, Dr Amani Ngusaru, Lydia Mwakanema, C K Rumisha (Dar es Salaam); Dr Anthony King, J Mwaisaka, S Mndolwa, B Chiwanga and R Nalinga and staff of MBREMP (Mtwara); Jason Rubens, George Msumi and the staff of Mafia Island Marine Park (Mafia); Dr Eric Verheij, S Mhina and the staff of the Tanga Coastal Zone Conservation and Development Programme (Tanga); Dr Olivier Hamerlynck, Frederick Mngube, Councillor Palla and staff of the Rufiji Environment Management Programme (Rufiji); O. Mvula, D Masasi and S Kipea (Kilwa); B Lamerck, A Mposi and H Matola (Bagamoyo); Dr Shaghude, Dr S Mzee, O Salim, E Matee and S Hamza (Zanzibar); S Ngaweje and Mr Mchalanganya (Lindi), P and S Dutton (Mozambique / South Africa) and D Boles (New York). Paul Dutton and Doug Perrine (Seapics.com) are very kindly acknowledged for providing the photographs on pages 2 and 15.

This survey would not have been possible without the cooperation of all the individuals interviewed and we would like to thank them for giving their time and for imparting their knowledge of dugongs. Also to members of Village Councils, Environment Committees and Fishermen Confederations who helped identify key informants and to the many villagers who were so hospitable. Finally, sincere thanks to Louisa Muir and Jason Rubens for their valuable comments on an earlier draft of this report.

Summary

Globally the dugong (Dugong dugon - Müller, 1776) is listed by IUCN as vulnerable. However, in the Western Indian Ocean they are almost certainly endangered as a result of decades of active hunting for meat and oil, as well as by incidental capture in gillnets, habitat degradation and dynamite fishing. Once commonplace along Tanzania's 900 km coastline, by the beginning of the twenty first century the animal was so rarely seen that its status was no longer known.

Thus, in order to determining the status, distribution, threats, uses and attitudes towards dugongs in Tanzania, an investigative survey was carried out in all five coastal regions of the country, as well as the Zanzibar islands of Pemba and Unguja. Information was gathered between April and June 2003 mainly through semi-structured interviews, with key informants at 9 sites along the coast. This represents the first nationwide assessment of this species in Tanzania.

The results indicate that 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 30 years however, dugong numbers have declined dramatically and sightings are now rare. Interviews with 420 fishermen from 57 villages yielded just 32 reported sightings since the start of 2000 (24 incidental captures and 8 of live animals). Small resident populations are reported to exist in just two remaining areas: the Rufiji-Kilwa border (between Jaja in Rufiji and Somanga in Kilwa) and Moa in Tanga region, just south of the Kenya border.

In Rufiji-Kilwa, dugongs were reported to range closer to the shore during the southeast monsoon from May-August when sea temperatures are lower. This period corresponds to the timing of most incidental gillnet capture reports. Fishers believe that dugongs move to deeper waters during the northeast monsoon because of the higher sea temperatures at that time. The main use of dugong is for meat, a prized source of protein, which has a current market value of US\$ 1.00 per kg. The results did not reveal any significant cultural or mythical traditions and only limited medicinal value, attached to dugongs.

The main threat to dugongs in the past was deliberate hunting for meat. Today, with 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 mortality in Tanzania. Disturbance, both to dugongs directly and to critical seagrass feeding habitats, from commercial prawn trawling 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.

It is clear that dugongs are now critically endangered in Tanzania, and the species is probably one of the country's rarest and most threatened mammals. 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, as well as mapping of seagrass distribution by species. Other research priorities include a mechanism to monitor incidental captures and an assessment of the impact of prawn trawling.

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 in Rufiji-Kilwa. Success is likely to depend particularly on the provision of genuine alternatives to gillnet fishers, particularly financial incentives to release animals caught accidentally. A body such as a national dugong task force could assist in the development of a national dugong conservation strategy, including the establishment of one or more sanctuaries. Relevant district authorities and existing projects and NGOs must play a major role in raising awareness amongst the relevant communities.

1. Introduction

Dugongs are believed to be the most endangered large mammal on the African continent (Cockcroft, 1995; Korrubel & Cockcroft, 1997), and there is growing concern in East Africa that they are in grave danger of local extinction unless immediate conservation measures are taken (Marsh *et al.*, 2001). In Tanzania, information on dugong distribution and abundance is scarce and comes mostly from anecdotal reports and incidental sightings. Indeed, a recent UNEP report on the global status of dugongs, stated that the species was thought until recently to have already disappeared from northern Tanzania (their former stronghold) and their presence in the south was unknown. As a consequence, the entire Tanzania coast was highlighted as a priority area for research (Marsh *et al.*, 2001). On-going research on Mafia Island meanwhile, indicated the existence of a small and threatened population in the Mafia-Rufiji-Kilwa area (Muir & Abdallah, 2003).

The absence of comprehensive, contemporary data on dugongs for Tanzania, coupled with increasing alarm about their status, prompted this current study. It is the first survey of its kind in Tanzania and an important step in the conservation of this highly threatened species. It is hoped that the findings will provide valuable input in the development of immediate conservation actions, including further research on dugong populations by WCS, as well as WWF's Eastern Africa Marine Ecoregion (EAME) regional initiative to produce a Western Indian Ocean dugong strategy and action plan.

2. Background

2.1 Taxonomy and description

Dugongs (*Dugong dugon* - Müller, 1776) 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 belonging to the family Trichechidae (Marsh *et al.*, 1978).

Fig. 1. Adult dugong (*Dugong dugon*)
(Photo © Doug Perrine/ Seapics.com)



Dugongs descended from terrestrial mammals that browsed in shallow grassy swamps during the Eocene and their closest modern relative is the elephant (Ripple, 1999). Their smooth skin is slate-grey in colour and their body more stream-lined than manatees, with a fluke-shaped tail and a pig-like head. 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 about 70 years (Marsh *et al.*, 1984).

2.2 Distribution

Dugongs have an extensive range spanning at least 37 countries and territories, and occur in association with coastal and island seagrass beds in the tropical and subtropical waters of the western Pacific and Indian Oceans (Marsh *et al.*, 2001). 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. Elsewhere, populations are small and fragmented and in some areas, such as Mauritius, the Maldives and parts of Cambodia and Laos, dugongs have already disappeared (Bryceson, 1981; Marsh & Lefebvre, 1994; Marsh *et al.*, 2001).

2.3 Conservation status and threats

Dugongs are listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and classified globally as 'vulnerable to extinction' due to a population decline of at least 20% in the last 90 years (IUCN, 2000). Their habitat requirements and slow rate of reproduction render them particularly vulnerable to anthropogenic activities, and they are threatened by hunting, incidental net captures, pollution, coastal development and disease (Korrubel & Cockcroft, 1997; Marsh *et al.*, 2001).

2.4 Life history and reproductive ecology

Although dugongs can live up to 70 years or more, they are slow to reproduce (Marsh *et al.* 1978). Both males and females become sexually mature at about 10 years of age although some females mature as late as 17. 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 about 5% a year and therefore can sustain only a low level of anthropogenic mortality of 1-2% (Marsh *et al.*, 1984; Marsh *et al.*, 1995).

2.5 Habitat and diet

Dugongs commonly occur in shallow, sheltered bays and lagoons, less than 5m deep. They 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. For example in the Torres Strait between Australia and Papua New Guinea, dugongs are seen more than 10 km from land (Marsh & Saalfeld, 1989) and at the Sahul Banks off northwestern Australia they have been observed in waters up to 90m deep (Whiting, 1999).

Dugongs feed primarily on seagrasses. Recent studies indicate that they prefer species high in nitrogen and low in fibre such as *Halophile ovalis* (Preen, 1995). They can manipulate seagrass beds to encourage regeneration of fast-growing pioneer species, which they prefer. Maintaining a highly palatable area of food has been coined 'cultivation grazing' (Preen, 1995). They generally uproot whole plants producing distinctive feeding trails. Like the hippopotamus, which supplies freshwater habitats with up to 50 kg of processed plant material a day, the dugong also recycles marine meadow nutrients (Dutton & Dutton, 1997), although the extent of this important ecological process remains to be quantified.

2.6 Movements

Dugong movements have been tracked in studies using VHF and satellite transmitters (Marsh & Rathbun, 1990). Most movements are within areas of seagrass beds and are dictated by the tides. 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 indicating the importance of international collaboration in their management (Marsh *et al.*, 2001).

3. Study justification

Although listed as vulnerable globally, the status of dugongs in the Western Indian Ocean (WIO) is almost certainly endangered, from years of active hunting for meat and oil as well as incidental capture in gillnets, habitat degradation, and dynamite fishing (Ray, 1968; Howell, 1988; UNEP, 2001; Marsh *et al.*, 2001). Within the region, quantitative data on population distribution and size is scanty. In Kenya, herds of 80 animals were reported at Manda Bay in 1996 but recent aerial surveys of the entire coastline indicate a sharp downward population trend with 10 and 6 dugongs counted in 1994 and 1996 respectively (Cockcroft, 1995; Komora, 1996; Wamukoya *et al.*, 1997). In 2002, only between 5 and 8 animals were reported to remain at Siyu Channel and Kiunga Muini in northern Kenya, an area previously distinguished as the most important dugong habitat on the Kenyan coast (Mohammed *et al.*, 2002).

Dugongs occur in small numbers in the Comoros Islands and a total of 5 dugongs were sighted on four occasions in the shallow lagoonal waters of Aldabra Atoll between August and October 2001 (Sirenews, 2001). In Madagascar, dugongs are no longer common (Marsh *et al.*, 2001). The largest remaining population in the region is believed to be in the Bazaruto Archipelago in Mozambique, where approximately 104 dugongs remain (Mackie, 2001). On-going dugong research and conservation initiatives within the WIO exist in Kenya (Kiunga), Tanzania (Mafia Island) and Mozambique (Bazaruto).

In Tanzania, detailed seagrass distribution maps or area estimates are few and mainly restricted to the Zanzibar island of Unguja (Ochieng & Erftemeijer, 2002). However, Tanzania's 900 km 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), appears to have 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). Twelve 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).

No aerial dugong surveys have been conducted in Tanzania and few confirmed data exist on numbers. The first documented photographic records are 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). The most recent report from this area is of a dugong accidentally caught in a gillnet at Pangani in 1990 (Chande *et al.*, 1994). Populations have declined significantly in recent years possibly to the point where they cannot recover and their numbers are estimated to be no more than 100 individuals (Ngusaru *et al.*, 2001). In northern Tanzania they are believed by some to be locally extinct (Cockcroft *et al.*, 1994; Marsh *et al.*, 2001).

The most recent information on dugongs in Tanzania is from opportunistic 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 have been 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 sharks and other pelagic species.

4. Study aims

The aim of this study was to collect baseline information on the status, distribution and threats to dugongs in Tanzania. The specific objectives were to:

- a) Determine the population status and distribution of dugongs
- b) Identify the main threats to dugongs
- c) Gather information about local beliefs, uses and values of dugongs
- d) Establish local opinions on dugong conservation
- e) Make recommendations for priority actions

5. Study area and timetable

Sites in all 5 coastal regions (Tanga, Dar es Salaam, Coast, Lindi and Mtwara) as well as the Zanzibar islands of Pemba and Unguja, were visited during this survey. Results from on-going research at Mafia Island (100 interviews from 10 villages) are also included in the results below (Muir & Abdallah, 2003).

As such, the entire coast of Tanzania, from Kenya in the north to Mozambique in the south, is covered within the results. Table 1 provides a timetable of fieldwork, and a map of sites covered is shown in Figure 2. A list of contacts is presented in Appendix III.

Fig.2 Map showing sites surveyed



Table 1. Timetable of activities

Dates	Location	Villages
2001-2003	Mafia	10
07 – 13 April 2003	Mtwara	10
17/18 April & 22/23 May 2003	Kilwa	4
25 – 27 April 2003	Bagamoyo	5
28 April – 03 May 2003	Muheza / Pangani	8
30 April – 01 May 2003	Unguja	2
06 – 11 May 2003	DSM	4
19 – 21 May 2003	Rufiji	5
03 – 04 June 2003	Lindi	3
10 – 12 June 2003	Pemba	6
TOTAL		57

6. Methods

6.1 Literature review

A review of available literature on dugongs and their habitats was undertaken prior to the fieldwork. In addition, relevant Tanzania organizations and authorities were contacted to obtain information on any past or current dugong research and conservation initiatives. These included the University of Dar es Salaam, Marine Parks & Reserves Unit, National Environment Management Council, Tanzania Coastal Management Partnership and WWF.

6.2 Interview survey

Available options

Several survey techniques have been developed to assess marine mammal populations. These include interview surveys, land-based monitoring and aerial and ship/boat surveys. There is no single best method and a chosen technique will depend on study objectives and available resources (Aragones *et al.*, 1997). Interview surveys are simple and relatively inexpensive to implement and have been recommended as an appropriate starting point to assess dugong populations in developing countries (Aragones *et al.*, 1997; Marsh *et al.*, 2001). They provide broad qualitative information on the occurrence and distribution of a

species and the resultant data can be valuable in highlighting priorities and generating research hypotheses for future quantitative surveys. However, reliability of data is a limitation and information gathered from interviews should be verified where possible (Aragones *et al.*, 1997). Interview surveys have been successfully used to assess dugong status, threats, behaviour, local perceptions and uses in Australia (Anderson, 1978), Palau (Marsh *et al.*, 1995) and Vietnam and Cambodia (Sirenews, 2002) and to assess the conservation status of the West Indian manatee in Nicaragua (Jimenez, 2002).

Land-based monitoring can also be inexpensive and has been used to obtain quantitative data on population trends of migratory species such as Bowhead whales, as their movements are seasonally predictable. This method requires elevated platforms, good weather conditions and marine mammal species with near-shore distribution. As such its use can be limited. Comprehensive aerial surveying is also an effective technique in obtaining information on the distribution and the absolute and relative abundance of dugongs, and has been used to assess contemporary dugong populations mostly in Australia (Marsh & Lawler, 2000), but also in countries such as Kenya and Mozambique (Wamukoya *et al.*, 1997; Mackie, 2001). However, it requires expert personnel and sophisticated, expensive equipment and tends to be used for focused research once initial baseline surveys have been completed (Aragones *et al.*, 1997).

Chosen option

Since dugongs are rare in Tanzania and information on their status and distribution is limited, neither aerial / boat nor land-based surveys were considered feasible or appropriate at this stage. An interview survey technique was therefore selected as a suitable initial step in gathering baseline anecdotal information on dugongs in Tanzania, and as a scoping study to identify areas for more intensive investigation in the future. A non-random sampling approach was used. This method was adopted to enable key informants to be targeted, namely gillnet and other fishers, who were likely to have some knowledge about dugong abundance, mortality and life history in the areas surrounding their community. Results are a mixture of semi-quantitative data and qualitative information.

Questionnaire & Sightings Sheets

In each village, informants were identified with the assistance of the Village Chairperson and/or members of the Village Council or occasionally the local Fisheries Officer. Both older and younger villagers were interviewed to ensure a range of perceptions and as a gauge to estimate the point at which dugong populations started to decline in Tanzania. One-to-one interviews were conducted in Kiswahili by the authors, with the help of marine park staff in Mtwara and Fisheries Officers in Bagamoyo, using a semi-structured questionnaire. This covered subjects including dugong distribution, habitats, threats, uses, beliefs, trends and conservation as well as information on recent sightings. Interviewees were also asked whether they were residents or visiting and what fishing gear they used. Marine mammal and seagrass identification cards were shown to respondents to determine whether they could correctly identify the different species. The questionnaire is presented in Appendix I.

Results from interviews conducted on Mafia (Muir & Abdallah, 2003) have been included in this report to avoid duplication and to give a more comprehensive overview of dugong status and distribution along the coast. Dugong 'sighting sheets' were also left with the Village Chairperson and /or Environment Council Chairperson in most villages visited for the purpose of keeping accurate records of future dugong sightings or incidental captures (Appendix II).

6.3 Opportunistic observations

During fieldwork, known dugong areas were visited by boat whenever resources and time permitted. Areas included the southern section of the Rufiji Delta (Dima, Mbwera, Jaja, Pombwe and Mohoro Bay), Somanga, Pangani, Pemba, Kilwa and Mtwara. It was not possible to snorkel to investigate seagrass species or dugong feeding trails because of turbid waters caused by strong winds and rough seas brought on by the onset of the south-east monsoon (*kusi*).

7. Results

7.1 Summary

Prior to the early to mid-1970s, dugongs were reported to be relatively 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 dugongs have declined dramatically and sightings are now very rare. Some 32 dugong observations were reported (24 incidental captures and 8 of live animals) since 2000. Small remnant populations are still believed to exist in the southern section of the Rufiji Delta and at Moa in northern Tanzania.

The main use is meat, which has a high fat content. The oil is used as cooking fat and a small number of respondents reported using oil as a remedy for respiratory diseases, skin ulcers and muscle pain. Dugongs are believed by some to be mermaids. The main threats to dugongs were cited as past hunting, incidental capture in gillnets, habitat disturbance and destructive fishing practices such as dynamite fishing and trawling. Conservation measures considered by villagers included awareness raising and education, establishment of dugong sanctuaries, law enforcement, control of trawling activities and further research. During the survey no opportunistic sightings of dugongs, live or dead, were made.

7.2 Respondent profile

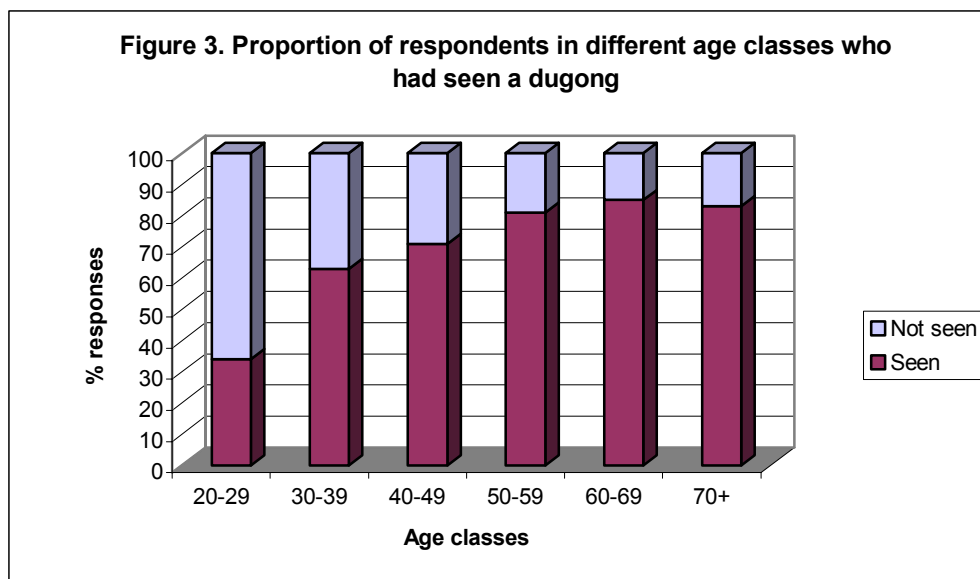
Some 320 interviews were conducted in 47 villages and sub-villages along the Tanzania coast during this survey. When the Mafia Island responses are incorporated, this gives a total of 420 interviews from 57 villages (Table 2). Since fishing is a male-dominated industry, fishermen were targeted (96% of respondents). When key informants were not available, interviews were conducted with non-fishers of both sexes. 94% of respondents 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.

The general level of awareness of dugongs amongst respondents was high and nearly 70% were able to identify the dugong on the identification card and distinguish it from other marine mammals. 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 Kiswahili word for dugong is "nguva" which was commonly used along the coast, apart from Rufiji District where there was a slight variation to "ngufa".

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 3).

Table 2. 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



7.3 Dugong 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. Some 281 (67%) respondents claimed personally to have seen a dugong, of which 272 had sighted dugongs in Tanzanian waters, 3 in southern Kenya and 6 in northern Mozambique. Of these respondents 41% (115) had themselves captured a dugong in gillnets (*jarife*), with a mesh size of between 8 – 12 inches (*sinia*). Others reported seeing a carcass at a landing site or meat sold in a market and 8% (23) of respondents reported having seen live, free-swimming dugongs (ie not caught in gillnets).

Fig.4 Map of dugong sightings since 2000



During the survey, 32 dugong sightings were reported as having been made along the Tanzanian coast since January 2000 (Table 3). Of these, 24 were incidental captures in gillnets and 8 were sightings of live, free-swimming animals. Of the 32 sightings, 22 (69%) were from the Rufiji-Kilwa area indicating that the largest remaining concentration of dugongs in Tanzanian waters occurs there. A single sighting 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 from where they were previously thought to have disappeared. Other isolated sightings were reported from Mafia, Pangani and Pemba but there was little indication to support the view that there are resident populations in these areas.

Significantly, 79% reported a dramatic decline in dugong numbers since the mid to late '70s. 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 perception in all areas including Rufiji-Kilwa, is that it may already be too late for numbers to recover.

Table 3. Records of dugong observations: 2000-2003

	Reporter	Date seen	Location	No. animals	Sex/size	Circumstances	
2003	1	May '03	Mombasa, Kenya	2	?	Live	
	2	30 Feb '03	Twana, Rufiji	2	Sub-adults	Caught in gillnet.	
	3	22 Feb '03	Ukambara, Rufiji	1	?	Live	
	4	Feb '03	Kichinja ya Mbuzi, Rufiji	1	Adult	Caught in gillnet.	
	5	2003	Somanga, Kilwa	3	calf & 2 A	Live	
			TOTAL	9			
2002	6	Dec '02	Mbayae, Moa	1	Adult	Live	
	7	Nov '02	Somanga, Kilwa	1	?	Caught in gillnet.	
	8	7 July '02	Somanga, Kilwa	1	?	Caught in gillnet.	
	9	June '02	Kichinja ya Mbuzi, Rufiji	1	F / 3m	Caught in gillnet.	
	10	March '02	Njao gap, Pemba	1	Adult	Live	
	11	15 Jan '02	Mafia	1	Calf	Caught in gillnet.	
	12	2002	Utigiti, Rufiji	1	Adult	Caught in gillnet.	
	13	2002	Mohoro Bay, Rufiji	1	Adult	Live	
	14	2002	Somanga, Kilwa	2	Adult	Caught in gillnet.	
	15	2002	Somanga, Kilwa	1	F / 3m	Caught in gillnet.	
	16	2002	Fungu Mbwamba, B'moyo	15	?	Live	
				TOTAL	26		
	2001	17	04 Oct '01	Somanga, Kilwa	1	Adult	Caught in gillnet.
		18	Sep '01	Somanga, Kilwa	1	F / 1m	Bought for TSh 9,000/-
		19	Apr '01	Matula, Rufiji	1	F / 1.5m	Bought for 16,000/-, sold 34,000/-
		20	Feb '01	Bwejuu Is., Mafia	1	?	Caught in gillnet.
21		2001	Jaja, Rufiji	1	?	Caught in gillnet.	
22		2001	Somanga, Kilwa	1	Calf	Caught in gillnet.	
23		2001	Somanga, Kilwa	1	M / 3m	Caught in gillnet.	
			TOTAL	8			
2000	24	20 Aug '00	Kilwa	3	Adults	Caught in gillnet.	
	25	June '00	Somanga, Kilwa	1	F / Adult	Caught in gillnet.	
	26	Apr '00	Buyuni, Pangani	1	F / 2.5m	Caught in gillnet.	
	27	2000	Bwejuu, Mafia	1	?	Caught in gillnet.	
	28	2000	Ngolwe, Mohoro Bay, Rufiji	1	F / 3m	Caught in gillnet.	
	29	2000	Somanga, Kilwa	1	?	Live	
	30	2000	Somanga, Kilwa	1	?	Caught in gillnet.	
	31	2000	Mafia	1	M / adult	Caught in gillnet.	
	32	2000	Somanga, Kilwa	1	Adult	Caught in gillnet.	
			TOTAL	11			

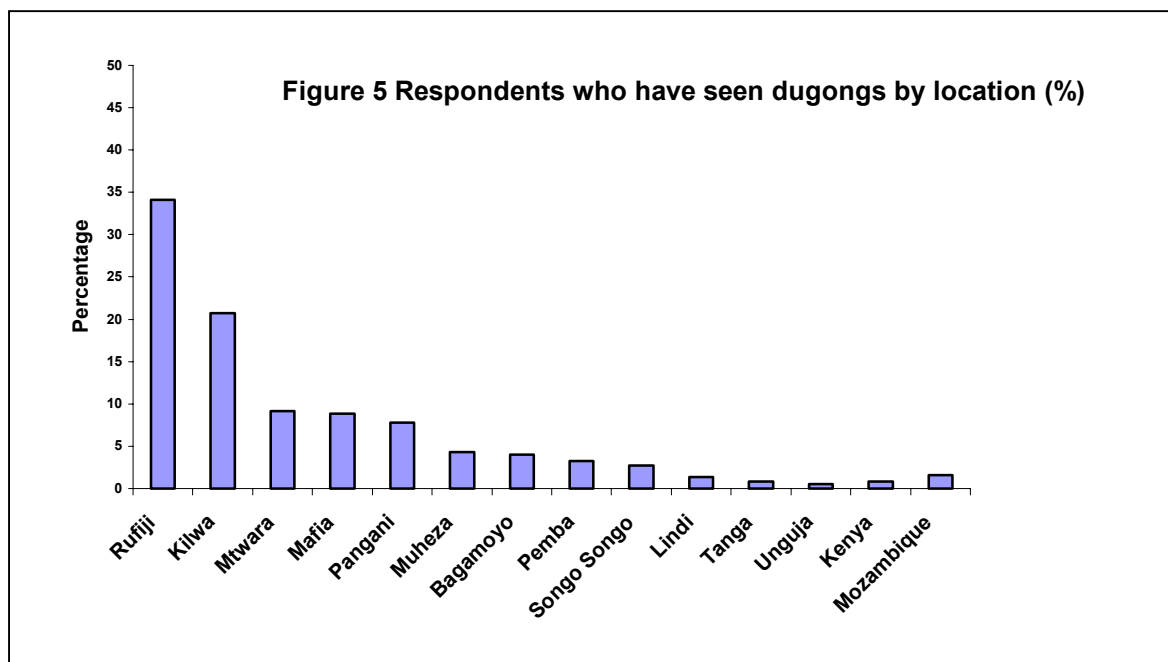
7.4 Dugong distribution

A distribution map of important dugong areas and recent sightings in Tanzania is presented in Figure 4. The most frequent dugong records, from the 1950s to the present day, were in the waters off the Rufiji Delta (Pombwe & Utigiti) and Kilwa (Somanga & Matapatapa).

Kilwa – Somanga - Rufiji

Over half of all the respondents (55%), from villages along the entire Tanzania coast, 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. Seven 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 seas prevented attempts to snorkel in the bay.



Bagamoyo - Pangani - Muheza

Three (of 5) fishers interviewed at Moa, and several from Kwale village, claimed that dugongs were abundant until the late 1970s, and that a small population of dugongs still exists close by at Mbayae / Kigomeni (approx. 15km south of the Kenya border) where it is possible to observe them early in the morning between 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 adult cow at Buyuni in April 2000.

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.

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).

Zanzibar (Unguja & Pemba)

One dugong was reported at Kazimkazi 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.

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.

7.5 Ecology

Some 56% (180) respondents (excluding Mafia) 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. Most respondents were unable to distinguish between the different species of seagrasses. However, a small percentage (11%), mostly from Kilwa and Somanga, reported that dugongs eat a specific type of seagrass called 'uriti' or 'mwani ya nguva'. Uriti was described as long and thin and identifications from the identification card by different respondents included: *Halophila ovalis*, *Halodule uninervis*, *Zostera capensis* and *Syringodium isoetifolium*.

In the Rufiji-Kilwa area dugongs were said to move close to the shore during the cooler months of the southeast monsoon or *kusi* (May – August) when sea temperatures are relatively low, and move to deeper waters during the warmer months of the northeast monsoon or *kaskazi* (November – February). Seasonal movements close to shore correspond to periods when respondents reported the highest incidental gillnet catches: *kusi* 33% (106 responses); *kaskazi* 20% (64) and the *matlai* season, a period of relative calm between the monsoons 16% (51). Some 31% (99) did not know. Dugongs were reported to feed mainly during the night, returning to deeper waters in the morning.

7.6 Dugong uses and myths

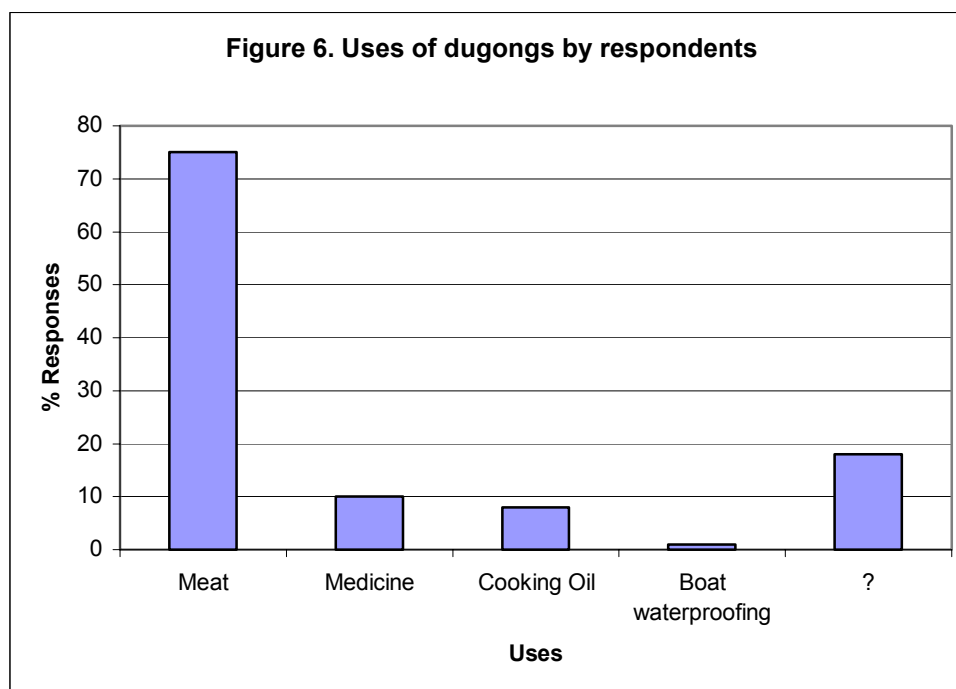
7.6.1 Uses

The main use of dugongs is for meat, a prized source of protein. Although fishers were generally aware that killing dugongs is illegal, many admitted that if a live dugong were caught accidentally, it would invariably be killed and eaten. Several respondents (6 from Rufiji, 1 from Bagamoyo and 1 from Lindi) claimed that dugong meat has special qualities, giving strength and good eyesight. Some 47% of respondents had tasted the meat which they likened to prime beef, yet more delicious. A fisher from Rufiji believed the meat was more similar in taste to giraffe.

A small proportion of 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 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 into pieces (*fungu*), roughly ½ kg each and sold for an average price of TSh 1,000/- (USD 1.00) per kg. A whole animal was said to be worth from TSh 9,000/- to 80,000/- (USD 9 – 80), and a valuable, if irregular, source of income given an average monthly wage of TSh 30,000/-. The price was said to vary according to size, the amount buyers could afford and the freshness of the meat. In the 1960s and 70s, meat fetched between TSh 10 – 50/- (USD 0.01 – 0.05) per *fungu* or else was bartered for rice or flour.

Reported uses, other than meat, were few. However, 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, earache 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. These findings compare to studies in neighboring Kenya, where the meat, oil, bones and tusks are used to cure 21 ailments including asthma, and protection against evil spirits (Marshall, 1998), and in Cambodia and Laos where bones are reported to cure fevers and the teeth and tusks are carved into jewelry. The tusk is the most expensive part, followed by the skin and meat (Sirenews, 2002). Dugong hunters in Palau use the ribs to make jewelry and prefer the meat of female and juvenile dugongs to that of adult males (Marsh *et al.*, 1995).



7.6.2 Myths & Beliefs

Myths about dugongs along the Tanzania coast were not particularly common and more than two-thirds of the respondents (68%) had no stories to tell, and regarded dugongs as “just fish or dolphins”. Of the minority who held beliefs about dugongs, the most common description was of 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. Some 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.

Five fishers (3 from Somanga and 2 from Pombwe) reported a dugong spirit or ghost living in the area of Pombwe and Mohoro Bay, 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

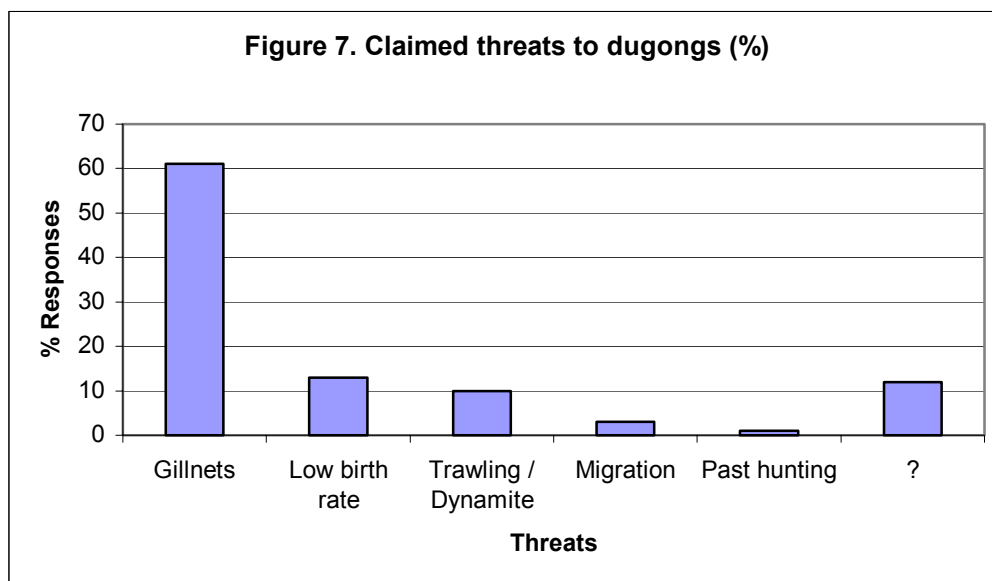
as dugongs. Other tales included the belief that: by eating dugong meat, it is possible to live to be 1025 years old (reported in Mtwara); dugongs come ashore during the night and return to the sea in the morning (Mtwara); dugongs come out of the sea in the day to warm up in the sun (Mtwara); and that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

7.7 Threats and conservation

7.7.1 Threats

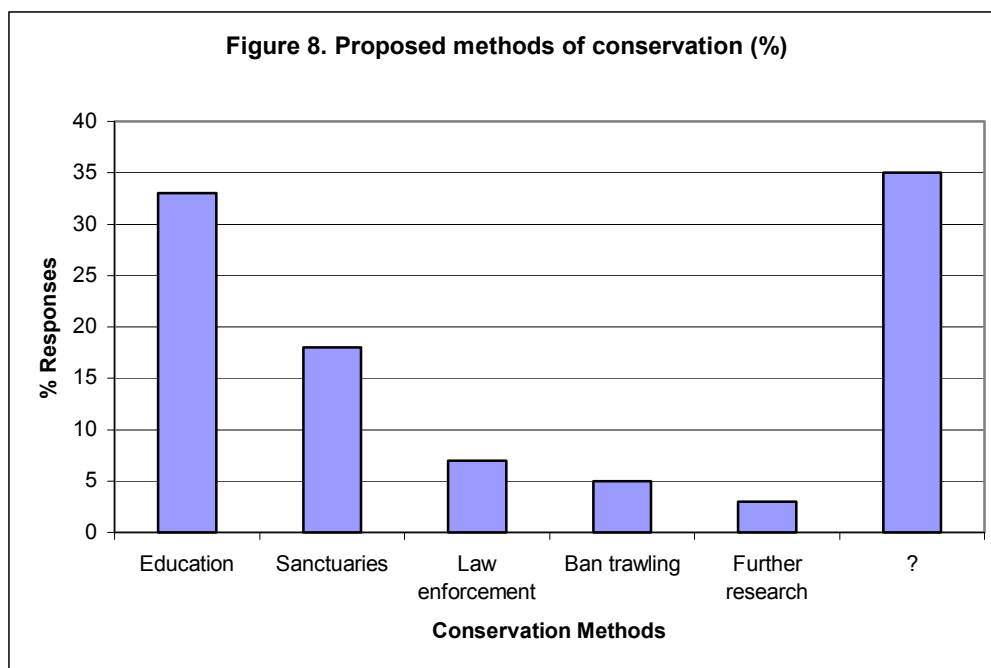
Accidental entanglement and drowning of dugongs in gillnets (both set and drift) is a significant threat to dugongs in Tanzania (Figure 7). In this survey, 85 fishers had personally caught a dugong in their net, 98% of which were gillnets with mesh sizes ranging from 5 – 16". Gillnets are typically set 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 were 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. Other types of net in which they were reported to have been captured included fence traps (Rufiji) and seine nets, although these only accounted for 2% of responses.

In Kwale (Muheza District) it was noted that dugongs were actively hunted using dynamite until the 1970s. Fishermen would follow groups or single dugongs in dugout canoes (*mitumbwi*) and when suitably close throw the dynamite stick directly at the animal. Many adults and calves were allegedly killed, as were several fishermen. Damage to seagrass beds and general habitat disturbance by prawn trawlers was cited, mostly by fishers from Rufiji and Bagamoyo (48% and 44% of respondents, respectively), which are important prawn trawling grounds. A fisherman from Rufiji claimed that a dugong was caught in a trawler net in 2000. Population declines were also attributed to low reproduction rates of dugongs.



7.7.2 Conservation

The general consensus among respondents (71%) was that conservation measures are necessary because dugong populations have been decimated and the animal is 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 8).



8. Discussion

8.1 Status

This study provides the first comprehensive data on the current status and distribution of dugongs along the entire coast of Tanzania and confirms the significance of Rufiji - Kilwa as an important dugong zone, in particular the area between Jaja and Somanga and is consistent with previous reports (Ray, 1968; Bryceson, 1981; Muir & Abdallah, 2003). Results further suggest that while they may no longer occur around Unguja Island (Zanzibar), it is possible that a small remnant population exists near Moa, just south of the Kenyan border.

Further studies are necessary to determine the sizes of both populations and movements, as well as the condition of their seagrass habitats. Elsewhere in Tanzania, there is no evidence to suggest that any other resident dugong population remains.

Dugongs are particularly vulnerable to over-exploitation or harvesting due to their slow reproductive rate and dependence on seagrasses that grow in shallow coastal waters. On average, females over 10 years old produce one calf every 5 years. With an annual growth rate estimated at only 5% per year, the sustainable level of exploitation may only be 1-2% of females per year (Marsh *et al.*, 1995). Based on recent records from this survey, if 8-10 dugongs are being killed each year in Tanzania, then a population of at least 1,000 (500 females) may therefore be necessary to assure long-term survival of the species. There is no evidence to suggest that a population anywhere near this size exists in Tanzania.

It is very unlikely, therefore, that the remaining dugong population can sustain the current level of mortality. Unless immediate measures are taken to mitigate the threats and protect their habitat, the future of the dugong in Tanzania must, at the least, be deemed uncertain.

8.2 Threats

There are several possible factors that may be responsible for the decimation of dugongs in Tanzania from the late 1960s to mid 1970s. These include past hunting, incidental captures in gillnets, dynamite fishing, habitat disturbance and pollution.

Hunting

Prior to the 1970s (when the 1970 Fisheries Act came into place and dugongs became officially protected) our research suggests that dugongs were actively hunted. This may have had the biggest impact on their current population status. Respondents were certainly aware that dugong hunting is illegal; suggesting that awareness of national legislation does filter down to rural coastal communities. However, although hunting is no longer practiced (because they are so rare) the research revealed that when dugongs are caught live in nets they are still killed and eaten. Thus, either fishers do not associate the illegality of hunting dugongs with the harvesting of live animals accidentally caught in nets, or they are consciously disregarding the law.

Fig 9. Dugong being butchered for meat (Photograph by P Dutton)



Gillnet Fishery

Nylon filament gillnets were introduced to Tanzania in the late 1960s (Amir *et al.*, 2002) and pose a major threat to dugongs. Entanglement in both set and drift nets with a mesh size of >6', targeting finfish and rays, was consistently cited as the main cause of mortality in Tanzania waters. Indeed, it is reported to be a problem throughout the animal's range (Chande *et al.*, 1994; Cockcroft & Krohn, 1994; Preen, 1998; Ngusaru *et al.*, 2001; Marsh *et al.*, 2001). In shallow bays with large tidal fluctuations, dugongs and fishers use inter-tidal areas during the high tide, increasing the risk of accidental capture (Marsh *et al.*, 2001). This is believed to be the reason for the high incidence of captures in Shoalwater Bay in Australia and may account for the large number of accidental drowning in gillnets in Mohoro Bay in the southern Rufiji Delta. In Australia, dugongs are mainly threatened by incidental capture in commercial gillnets. Although coastal set and drift gillnet fisheries are generally artisanal and most are at subsistence level in the Indian Ocean region, Cockcroft & Krohn (1994) suggest that this fishery is likely to expand with a concurrent increase in marine mammal by-catch. Accidental capture in large mesh gillnets appears to be the greatest threat to dugongs in Tanzania today. The impact of this fishery on dugongs therefore, must be addressed in any plans for dugong conservation and management.

Dynamite Fishing

The use of dynamite for fishing also started in the late 1960s (Ray, 1968;). It was subsequently rife along the entire coast of Tanzania until a major campaign to stop it was initiated in the early to mid 1990s. The impact on marine life and corals along the coast was devastating and although there is still evidence of occasional dynamiting, it has become a high profile conservation issue and is now being monitored and controlled. In this study, there was only one report of the deliberate use of dynamite to kill dugongs (in Tanga in the 1970s). Dynamiting does not appear to have been used extensively as a specific method to kill dugongs. However, considering the extent of its use over two decades to target fish, it is likely that the dugong population was affected (either from the physical impact of blasts or by forcing them to migrate to safer waters).

Prawn Trawling

Destruction of seagrass meadows by prawn trawling nets may also have played a significant role in the decline of dugongs in Tanzania. Commercial trawling started in the late 1960s. 22 vessels currently operate along the coast in 3 zones (6/7 working each zone): Zone 1 extends from the Kenya border to Dar es Salaam; Zone 2 extends from Dar es Salaam south to Ras Twana in the northern Rufiji Delta, and Zone 3 stretches from Ras Twana south to the border with Mozambique (Richmond *et al.*, 2002). 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 on the border of Zones 2 and 3, and when good prawn concentrations are found, a maximum of 14 vessels might be fishing along the shores of the Rufiji District. There is no exclusion zone for artisanal fishers along the Tanzania coast, and trawlers are permitted to fish up to the beach in waters 3m deep, although most trawling occurs between 4-10m (Richmond *et al.*, 2002). Ochieng & Erfteimeijer (2001) reported that commercial trawlers are non-selective and are destroying the seabed. Uprooted plants have been recovered from by-catches of commercial trawlers in Bagamoyo. In this study, the waters off Jaja were highlighted as a prime dugong area in Tanzania. The season most frequently cited as when dugongs move into shallow waters, possibly to feed and/or breed was April to August. Further investigation should determine the impact of prawn trawling on dugong populations and habitat in this area and should be incorporated into any future dugong management plan.

Habitat Destruction & Pollution

The five coastal regions of mainland Tanzania encompass about 15% of the country's land area and approximately 25% (8 million) of the population. This is expected to double by 2010 (TCMP, 2003). 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 thus reducing water quality. Industrial and domestic effluents, increased pressure on marine resources and the siltation of inshore waters, are all affecting important dugong feeding grounds (Cockcroft *et al.*, 1994).

Developmental activities in the vicinity of large urban centres such as Dar es Salaam, Tanga, Zanzibar, Bagamoyo, Kilwa and Mtwara are polluting the marine environment and the levels of pollutants are expected to rise (Pratap, 1988; Ngoile, 1988). Pollutants include raw sewage and a variety of untreated industrial effluents such as fertilizers and heavy metals. Dugongs accumulate high levels of some heavy metals with age although the effect on their health is unknown (in Marsh *et al.*, 2001).

Increased siltation and/or increased epiphytic growth caused by nutrient enrichment can lead to seagrass die-off. In Tanzania heavy sedimentation is reported in the Rufiji Delta, the tidal flats off Mkuranga and Njimbani river in Ilala (Ngusaru *et al.*, 2001), and high levels of epiphytic macroalgae have been found on the stems of *Thalassodendron ciliatum* off the coast of Dar es Salaam in areas of high sewage

discharge. Although there is no evidence to suggest that sedimentation and epiphytic growth are yet destroying seagrasses in Tanzania, studies elsewhere have shown that the response of dugongs to seagrass loss include large-scale movements and starvation (Marsh and Lawler, 2002). For example, Preen and Marsh (1995) noted that following floods and a cyclone in Hervey Bay in Queensland in 1992, more than 1000 km of seagrass were lost. Some dugongs relocated to other areas but many died of starvation, and recovery of the population was expected to take more than 25 years.

8.3 Ecology

Consistent statements were made about movements and seasonality in the Rufiji-Kilwa area. Dugongs were said to move to shallower lagoons and bays from April to September when water temperatures are lower. Howell (1988) noted that dugongs move to sheltered bays between April and October when seas are rough, and shift to deeper waters beyond reefs between November and March (north-east monsoon) during calm seas. Captures of calves were reported in the shallow waters at Jaja, Pombwe and Mohoro Bay during the cooler southeast monsoons which may correspond to their breeding season which is reported to be between the months of May and August (Marsh *et al.*, 1984). Dugongs were reported to feed mainly during the night. Such behaviour is typical in areas where dugongs are intensively hunted (Fred, 1975). These findings will help to focus more in-depth conservation research in Tanzania in the future, not only in terms of geographic location but also the time of year.

8.4 Utilisation

Some cultures, such as the Aborigines and Torres Strait Islanders in northern Australia, regard dugong meat and oil as among their most valuable traditional food and give dugong hunters high status in the community (Marsh *et al.*, 2001). This research, however, suggests that coastal communities in Tanzania do not attach great cultural or social significance to dugongs. In the past when dugong hunting was common, dugong meat did provide an important food source to communities along the coast of Tanzania. Today, whilst still a valuable and desirable meat, it has become an opportunistic delicacy on the few occasions that a dugong is accidentally caught in a net. The challenge is to provide fishers with the motivation to release live dugongs from nets and report accidental captures.

8.5 Conservation measures

In Tanzania, dugongs are officially protected under the 1970 Fisheries Act. However, aside from a dedicated on-going turtle and dugong conservation programme based on Mafia Island, no other local dugong conservation project exists in the country. More importantly, no national dugong conservation strategy has been developed for their protection and management. Education and awareness-raising rated highly in the interviews as the most effective way to conserve dugongs. Relevant district authorities and existing marine protected areas as well as conservation and development initiatives could play a major role in raising awareness amongst relevant communities.

In order to persuade people to change behaviour, particularly one that impacts on their financial position, economic alternatives should be sought and encouraged. In Mafia, a turtle nest protection incentive scheme has proved highly successful with a dramatic increase of over 140% in the number of turtle nests reported and a decline in nest poaching from 49% to 5% over a period of one year (Muir & Abdallah, 2002). The provision of incentives to encourage fishers to release live dugongs from their nets may prove an equally effective and inexpensive conservation measure, at least in the short term, and something that conservation NGOs and projects should be willing and able to support.

Establishing dugong sanctuaries was also mentioned during this survey. Thirty-five years ago, Ray recommended the gazettement of the Rufiji Delta as a park to protect dugongs, and the creation of 6 reserves along the Tanzanian coast including a dugong sanctuary at Kilwa (Ray, 1968). In Australia, 16 Dugong Protection Areas (DPAs) were established along the Queensland coastline in 1997 to arrest the decline of dugongs. Within these zones, gill and mesh net fishing is restricted and in some areas boat

speeds are restricted. These DPAs have proved an important first step in the recovery of dugongs and their habitats along the coast (Marsh, 2000; Lawler *et al.*, 2002). Marsh *et al.*, (1999) recommended setting aside areas as dugong sanctuaries as the optimum conservation strategy in countries where human population growth and industrialisation is rapid. Factors to consider in the establishment of dugong sanctuaries include adequate size (to incorporate dugong home range), habitat quality, control of netting and mining, appropriate enforcement (Preen, 1998) and (sustainable) funding.

Along the coast communities rely heavily on fishing for their livelihood. Success of sanctuaries is clearly unlikely therefore without genuine community involvement and support. Experience comes from Australia's Northern Territory, where the Parks & Wildlife Service is working with local fishers, dugong hunters, fisheries experts and other stakeholders to identify areas of dugong habitat and gillnet use. Mechanisms to monitor and reduce incidental catch, such as regulating the use of certain fishing gears and zonal closures have proved effective (NT Parks & Wildlife Service, 2002). Even if decisions are taken to introduce sanctuaries (ie at Rufiji-Kilwa and Moa), policy decisions and implementation can be slow and it will fall on donors and NGOs to bridge the gap. Meanwhile, further detailed research in these critical dugong sites is needed in the immediate future and will form a very important part of a conservation strategy.

9. Conclusions

In Tanzania, dugongs are endangered. Recommendations made 30 years ago to protect them and their habitats have gone un-heeded. This study provides anecdotal evidence that two small and discrete dugong populations may still persist in Tanzania. Although dugongs are only occasionally accidentally caught in gillnets, the annual rate of mortality cannot be sustained at current levels. If this species has any chance of survival in Tanzanian waters, action is required urgently to protect critical habitats such as feeding pastures and calving grounds and to mitigate the threats. If addressed immediately, it may be possible to bring dugongs back from the brink of local extinction and ensure their place in Tanzania's rich and diverse natural heritage.

10. Recommendations

10.1 Research and monitoring

Detailed surveys are required as a matter of urgency in the two remaining dugong areas of Rufiji-Kilwa and Moa. Such surveys should seek to verify dugong presence and determine abundance and movements through land-based / boat surveys and snorkeling. Moreover, the distribution and abundance of seagrass should be mapped and seagrass diversity determined. At the same time, the local threats (especially from gillnets) should be quantified and the areas where dugong habitat and gillnet fishing overlap identified. Ideally, and on completion of such research, it is recommended that aerial surveys be conducted along the coast concentrating in the Rufiji – Kilwa area from Twana to Somanga, and in northern Tanzania from the Kenya border to Buyuni (Pangani).

The Wildlife Conservation Society (WCS) plans to begin aspects of the above mentioned research this year as part of their on-going dugong census initiative.

Other research priorities include an assessment of the practicalities and appropriate incentive levels of introducing a dugong release incentive scheme, the design and implementation of monitoring programmes including for incidental catch and an assessment of the impact of prawn trawling on seagrasses and dugongs.

10.2 Conservation measures

Sensitisation & Public Awareness

It is hoped that this document will initiate the process of wider public awareness of the plight of dugongs in Tanzania. There are many ways this could be achieved either nationally or locally. Educational materials on aspects of dugong conservation and methods to minimize incidental catches could be developed. Information should be disseminated through district authorities and the existing network of marine protected areas and conservation projects 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. All of the above would be greatly facilitated by the establishment of a Tanzania 'Dugong Day', along similar lines to the Dugong Festival held annually in Kenya.

Dugong Sanctuaries

It is recommended that dugong sanctuaries be established 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. Success is likely to depend particularly on an effective programme providing incentives and alternatives to gillnet fishers.

National dugong conservation body

A body such as a 'national dugong task force' would greatly assist in the development of a national dugong conservation strategy, including the establishment of sanctuaries and national awareness campaigns.

Task force members could include representatives from key local communities (Rufiji, Kilwa, Mafia and Muheza Districts); marine and coastal conservation initiatives such as the Tanga Coastal Zone Conservation & Development Programme (TCZCDP), Tanzania Coastal Management Partnership (TCMP), Kinondoini Integrated Coastal Area Management Programme (KICAMP), Mafia Island Marine Park (MIMP), Rufiji Environment Management Programme (REMP) and Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP); relevant government agencies such as Fisheries Division, Marine Parks & Reserves Unit (Ministry of Natural Resources & Tourism) and the Department of the Environment, Zanzibar; representatives from relevant non-governmental organisations such as WCS and WWF.

11. References

- Amir, O, Berggren, P & Jiddawi, N. 2002. Incidental catch of dolphins in gillnet fisheries in Zanzibar, Tanzania. *Western Indian Ocean Journal of Marine Science*. Vol 1, No. 2: 155–162.
- Anderson, P. K. 1978. The status of the dugong, and dugong hunting in Australian waters: a survey of local perceptions. *Biological Conservation*. 13: 13-26.
- Aragones, LV, Jefferson, TA & Marsh, H. 1997. Marine mammal survey techniques applicable in developing countries. *Asian Marine Biology* 14: 15-39.
- Bryceson, I. 1981. A review of some problems of tropical marine conservation with particular reference to the Tanzania coast. *Biological Conservation*. 20: 163-171.
- Chande, A I., Mtoka, G F & Mhitu, H A. 1994. Marine mammals and fisheries interactions in Tanzania. UNEP.
- Cockcroft V G, Salm, R V & Dutton, T P. 1994. The status of dugongs in the Western Indian Ocean. *First International Manatee and Dugong Research Conference*. Florida 11-13 March.
- Cockcroft, V. G. & Krohn, R. 1994. Passive gear fisheries of the southwestern Indian and southeastern Atlantic Oceans: an assessment of their possible impact on cetaceans. Report of the International Whaling Commission. Issue 15: 317 – 328.
- Cockcroft, V G. 1995. Dugongs of Coastal Africa. *African Wildlife Update*.
- Dollman, G. 1933. Dugongs from Mafia Island and a manatee from Nigeria. *Natural History Magazine*. No. 28, vol IV: 117-125.
- Dutton, P & Dutton, S. 1997. Mermaids in distress. *African Wildlife*. 51 No 6.
- Frazier, J. 1974. Marine turtles in Tanzania. Report to the Ministry of Natural Resources, Tanzania.
- Fred, K. 1975. Dugongs. In: R Altevogt, R Angermann, H Dathe, B Grzimek, K Herter, D Muller-Using, U Ruhm & E Thenius (Eds). *Animal Life Encyclopedia*. Mammals III. 12: 527-530.
- Howell, K. M. 1998. The conservation of marine mammals and turtles in Tanzania. In: JR Mainoya (Ed.) *Proceedings of the Workshop on Ecology and Bioproductivity of the Marine Coastal Waters of Eastern Africa*. 18-20 January, 1998, Dar es Salaam, Tanzania.
- IUCN (The World Conservation Union) 2000. The 2000 Red List of Threatened Species. IUCN, Gland, Switzerland.
- Jimenez, I. 2002. Heavy poaching in prime habitat: the conservation status of the West Indian manatee in Nicaragua. *Oryx*. 36 (3): 272-278
- Komora, A. 1996. Last chance for Kenya's mermaids. *Swara*. 19 (5): p13.
- Korrubel J & Cockcroft, V. 1997. Dire days for dugongs. *Africa – Environment & Wildlife*. Vol 5. No 1: 28-33.
- Lawler, I & Marsh, H. 2001. The green, green grass of home. *BBC Wildlife Magazine*.
- Lawler, I., Marsh, H., McDonald, B. & Stokes, T. 2002. Dugongs in the Great Barrier Reef: Current state of knowledge. CRC Reef Research Centre. Australia.
- Mackie, C. 2001. Aerial census of dugongs, dolphins and turtles in the Bazaruto National Park, WWF Eastern African Marine Ecoregion Programme. Report to the Directorate of Forestry and Wildlife, Ministry of Agriculture, Mozambique. 11pp.
- Marsh, H., Spain, A. V. & Heinsohn, G. E. 1978. Physiology of the dugong. *Comp. Biochem. Physiol.* Vol 61A: 159-168.
- Marsh, H, Heinsohn, G E & Marsh, L M. 1984. Breeding cycle, life history and population dynamics of the dugong, *Dugong dugon* (Sirenia: Dugongidae). *Australian Journal of Zoology*. 32: 767-88.
- Marsh, H, & Saalfeld, W K 1989. The distribution and abundance of dugongs in the northern Great Barrier Reef Marine Park. *Australian Wildlife Research*. 16: 429-440.
- Marsh, H & Rathbun G. B. 1990. Development and application of conventional and satellite radio tracking techniques for studying dugong movements and habitat use. *Australian Wildlife Research*. 17: 83-100.
- Marsh, H & Lefebvre, L W. 1994. Sirenian status and conservation efforts. *Aquatic Mammals*. 20.3: 155-170.
- Marsh, H., Rathbun, G. B, O'Shea, T. J. & Preen, A. R. 1995. Can dugongs survive in Palau? *Biological Conservation*. 72: 85-89.

- Marsh, H., Eros, C., Corkerton, P & Breen, B. 1999. A conservation strategy for dugongs: implications of Australian research. *Marine Freshwater Research*. 50: 979-990.
- Marsh, H. 2000. Evaluating management initiatives aimed at reducing the mortality of dugongs in gill and mesh nets in the Great Barrier Reef World Heritage Area. *Marine Mammal Science*. 16 (3): 684-694.
- Marsh, H. & Lawler, I. 2000. Dugong distribution and abundance in the northern Great Barrier Reef Marine Park – November 2000. Research Publication No. 77. 38pp. Great Barrier Reef Marine Park Authority.
- Marsh, H., Penrose, H., Eros, C. & Hughes, J. 2001. Dugong Status Report and Action Plans for Countries & Territories. UNEP/IUCN.
- Marshall, N T. 1998. Searching for a cure: conservation of medicinal wildlife resources in Eastern and Southern Africa. TRAFFIC International.
- Mohammed, M., Alderson, R & Williams, R. 2002. Report on dugong research trips to Siyu Channel and Kiunga Muini areas, Kenya. April – May 2002. Unpublished report.
- Muhando, C., Mndeme Y. & Kamkuru, A. 1999. Environmental Assessment in Mnazi Bay – Ruvumu Estuary Area.
- Muir, C. E. & Abdallah, O. 2002. Mafia Island Sea Turtle & Dugong progress report: Jan – Dec 2002. Report to the Commission for Science & Technology, Dar es Salaam.
- Muir, C. E. & Abdallah, O. 2003. A survey to assess the status of dugongs in Mafia Island and Rufiji, Tanzania. Unpublished report.
- Ngoile, M. A. K. 1988. Marine pollution in Tanzania: Sources, dispersion and effects. In: J R Mainoya (ed). Proceedings of the Workshop on Ecology and Bioproductivity of the Marine Coastal Waters of Eastern Africa, 18-20 January 1988. Dar es Salaam. Tanzania.
- Ngusaru, AS, Tobey, J & Luhikula, G. 2001. Tanzania State of the Coast 2001: People and the Environment. Tanzania Coastal Management Partnership, Science & Technical Working Group, Dar es Salaam.
- Northern Territory Parks & Wildlife Service. 2002. Management programme for the dugong (*Dugong dugon*) in the Northern Territory of Australia: 2003 - 2008. Department of Infrastructure, Planning and Environment.
- Ochieng, C A & Erfteimeijer, P L A. 2002. The status of seagrass ecosystems in Kenya and Tanzania. University of Dar es Salaam. 39pp.
- Pratap, H. B. 1988. Impact of heavy metal pollution on the bioproductivity of marine coastal waters. In: J R Mainoya (ed). Proceedings of the Workshop on Ecology and Bioproductivity of the Marine Coastal Waters of Eastern Africa, 18-20 January 1988. Dar es Salaam. Tanzania.
- Preen, A. 1995. Impacts of dugong foraging on seagrass habitats: observational and experimental evidence for cultivation grazing. *Marine Ecology Progress Series*. 124: 201-213.
- Preen, A. & Marsh, H. 1995. Response of dugongs to large-scale loss of seagrass from Hervey Bay, Queensland, Australia. *Wildlife Research*. 22: 507-519.
- Preen, A. 1998. Marine protected areas and dugong conservation along Australia's Indian Ocean coast. *Environmental Management*. Vol 22, 2: 173-181.
- Ray, C. 1968. Marine Parks for Tanzania, results of a survey of the coast of Tanzania. The Conservation Foundation, New York Zoological Society.
- Richmond, M (Ed). 1997. A guide to the Seashores of Eastern Africa and the Western Indian Ocean islands.
- Richmond, M.D., Wilson, J., Mgaya, Y. & Le Vay, L. 2002. An analysis of smallholder opportunities in fisheries, coastal and related enterprises in the foodplain and delta areas of the Rufiji River, Tanzania. Consultancy report to Rufiji Environment Management Project (REMP), IUCN. 96pp.
- Ripple, J. & Perrine, D. 1999. Manatees and Dugongs of the World. Voyager Press. 131pp.
- Semesi, A. K. 1998. Seasonal changes of macro-epiphytes on seagrass *Thalassodendron ciliatum* (Forssk. Den Hartog) at Oysterbay, Dar es Salaam. Tanzania. In: J R Mainoya (ed). Proceedings of the Workshop on Ecology and Bioproductivity of the Marine Coastal Waters of Eastern Africa, 18-20 January 1988. Dar es Salaam. Tanzania.

- Sirenews. 2001. Dugongs at Aldabra. Number 36.
- Sirenews. 2002. Tri-national dugong conservation in Vietnam-Cambodia-Thailand, July 2002. No. 38.
- Tanzania Coastal Management Partnership, 2003. National Integrated Coastal Environment Management Strategy. Vice President's Office, Dar es Salaam, Tanzania.
- UNEP, 2001. Eastern Africa Atlas of Coastal Resources: Tanzania. Nairobi, Kenya.
- Wamukoya, G. M., Ottichilo, W. K & Salm, R. V. 1997. Aerial Survey of dugongs (*dugong dugon*) in Ungwana Bay and the Lamu Archipelago, Kenya. Kenya Wildlife Service. 13pp.
- Whiting, S D. 1999. Use of the remote Sahul Banks, Northwestern Australia, by dugongs, including breeding females. *Marine Mammal Science*, 15 (2): 609-615.

APPENDIX I Dugong Questionnaire

Reporter: Date:
 Name of interviewee: Location of interview:
 Age: Occupation:
 Place of birth: Sex:
 Tribe:

(NB: personal information can be collected at the end if necessary)

A. MARINE MAMMALS

1.1 How long have you been fishing / lived in the area?

1.2 Do you recognize these animals? (Show picture) Y / N.

1.3 If YES, what do you call them?

1.4 How often, and where, do you see these animals?

1.5 Have you ever seen one of these (DUGONG)? Y / N

1.6 If NO, do you know of anyone else who has seen one? Y / N.

If you have, who and under what circumstances ((dead: caught in net accidentally, hunted, seen /eaten meat; alive: swimming / feeding)

Name	Month	Year	Location	Circumstances

If YES, when did you last see one & what were the circumstances (dead: hunted, caught in net accidentally, seen /eaten meat; alive: swimming / feeding) (NB: Let interviewee give details first before asking specifics as below.)

Date (D/M/Y)	Locn	Season	No. in herd	No. calves	Length (m)	Sex (M/F)	Dead/Alive (Circumstance)

1.8 Do you think people specifically hunt dugongs? If yes, why?

1.9 Have you caught a dugong in your net? Y / N.

1.10 If yes, what type of net:

Jarife/gill (drift/set) (specify mesh size)

Seine Others (specify)

1.11 How often & what time of day / tide have you caught a dugong (other marine mammals)

No./ month / year

Time of day / tide

- 1.12 Where are the main feeding & breeding grounds?
- 1.13 What type of habitats are the feeding/breeding grounds (coral reef, seagrass bed, deep sea etc)?
.....
- 1.14 Have you ever eaten dugong meat? Y / N.
1.14a or used parts for medicine? Y/N
- 1.15 Is dugong meat special? (e.g. aphrodisiac)? Y / N. If yes, give details
- 1.16 What are dugong parts used for (e.g protein, medicine)?
Meat
Bones
Oil
Others (e.g tusks - specify)
- 1.17 What is the average price of:
Meat
Bones
Oil
Others (e.g tusks - specify)

Do you know of any stories about dugongs? If so, provide details:

.....
.....
.....

Have you seen a change in dugong numbers? If yes, since when (year) has this change occurred and have numbers increased / decreased / stayed the same? Why?

.....

1.20 Do you think dugongs need to be protected? Y / N.

1.21 If yes, how?

1.22 Any other relevant information:

B. GENERAL INFO

2.1 What fishing gear do you use?

2.2 Where do you fish?

2.3 When do you fish? Season / tide?

2.4 What types of fish do you catch in your net?

2.5 Do you think the number of fish is increasing / decreasing?

2.6 Why increasing / decreasing?

2.7 In your village /area, how many fishing vessels?

Boat	
Dhow	
Mashua	
Ngalawa	
Mitumbwi	

2.8 Are the fishers in your village / area local or visitors?

APPENDIX II Dugong sighting sheet

Date or season	Time of day	Month	Year	Observer Name	Location	Species	No. of Individuals	Sex (M/F)	Body length (m)	Remarks

APPENDIX III List of Contacts

Organisation / Institution	Contact	Address	Tel/fax	Email
Wildlife Conservation Society (WCS)	Dr D De Luca Dr T R B Davenport	P O Box 1475, Mbeya	025 250 3541	dwdl@atma.co.tz trbd@atma.co.tz
Marine Parks & Reserves Unit	C Rumisha	P O Box 7565, DSM	022 215 0420	marineparks@raha.com
Tanzania Coastal Management Partnership	J Daffa Rose Sallema	P O Box 71686, DSM	022 266 6190	tmp@epiq.or.tz nrsallema@hotmail.com
National Environment Management Council	Dr M Ngoile	P O Box 63154, DSM	022 213 4603	
University of Dar es Salaam	Dr G M Wagner	P O Box 35064, DSM	022 241 0193	gwagner@tz.ca
Institute of Marine Sciences (IMS)	Dr N Jiddawi, Dr Shagude Dr S Mzee	P O Box 668, Zanzibar	024 223 2128	N_jiddawi@yahoo.com
IUCN Tanzania Country Office	Abdu Rahman Issa Barnabus Mgweno	P O Box 13513, DSM	022 266 6190	iucndar@epiq.or.tz
Mnazi Bay – Ruvuma Estuary Marine Park (MBREMP), Mtwara	E Machumu Dr A King	P O Box 845, Mtwara	023 233 3259	mbremp@makondenet.com
Rufiji Environment Management Programme (REMP), Rufiji	Frederick Mngube Dr O Hamerlynck	P O Box 11 Utete, Rufiji	023 240 2972	remputete@twiga.com
Mafia Island Marine Park (MIMP), Mafia	G Msumi	P O Box 74, Mafia		mimp@bushlink.co.tz
WWF Mafia	J Rubens	P O Box 23, Mafia		wwfmafia@bushlink.co.tz
Mafia Island Turtle & Dugong Conservation Programme	C Muir	P O Box 23, Mafia		cmuir@africaonline.co.tz
WWF Tanzania Programme Office	Dr H Mwageni Dr A Ngusaru	P O Box 63117, DSM	022 2700077	tzrep@wwftz.org
Tanga Coastal Zone Conservation & Development Programme (TCZCDP)	E Verheij	P O Box 5036, Tanga	027 264 7463/4	tangacoast@kaributanga.com

The dugong in Tanzania: A national assessment of status, distribution and threat

Pangani District Natural Resources Office	S S Mhina Z M Chomoka	P O Box 80, Pangani	027 263 0261 027 263 0017	
Muheza District Natural Resources Office	K M Chambo	P O Box 20, Muheza	027 264 1105 0744 285 752	
Tanga District Natural Resources Office	E M Kalolo			
Bagamoyo Fisheries Office	January		0744 808 982	
Kilwa Fisheries Office, Kilwa Masoko	O Mvula, D Masasi		023 240 2364	
Kilwa Kivinje Fishermen Confederation	Shaibu Mohamed Mmulla			
Kilwa Masoko	Ahmed Abdallah Shukra	P O Box 55, Kilwa Masoko		
Kilwa Ruins Hotel, Kilwa Masoko	Simon Kipea	Box 44, Kilwa Masoko	023 240 2397 Ask 137 Op.	kilwalodge@shyfile.com
Lindi District Natural Resources Office	Mr Ngaweje	P O Box 98, Lindi	023 220 2682	
Lindi District Natural Resources Office	O Mchalaganya	P O Box 489, Lindi	023 220 2197	
Misali Island Conservation Area, Pemba	Ali Said Hamad			cnrpemba@redcolobus.com
Wete, Pemba	Ms Hidaya Khamis Hamad			
Wete, Pemba	Omari Makame			
Chake Chake, Pemba	Bakari Mshindo			
Department of Fisheries & Natural Resources	Musa Hamad		024 245 4101 024 245 4126	
Menai Bay Conservation Area, Znz	Omar Salim		0747 423 556 024 223 9623	
Pombwe Ward, Rufiji	Kassim A Palla	P O Box 28, Utete, Rufiji		
Somanga	Omari B Ngyu	P O Box 160, Kilwa Masoko		
Somanga Fishermen Conferderation	Mustapha Mkunga	P O Box 160, Kilwa Masoko		