The Status of Marine Turtles in the United Republic of Tanzania, East Africa

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March 2005

Sea Sense
Helping coastal communities protect endangered marine life in Tanzania

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Cover photo

Green turtle, Mafia Island: Jason Rubens/WWF

Acronyms

BRD	Bycatch Reduction Device
CBC	Community-based Conservation
CBD	Convention on Biological Diversity
CCA	Conservation Corporation Africa
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CMS	Convention on the Conservation of Migratory Species of Wild Animals
IUCN	World Conservation Union
KESCOM	Kenya Sea Turtle Conservation Committee
MBREMP	Mnazi Bay-Ruvuma Estuary Marine Park
MICA	Misali Island Conservation Association
MICODEP	Misali Island Conservation and Development Project
MIMCA	Mnemba Island Marine Conservation Area
MIMP	Mafia Island Marine Park
NEPAD	New Partnership for Africa's Development
TCMP	Tanzania Coastal Management Partnership
TED	Turtle Excluder Device
TTDCP	Tanzania Turtle & Dugong Conservation Programme
URT	United Republic of Tanzania

Acknowledgements

This report was commissioned by the National Tanzania Turtle Committee with funding from the WWF Eastern Africa Marine Ecoregion Programme.

The author gratefully acknowledges the invaluable information and data provided by the following individuals and institutions:

In mainland Tanzania: the Tanzania Turtle & Dugong Conservation Programme for providing unpublished data for inclusion in this report and to Omari Abdallah and the Community Turtle Monitors; Mnazi Bay – Ruvuma Estuary Marine Park and in particular to Mr Mchumi, Dr Anthony King and Mr Jairos Mahenge;; Tanzania Coastal Management Partnership; Mafia Island Marine Park; Ministry for Natural Resources and Tourism (Fisheries Division and Marine Parks & Reserves Unit); and local coastal communities.

In Zanzibar: Institute of Marine Sciences; Zanzibar Turtle Conservation Committee; Misali Island Conservation and Development Project, Conservation Corporation Africa; and Frontier-Tanzania.

Jason Rubens kindly reviewed and edited the report. Additional input was kindly provided by the Kenya Sea Turtle Conservation Committee (KESCOM); and Jeanne Mortimer from the Seychelles.

Executive Summary

Five species of marine turtles occur in Tanzania's waters. These include green, hawksbill, loggerhead, olive ridley and leatherback. Two species – green and hawksbill – nest. All are categorised by IUCN as endangered or critically endangered and are listed on Appendix I of CITES. Populations are declining as a result of habitat destruction and alteration, overexploitation for meat and eggs, and incidental capture in gillnets and trawlers.

Although conservation and management efforts are underway in some areas of Tanzania including the Zanzibar islands of Pemba and Unguja, and Mafia, Bagamoyo, Temeke, Mkuranga and Mtwara districts on the mainland, the conservation status of turtles in Tanzania remains largely unknown. Information concerning population dynamics is incomplete, while knowledge of nesting populations and feeding habitats is patchy and of developmental habitats almost non-existent.

The green turtle is the most common and widespread species in Tanzania. While low density nesting has been reported along the mainland coast from Tanga in the north to Mtwara in the south, the most concentrated numbers of nests appear to be on the offshore islands of Zanzibar, Mafia and possibly the Songo Songo archipelago. The main nesting season is between February and July. Evidence from tag returns indicate that while some green turtles are probably resident, others are highly migratory moving to and from nesting and feeding grounds in Kenya, Seychelles, Comoros, Mayotte, Europa Island and South Africa.

Hawksbills are also widely distributed but are less abundant. Nesting has only been recorded in low numbers on small remote offshore islands such as Misali and Mnemba Islands in Zanzibar, the small islands off Dar es Salaam, Shungi-mbili Island in northwest Mafia and the Songo Songo archipelago. The most important nesting sites in Tanzania are Misali Island, off Pemba, and Mafia Island. The main nesting season is during the northeast monsoon between December and April. Although no animals bearing tags from other countries in the region have been recorded, the hawksbill is a migratory species so it is probable that Tanzania harbours both residents and migrants.

Little is known about the status of olive ridley turtles although they are no longer reported to nest. They were observed nesting on Maziwe Island south of Tanga in the mid 1970s but the island has subsequently submerged and no further nesting records for this species have been made. Local fishers report that they are occasionally accidentally catch in gillnets along the Tanzania coast and net captures have been confirmed in Mtwara, near the border with Mozambique.

Loggerhead turtles are relatively rare in Tanzania and there is no indication that they nest. However, evidence from tag returns signify that southern Tanzania and the Mafia area are important foraging grounds for loggerheads nesting in Tongaland and Natal in South Africa.

Very little information is available on leatherback turtles because they are so rarely sighted and because indigenous knowledge is limited. Two leatherback turtles were caught in offshore waters on Pemba Island in 1997 and three were washed up on Mafia beaches in 2002 and 2003. This suggests that they may feed in the area or are en route to nesting sites in Natal.

The main threats to turtles in Tanzania are disturbance of nesting and foraging habitats, incidental net captures (gillnets and trawlers), poaching of meat and eggs, lack of adequate protection and enforcement, limited awareness and land-based development and pollution.

Recommendations for research and monitoring include: further studies on turtle reproduction, nest biology, foraging habitats, genetics and threats; and tagging to determine movements and breeding frequency. Conservation and management priorities include: protection of key habitats, compulsory use of Turtle Excluder Devices by commercial prawn trawlers and restriction of gillnets in key foraging areas; promotion of community participation in the management of coastal and marine resources through recruitment of Community Turtle Monitors and involvement in Beach Management Units; awareness raising; development of a Turtle Recovery & Action Plan; coordination of activities at national and regional levels by the National Turtle Conservation Committee; and fund raising.

1. Introduction

There are seven species of marine turtle worldwide, five of which occur in the Western Indian Ocean (WIO). These species include the green, hawksbill, loggerhead, olive ridley and leatherback turtles. Marine turtles are long-lived and slow to mature and are susceptible to human exploitation at all stages of their life cycle. Globally, most turtle populations are depleted and some are already extinct as a result of centuries of human exploitation for food, oil, leather and ornaments, as well as mortality associated with incidental capture in the fishing industry, marine and land-based pollution and disruption of feeding and nesting sites. All five species feature on the IUCN Red List of Threatened Animals and are listed on Appendix I of CITES. In the WIO, various studies indicate that turtle populations have continued to decline with a high human pressure index accounting for approximately 85% of turtle mortalities and illegal take-offs in the form of poaching of turtle meat, eggs and oil.

Tanzania's 900km mainland coastline, together with Zanzibar and numerous smaller offshore islands, provides important feeding and breeding habitats for the five turtle species, and nesting grounds for green and hawksbills. The status of turtles in Tanzania was first assessed in the mid 1970s when populations of all species were reported to be declining. Since the early 1990s, several conservation and management initiatives have been implemented in some areas. However, these only cover approximately a third of the coast and information concerning turtle habitats, population dynamics and levels of threat is incomplete.

This report arose from Tanzania's commitment as a signatory of the *Memorandum of Understanding on the Conservation and Management of Marine Turtles of the Indian Ocean and South-East Asia (MOU IOSEA)* under the auspices of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) which recognizes the need for regional cooperation in turtle management and conservation.

The aims of the report are to review the historical and current conservation status of, and threats to, marine turtles in Tanzania, identify gaps in existing baseline information and make recommendations for research, conservation and management.

2. Background & Context

2.1 Global & regional turtle distribution & conservation status

Worldwide, there are 7 extant species of marine turtle, representing two families. The family Dermochelyidae includes the leatherback (*Dermochelys coriacea*) while the other six species are placed in the family Cheloniidae: green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*), olive ridley (*Lepidochelys olivacea*), Kemp's ridley (*Lepidochelys kempi*) and flatback (*Natator depressus*).

Marine turtles occur in tropical and sub-tropical seas throughout the world. Two species have a relatively restricted range: the Kemp's ridley occurs in the Gulf of Mexico and eastern seaboard of the United States, and the flatback is endemic to the Australian continental shelf (Meylan & Meylan, 1999). The other five species, all of which occur in the Western Indian Ocean (WIO), are cosmopolitan in distribution. Primary foraging grounds are generally in warm waters on relatively shallow continental shelf areas and nesting tends to follow a tropical pattern predominantly on small islands and mainland beaches (Miller, 1997).

For centuries, marine turtles have served as an important natural resource for humans, both nutritionally and economically. Turtles and their products have been over-exploited for subsistence use and for national and international trade supplying protein (eggs, meat, calipash), leather, oil and ornamental objects to coastal communities and to markets in Europe, America and Asia. Green turtles have been targeted for meat, eggs, oil and medicine and hawksbills to supply a world market with highly valued tortoiseshell (Frazier, 1980). Misuse of marine turtles has resulted in severe declines of most populations around the world.

The threat to turtles from direct consumption has been exacerbated more recently from incidental captures in commercial, and to a lesser extent, artisanal marine fisheries, notably drift-netting, prawn trawling and long-lining, as well as the effects of nesting beach alteration or destruction, marine and land-based pollution, erosion, destructive fishing practices and sea level rise associated with global warming.

These combined factors have led to a dramatic decline in global turtle populations with certain species, notably leatherback and hawksbill, witnessing population declines of almost 80% in recent decades (Pritchard, 1982; Spotila *et al.,* 1996; IUCN, 2004). All of the species occurring in the region feature on the IUCN Red List of Threatened Species: hawksbill and leatherback are categorised as "critically endangered", and the green, loggerhead and olive ridley are "endangered" (IUCN, 2004). All are listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) which prohibits commercial trade.

Table 1. Status of marine turtles in the WIO region

Common	Scientific	Kiswahili	IUCN Category
Hawksbill	*Eretmochelys imbricata*	Ng'amba	Critically endangered
Leatherback	*Dermochelys coriacea*	Noa	Critically endangered
Green	*Chelonia mydas*	Kasa kawaida	Endangered
Loggerhead	*Caretta caretta*	Duvi	Endangered
Olive Ridley	*Lepidochelys olivacea*	Kigome	Endangered

Marine turtles are becoming increasingly recognised for their passive use values including intrinsic, ethical, existence and bequest values (Troeng & Drews, 2004). A recent study on the economic aspects of turtle use and conservation revealed that non-consumptive use, such as turtle tourism, generates proportionally more revenue and provides more economic and social benefits than consumptive use (Troeng & Drews, 2004).

Within the WIO region, all five turtle species nest. The green turtle is the most widely distributed and most abundant and nests in Kenya, Tanzania, Mozambique, South Africa, Madagascar, Seychelles, Comoros and Mayotte. The Seychelles and Comoros have the largest green nesting rookeries in the region. With the exception of the Comoros, where the nesting population has increased by 180% to 5,000 since 1974, all other populations of green turtles in the region have declined over recent decades. In the Seychelles for example, there were believed to be between 11,000 – 13,000 turtles nesting annually on Assumption and Aldabra islands at the turn of the twentieth century (Hornell, 1927); the present figure is around 3,500 – 4,500, a decline of 65% (Mortimer, 1988). Tag returns indicate that green turtles are highly migratory in the region.

The hawksbill is also widely distributed. However, heavy exploitation of this species dating back to the first century AD, at which time Zanzibar was one of the world's major clearing houses for tortoiseshell exporting mainly to Japan and Hong Kong, has undoubtedly had a severe impact on regional populations. Today, hawksbill numbers are relatively few, nesting frequency is low and recent studies suggest that populations are still declining despite measures to halt trade in shells and other products (Frazier, 1975; Wamukoya *et al*., 1996; Khatib *et al*., 1996). Hawksbill turtles nest in all countries in the region except for South Africa.

The status of olive ridley turtles in the region is poorly known. They have been recorded nesting in Kiunga and Watamu in Kenya between 2000 and 2003 and in Tanzania they were observed nesting on Maziwe Island south of Tanga in the mid 1970s (Frazier, 1975). The island has subsequently submerged and no further nesting records for this species have been made. They also nest in Mozambique and Madagascar.

Loggerheads are less common and nest in Mozambique, Madagascar and South Africa. In Madagascar, loggerhead turtles may still be represented by substantial nesting populations in the

south-east of the country (Rakotonirina & Cooke, 1994) and the South African population has more than doubled since the 1960s when strong protective measures were introduced (Hughes, 1989).

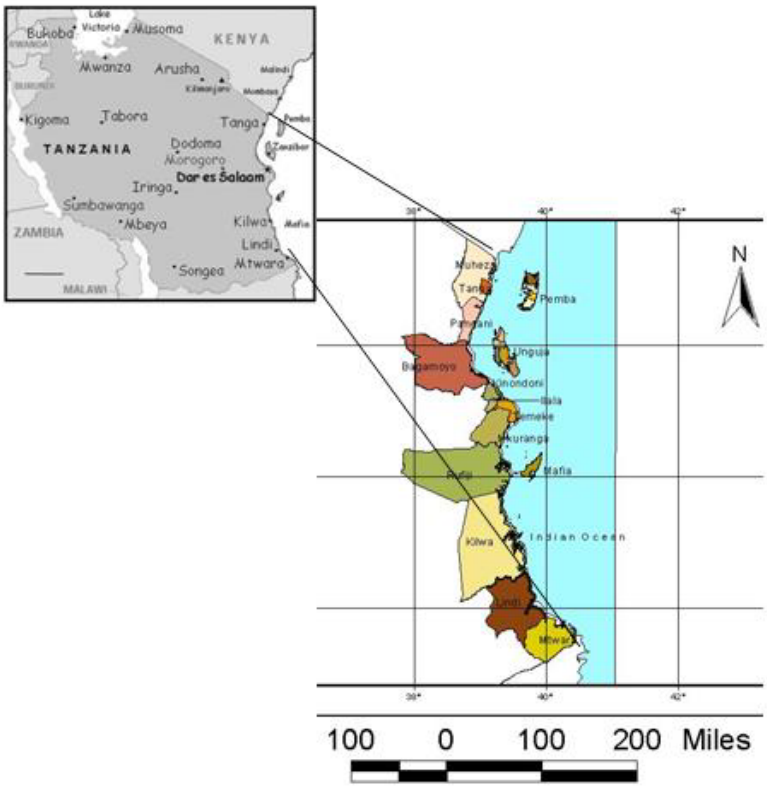
The leatherback is the rarest turtle in the region. The only areas of concentrated nesting are in Mozambique and South Africa. In South Africa, thirty years of protection have been paralleled by an increase in the annual nesting population from 20 to 90 (Hughes, 1989). Leatherback turtles are occasionally caught in gillnets, presumably en route between feeding and breeding grounds, and have been recorded from Zanzibar and Mafia in Tanzania (Slade *et al*., 1997; Muir, 2003).

2.2 The United Republic of Tanzania (URT)

Physical characteristics

Tanzania's extensive coast supports a rich array of natural systems including coral reefs, mangrove forests, estuaries, beaches and seagrass beds, providing important foraging and breeding grounds for marine turtles (Figure 1). All of the species recorded in the WIO region occur in Tanzania waters.

Figure 1. Map of Tanzania



The continental shelf is relatively narrow, extending about 5.8km offshore except at the Zanzibar and Mafia channels where it is about 60km wide. The coastline is dissected by several rivers including the Pangani, Wami, Ruvu, Rufiji and Ruvuma. The tropical climate is subject to two monsoon seasons, the warmer NE monsoon from November to March and the cooler SE monsoon between June and September. The spring tidal range is 2-4m (Richmond, 1997).

There are three main islands: Unguja and Pemba which comprise the island state of Zanzibar; and Mafia approximately 120km to the south. Numerous smaller islands include: Maziwe; Latham; Shungi-mbili, Nyororo and Mbarakuni off north-west Mafia; and the Songo Songo archipelago in Kilwa. Around two thirds of the coastline is protected by fringing coral reefs, often close to the shore and surrounding numerous small islands. Patch reefs are scattered along the continental shelf. The most important and extensive coral reef habitats occur at Tanga, Pemba, Unguja, Mafia, Kilwa and Mtwara.

Seagrass beds are widely distributed along the shallow continental shelf in intertidal and sub-tidal areas, coastal lagoons and mangrove creeks off the coast of Tanga (Moa), Bagamoyo, Rufiji, Kilwa and Mtwara and the west side of Pemba, Unguja and Mafia Islands (Richmond, 1997; Muhando et al., 1999; UNEP, 2001; Ochieng & Erftemeijer, 2002).

Mangrove stands occupy 108,000ha of the coast, with the Rufiji Delta supporting the largest contiguous block of mangrove forest on the Eastern Africa seaboard, over 1,000 km² supporting a diverse variety of flora and fauna and one of the richest prawn fishing grounds in the region (Wang *et al*., 2002).

Coastal population & economy

Tanzania has a population of 35.5 million people. 5 coastal regions encompass 15% of the Tanzania's land area and approximately 25% (8 million) of the population. With an annual growth rate of between 2-6%, it is estimated that the coastal population will double by 2010 (World Bank, 1996). 75% of Tanzania's industries are in urban coastal areas. Most rural coastal communities are very poor and average per capita income is US$ 150 per year. They depend on artisanal fishing, small holder farming, subsistence forestry, lime and salt production and seaweed farming for their livelihoods (URT, 2003).

The main economy is fisheries-based with near-shore artisanal fishing accounting for 96% of Tanzania's marine fish landings. The prawn fishery represents the only industrial-scale marine fishery in the country and has been operating since the mid 1980s (TCMP, 2003). This fishery is based mostly in the inshore shallow areas around the Bagamoyo / Saadani and the Rufiji Delta. Pressure on the inshore fishery has increased in recent years with escalating demand from a rapidly growing human population and tourism activities and the use of small mesh seine nets and destructive fishing practices such as dynamite fishing, which was widespread along the coast prior to the mid 1990s.

Wildlife resources in Tanzania rank among the finest in the world and both terrestrial and coastal tourism has expanded significantly over the past decade. Since 2001, tourist numbers have grown from 153,000 to over 500,000 and foreign currency earnings from US$65 million to US$725 million (TCMP, 2003). Most of the coastal tourist resorts are located on Unguja Island, Zanzibar where infrastructure is now well developed. While tourism provides many benefits to local livelihoods through employment, unplanned development can have negative impacts to the environment and local cultures such as demands on the fishery, fuel and water sources, and the impact of uncontrolled or illegal beach development on nesting turtles (TCMP, 2003).

Marine protected areas and conservation efforts

Tanzania and Zanzibar have 10 marine protected areas (MPAs) together with the Tanga Collaborative Fishery Management Areas which although not officially gazetted are actively managed. These include: Mafia Island Marine Park (MIMP), Mnazi Bay-Ruvuma Estuary Marine Park (MBREMP), Maziwe Island Marine Reserve, Dar es Salaam Marine Reserves, Menai Bay Conservation Area, Chumbe Reef Sanctuary, Misali Island Conservation Area, Mnemba Island Conservation Area, Kiwengwa Controlled Area and Jozani -Chwaka Bay National Park.

Tanzania has been at the forefront within the Western Indian Ocean region in the field of integrated coastal management (ICM). The National Integrated Coastal Management Strategy, adopted by the government of URT in 2002, provides a framework under the National Environment Policy which focuses on use of coastal and marine resources for sustainable food security, economic growth and poverty alleviation. The strategy aims toward improving decision-making, promoting and strengthening sectoral management, promoting local coastal management programmes and meeting regional and international commitments such as the Nairobi Convention and Convention on Biological Diversity (TCMP, 2003). One of the seven specific strategies is "conserving and restoring critical habitats and areas of high biodiversity" which include seagrasses, beaches and coral reefs, as well as marine mammals and turtles. Implementation of the strategy is being supported by external partners such as the Tanga Coastal Zone Conservation & Development Programme (TCZCDP), Marine Parks & Reserves Unit (MPRU), Kinondoni Integrated Coastal Area Management Programme (KICAMP) and others.

2.3 International conventions and national legislation pertaining to marine turtles

Tanzania has ratified several international treaties which pertain to marine turtle protection. At a national level, marine turtles are protected through fisheries legislation. Details of these treaties and national legislation are described below:

African Convention on the Conservation of Nature and Natural Resource (1968)

This Convention addresses cooperative efforts in Africa to conserve marine turtles and was signed by Tanzania in 1974.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), 1973

This convention was designed to prevent the extinction of species and to control international trade in listed species, their products and derivative parts, which include all species of marine turtle. Tanzania ratified this convention in 1980.

Convention on Biological Diversity (CBD, 1992 – 2002)

The emphasis under the CBD is placed on the conservation of ecosystems as part of a global approach to conservation rather than protection of species per se. However, it covers over-exploitation of target species and the effect on non-target species and the ecosystem as a whole, as well as the problem of incidental take.

Convention on the Conservation of Migratory Species of Wild Animals (1979)

In June 2001, Tanzania signed up to the *Conservation & Management Plan* (CMP), as an Annex to the *Memorandum of Understanding on the Conservation and Management of Marine Turtles of the Indian Ocean and South-East Asia,* developed under the auspices of the *Convention on the Conservation of Migratory Species of Wild Animals* (CMS). As such, Tanzania is committed to implementing the activities outlined in the CMP which aims to conserve stocks, control trade and preserve the natural habitat of marine turtles.

Nairobi Convention (1985)

The need for effective regional turtle protection and management has been recognised by the parties to *Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern Africa Region* or the Nairobi Convention of which Tanzania is a signatory. At the last meeting held in July 2004, contracting parties agreed *to conserve marine turtles in the region, in partnership with relevant conservation organisations.*

Sodwana Declaration (1995)

In 1995, a *Western Indian Ocean Training Workshop and Strategic Planning Session* was held in Sodwana Bay, South Africa as the first regional meeting on marine turtles to be convened under the auspices of the IUCN's Global Strategy for the Conservation of Marine Turtles. Key issues at national and regional levels have been outlined in the resultant *Marine Turtle Strategy and Action Plan for the Western Indian Ocean* (IUCN, 1996).

Protocol on Protected Areas and Wild Flora and Fauna in the Eastern Africa Region

This classifies all 5 species of marine turtles found in the region as protected migratory species and requires range states to coordinate their protection efforts.

National Legislation

In Tanzania, all species listed on Appendix I of CITES are officially protected. On the mainland, turtles fall under the responsibility of the Fisheries Division (Ministry of Natural Resources & Tourism). In the draft Fisheries Regulations, 2005, made under section 57 of the Fisheries Act of 2003, section 12 (1) (9) states that *no person shall kill or fish sea turtles or possess a sea turtle shell or deal in sea turtle shells or any other species listed as endangered in any International Convention, which the United Republic is a party to.* In the case of a first offence, the fine is TSh 200,000 or a 3 month sentence, and in the case of a second and subsequent offence, the offender is fined TSh 300,000 or a 6 month sentence, or both.

Additional regulations relating directly or indirectly to marine turtles include: section 24 (2) which states that *where a trawler has caught a live endangered species, the species shall be returned to the water immediately*; section 22 (3) in which *every fishing community in collaboration with the village government shall form Beach Management Units for the purpose of conserving fishery resources and the environment*; and section 52 in which *no person shall use for fishing a monofilament net in all fresh and marine water fisheries.*

On Zanzibar, marine turtles are also classified as "fish" and under the Fisheries Act of 1988, the Director has powers to make regulations on how, when and where and what species may be caught. Marine turtles are protected by the 1993 Fisheries Regulation which prohibits fishing of turtles as well as possession of hawksbill or any other species of "fish" which are considered endangered or threatened under international conventions or agreements.

In addition to Fisheries legislation, the Marine Parks & Reserves Act No. 29 of 1994 provides for the establishment of marine protected areas and the protection and conservation of coastal and marine life including turtles.

2.4 Turtle conservation initiatives in URT

The first studies on the status, distribution, uses of, and threats to, turtles in Tanzania were conducted by Frazier in the 1970s (Frazier, 1975; 1976; 1980). However, it was not until the early 1990s that more widespread efforts to conserve turtles were made (Table 2) and only more recently in some areas – Mafia, Pemba, Unguja, Saadani, Temeke and Mtwara - that more comprehensive, longer-term surveys have been conducted.

While these programmes have played a significant role in turtle protection in recent years through community involvement (employment of local "turtle monitors" and nest protection incentive schemes), research (including tagging), monitoring and awareness raising, there are large spatial and temporal gaps in information. For example, potentially important nesting and feeding sites in Tanga, Muheza, Pangani, Rufiji, Kilwa and Lindi districts remain un-surveyed and some initiatives have been sporadic over time because of funding and resource limitations.

Since nesting intensity can vary enormously from beach to beach and because females do not nest annually, studies on turtle reproduction and nest biology ideally need to be a decade or more long to provide a dependable source of information on population numbers and trends. As Table 2 and Figure 2 show, the spatial and temporal extent of turtle data collection and conservation efforts is currently insufficient to determine population numbers and distribution. Furthermore most, if not all turtle conservation programmes have focused on reproduction and nest biology, and little is known about foraging and developmental habitats, population dynamics, and threat levels particularly from fisheries bycatch.

Table 2. Location & duration of turtle conservation initiatives in URT

	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Zanzibar												
Pemba Is.												
Unguja Is.												
Mnemba Is.												
Misali Is.												
Mainland												
Bagamoyo (Madete)												
Mafia												
Mkuranga												
Mtwara												
Temeke												

Locations of turtle conservation programmes in Tanzania are shown in Figure 2. Currently turtle conservation activities are on-going in 5 mainland coastal districts (Bagamoyo, Temeke, Mkuranga, Mafia and Mtwara), as well as Misali Island and Mnemba Island in Zanzibar.

Figure 2. Map showing location of turtle conservation initiatives in Tanzania

Details of past and on-going programmes on Zanzibar and mainland Tanzania are summarised below.

Zanzibar (Unguja & Pemba Islands)

Prior to 1992, little was known about the status of marine turtles in Zanzibar. The first turtle assessment was conducted in 1992 on ***Pemba Island*** and valuable anecdotal information was collected from interviews with local fishermen on their status, distribution, uses and threats (Clark, 1992; Clark & Khatib, 1993). Following the initial assessment, nest recording programmes were initiated, using village-based observers, between 1995 – 1997 on Pemba and 1997 – 1998 on ***Unguja***, to determine the presence or absence of nesting turtles, verify the important nesting beaches and promote conservation education (Slade *et al*., 1997; Khatib, 1998). These surveys were conducted jointly by the Department of the Environment and local communities.

A private turtle conservation initiative has been on-going since 1996 on ***Mnemba Island***, located off the northeast coast of Unguja. The island has a circumference of approximately 1.5km and houses Mnemba Island Lodge, a high-end luxury resort which is managed by Conservation Corporation Africa (CCA). Activities include turtle nest protection, tagging, eco-tourism and education / awareness.

At ***Misali Island*** (approximately 0.9 km^2) on Pemba, information on nesting activity has been collected since 1998. The island is actively managed by the Misali Island Marine Conservation Area (MIMCA) Management Committee established under Legal Notice No. 48 of 1998 in the exercise of power conferred to the Minister under Section 7(1) and 32 of Fisheries Act No. 8 of 1988.

Recognising the need to address declining turtle populations in Zanzibar, a study was commissioned by the Department of the Environment in 1999 to develop a long-term strategy for turtle conservation which resulted in a Turtle Recovery Action Plan for Zanzibar (Slade, 2000). One of the major activities proposed in the recovery plan was the creation of an interdepartmental ***Turtle Conservation***

Committee (TTC) to oversee the implementation of the activities recommended. In response to the recommendation, the Zanzibar National Turtle Conservation Committee was formed on 5 January 2002, comprised of 12 members representing local communities and relevant government institutions. On-going activities include environmental awareness and monitoring.

Mainland Tanzania

The first committed turtle conservation project on the mainland coast of Tanzania was initiated in 1993. This, the ***Mkwaja Green Turtle Conservation Project***, was established by the Fox family at Madete, a 5km stretch of beach 13km south of Mkwaja village in Bagamoyo district. Two community turtle officers were employed to monitor turtle nesting and a small hatchery established at Madete Ranger Post. Nesting and hatching data were collected between 1993 and 2001. The project ended in 2002.

During the mid 1990s ***Frontier-Tanzania***, a collaborative venture between the University of Dar es Salaam and the UK-based Society for Environmental Exploration, collected opportunistic data of turtle nests in the Songo Songo archipelago and Simaya Island (southern Rufiji) and recorded incidental net captures in both Songo Songo and Mtwara as part of marine biological and resource use surveys (Darwall, 1996; Darwall & Choiseul, 1996; Guard *et al*., 1998).

In January 2001, a community-based turtle and dugong conservation initiative (the ***Tanzania Turtle & Dugong Conservation Programme – TTDCP***) was established in Mafia district (Mafia Island) to promote the long-term survival of turtles and dugongs, and their related habitats, in collaboration with Mafia District Council, Mafia Island Marine Park and local communities. Direct conservation, monitoring, tagging, public awareness, training and research are undertaken by a team of 8 village-elected "turtle monitors". A nest protection incentive scheme was initiated in 2002. Under this scheme, individuals who report a nest receive an initial reward of USD $3 once the nest is verified. They assist the turtle monitor in protecting the nest from human and non-human predators during the incubation period and are rewarded with a second payment of USD 0.40 for every successful hatchling and USD 0.20 for every rotten egg.

In 2003, TTDCP monitored nesting activity on the mainland coast in Temeke district for 12 months, specifically at Yale Yale Puna village where turtles were reported to be nesting. Also in 2003 (April – June) TTDCP conducted a national questionnaire survey (450 respondents) to determine the status, distribution, uses and threats to turtles in Tanzania. These data are as yet unpublished. In May 2004, the scope of the programme was scaled up to include the entire mainland coast of Tanzania, using Mafia as a successful working model. TTDCP has now initiated community-based turtle conservation and monitoring activities in 5 coastal districts - Pangani, Bagamoyo (including Madete beach), Temeke, Mkuranga and Mafia – and plans to start similar initiatives in the remaining coastal districts in 2005/6.

The ***Marine Parks & Reserves Unit*** (Ministry of Natural Resources & Tourism) has been monitoring turtle nesting activity in the Dar es Salaam Marine Reserves of Bongoyo, Mbudya and Pangavini islands with the help of Honorary Wardens since 2002.

In April 2004, a turtle monitoring and conservation programme was established by the **Mnazi Bay – Ruvuma Estuary Marine Park** (MBREMP) in Mtwara District using experiences from Mafia. Four locally elected villagers assist with patrols, data collection and awareness raising. A single incentive of US$3 is given to individuals who report a nest.

In September 2003, the national ***Tanzania Turtle Committee*** was established to conserve and manage marine turtles as part of Tanzania's commitment as a signatory to the *Memorandum of Understanding on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-east Asia* under the auspices of the Convention on Migratory Species. The committee is represented by the Fisheries Division, Environment Division, Marine Parks & Reserves Unit and University of Dar es Salaam from mainland Tanzania, and the Department of the Environment and Fisheries from Zanzibar. The main scope of the committee is to formulate and implement a National Turtle Recovery and Action Plan.

3. Marine turtle biology

3.1 Evolution and Taxonomy

Marine turtles represent the oldest group of living reptiles and have traversed the world's oceans for millennia. The first known turtles are represented by fossil records from the Late Triassic Epoch, some 230 million years ago (Kemf *et al.,* 2000). Marine turtles evolved into their present day form approximately 110 million years ago, during the Late Jurassic and early Cretaceous periods (Pritchard, 1997).

Today, there are 7 extant species of marine turtle worldwide, representing two families. The family Dermochelyidae includes the leatherback (*Dermochelys coriacea*) while the other six species are placed in the family Cheloniidae: green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), loggerhead (*Caretta caretta*), olive ridley (*Lepidochelys olivacea*), Kemp's ridley (*Lepidochelys kempi*) and flatback (*Natator depressus*).

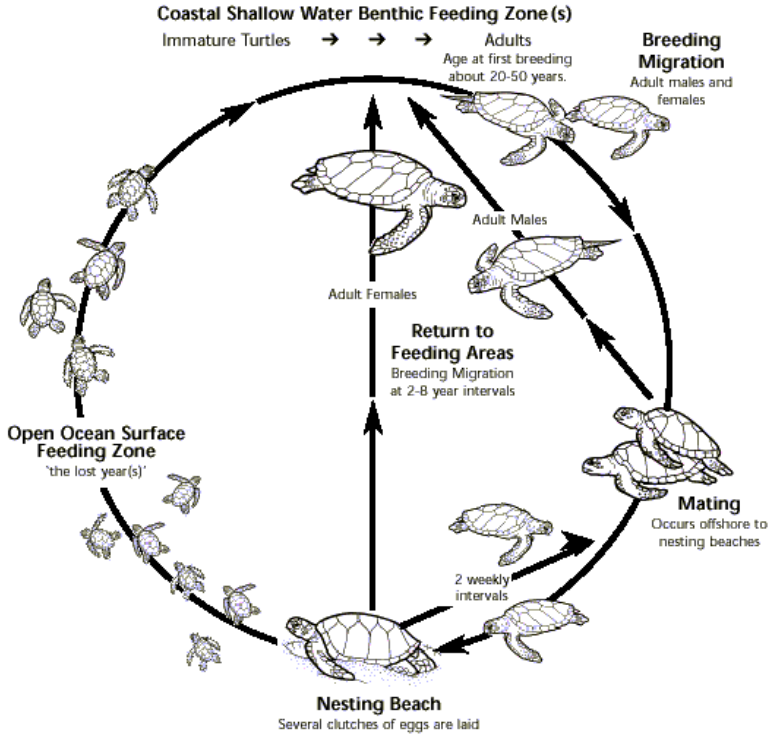
3.2 Life cycle

Marine turtles are long lived and slow to reproduce, with age to maturity ranging from 15 - 50 years or more, depending on the species and geographic area (Balazs, 1982). While each species varies in size and dietary requirements, all share a generalised life history, a model of which has been developed using data collected primarily from green turtles (Carr *et al*., 1978) (Figure 3).

Upon leaving the nesting beach as hatchlings, green, loggerhead and hawksbill turtles begin a pelagic (open water) phase which lasts several years. This has been coined the "lost years" by Carr *et al*. (1978). Here they drift with currents, feeding on weed or drift lines. Little is known about the post hatchling habitats of leatherbacks and ridleys.

As they develop, turtles pass through "developmental habitats" which are generally coastal feeding grounds. Adult turtles spend most of their lives in adult foraging grounds such as seagrass beds or areas seasonably rich in blooms of jelly fish or invertebrates.

Figure 3. Model of turtle life cycle



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During the reproductive season, adult turtles migrate from foraging areas to mate along migratory corridors, at courtship or breeding stations, in the region of the nesting area. Mating is a laborious and often violent affair and may last 10 or more hours. During this time, they are vulnerable to accidental and deliberate capture in fishing nets. No pair bond is formed and both sexes may mate with others several times during the mating season. Males and females mate several times, after which males return to their foraging grounds and females move to nesting sites in the region of their birth (Bowen et al., 1992).

Green turtle hatchling (C Muir)

Females store sperm for repeated fertilisation of eggs without the need for mating and typically lay several clutches of eggs, at approximately 2-week intervals, per reproductive season. Studies show that once a turtle has selected a nesting beach, she will tend to re-nest in relatively close proximity (0-5km) during subsequent nesting attempts (Bjorndal *et al*., 1985; Limpus *et a*l., 1992). Green turtles in particular shows high levels of nest site fidelity and have been observed re-nesting within 200m of the previous attempt and within a range of 600m over the course of the 3-month nesting season (in Miller, 1997). The next 2-5 years are spent in foraging grounds while she prepares for another nesting migration. Ridley turtles often nest in huge numbers, sometimes many thousands, a phenomenon known as an *arribada* (arrival).

In order to successfully nest, turtles need access to beaches with deep, fine, moist sand and a beach platform high enough that the nest is not inundated by spring tides or flooded by the water table below (Mortimer, 1995). Most turtles nest during the cooler hours of night. Using her front flippers, the turtle drags herself up the beach and having found a suitable location to nest, excavates a body pit. Using her hind flippers, she digs a flask-shaped egg chamber, into which are deposited a clutch of soft leathery eggs ranging in quantity from 50 (flatback) to 130 (hawksbill). During egg laying, all species of turtles are relatively tolerant of a modest level of external disturbance. Once oviposition is complete, the nest chamber is filled in, sand is thrown over the nest site and the female returns to the sea. She affords her eggs no further protection. The process of nesting typically takes about 1.5 hours (Hirth, 1980).

The incubation period averages between 55 and 75 days, dependent on the conditions within the nest environment. Under ideal conditions, hatchling success for a clutch of eggs is typically 80%. The hatchling sex is determined by temperature, with cooler temperatures producing males and warmer favouring the development of females (Godfrey & Mrosovsky, 1999). Within the underground egg chamber, which may be up to 100cm deep, the hatchlings cut through the eggshell and begin crawling upwards, usually emerging onto the surface of the beach in the early evening. The emergence may take several days, with batches of 20-50 hatchlings emerging at a time.

Aligning themselves with the main source of light, which under natural conditions is the marine horizon, they immediately crawl seaward across the sand to the surf where they being a period of high activity or “hatchling frenzy” in order to reach pelagic waters where predators are fewer (Lohmann, *et al.,* 1997).

Turtles are vulnerable to predation and exploitation during all stages of their life cycle. Eggs are susceptible to human and non-human predation (e.g. monitor lizards, dogs, mongooses) and hatchlings are predated upon by crabs, birds and large fish such as groupers and barracudas. Both immature and adult turtles face high risk at sea from capture in fishing nets and habitat destruction and females are particularly defenceless on land during nesting. Artificial beach lighting and human

activity on nesting beaches also pose a threat (Witherington, 1999). These factors combined mean that turtle survival rate to maturity is relatively low.

3.3 Movements

All marine turtles exhibit migratory behaviour at different times of their lives, and to varying degrees (Miller, 1997). They are able to orient and navigate across vast expanses of ocean with extreme accuracy (Lohmann *et al.,* 1997).

Data from tag returns and satellite telemetry, show that, as hatchlings, turtles swim from the natal beach to the open-ocean nursery grounds and as they develop, juveniles and sub-adults then move to coastal feedings areas often thousands of kilometres from the beach on which they hatched (Meylan, 1995; Bowen *et al*., 1995).

Similarly, adult females often travel thousands of kilometres from specific feeding areas to their natal beaches to nest. For example, hawksbills tagged while nesting at Tortuguero, Costa Rica, migrate to waters off Panama, Nicaragua, Honduras and Jamaica to reach their feeding grounds (Meylan, 1999). Similarly, giant leatherbacks that nest on the Pacific coast of Mexico and Costa Rica migrate south to feeding grounds off Peru and Chile and on to the Galapagos Islands (Reina *et al*., 2002) and loggerheads tagged in South Africa have been recovered 2,500 km to the north on Zanzibar and off the coast of Mozambique and Madagascar (Hughes, 1995). The extent to which turtles move highlights the importance and need for regional collaboration as a conservation strategy.

3.4 Ecology & Description

Turtles are a keystone species in coastal and oceanic marine ecosystems, contributing to healthy seagrass beds and coral reefs and transporting biological nutrients from marine to terrestrial ecosystems with benefits to numerous fauna and flora (Bouchard & Bjorndal, 2000).

They are morphologically highly adapted to life in the sea and have evolved strong paddle-shaped forelimbs and enlarged shoulders for swimming, tear glands to remove excess salts and streamlined shells to improve hydrodynamic efficiency (Meylan & Meylan, 1999).

Family Cheloniidae

Green (*Chelonia mydas*)

Green turtles are the largest of the cheloniid turtles, measuring up to 1.5m in length and weighing between 90kg and 200kg. They have a smooth, broadly oval carapace, dark brown or greenish in colour, and a blunt round head with one pair of prefrontal scales. Their common name is associated with the green-coloured stomach cartilage which has historically been used to make turtle soup. Hatchlings are white on the underside and dark above. Green turtles typically lay 110 eggs per clutch on average three times during a nesting season and return to nest again after 3 years.

Green turtles are highly migratory, moving long distances between foraging and nesting areas. Young green turtles are omnivorous and shift to a mainly herbivorous diet when they reach a size of 20-25cm carapace length. They feed primarily on seagrasses, preferring *Thalasiia, Halodule, Halophila* and *Syringodium* species. When availability of seagrasses is limited, they feed on marine algae.

Hawksbill (*Eretmochelys imbricata*)

The hawksbill turtle is medium-sized and the average adult weighs about 60kg. Hawksbills have an oval carapace with a strongly serrated posterior edge and thick overlapping (imbricate) scutes with an average length of 90cm. The head is relatively narrow with a straight bird-like beak from which it gets its common name. They nest during both the day and night, laying 60-200 eggs at a time, every 2-3 years.

They inhabit tropical reefs and their main diet consists of sponges and invertebrates, and occasionally seagrasses and algae. Over centuries, the hawksbill has been heavily exploited for the amber, yellow and brown scutes used to make “tortoiseshell” jewelry and ornaments. The main market for tortoiseshell has been eastern Asia and Japan and the sustained demand in these products has been the main reason for its decline.

Loggerhead (*Caretta caretta*)

Loggerheads weigh between 150-180kg with an average adult carapace length of over 100cm. The head is large and broadly triangular in shape and the front flippers are relatively short. The thick neck and strong jaws of the loggerhead distinguish it from other species and are used to crush the hard shells of crabs and molluscs, which form its main diet. This species lays an average of 110 eggs per clutch, 3-4 times per season.

Loggerheads are widely distributed in coastal tropical and subtropical waters and migrate large distances following major warm currents. Mating occurs some distance from the shore in open water. The main nesting grounds are the coasts of Florida and South Carolina, Greece, Turkey, Israel, Tunisia and Libya and throughout south east Asia to Australia. In the Indian Ocean, loggerheads only nest in northern Natal and Oman.

Olive Ridley (*Lepidochelys olivacea*)

Olive ridley turtles are the smallest of the Cheloniids weighing 35-50kg. The heart-shaped shell reaches a maximum length of 75cm. They are distributed in tropical waters of the Pacific, Indian and South Atlantic Oceans. The main nesting beaches of the olive ridley are along the eastern Pacific coastal of Central America from Mexico to Costa Rica, northeastern India and Suriname. This species nests in huge concentrations or *arribada*, on a few days each year at a very restricted number of locations. Nesting occurs at night and clutches of 80-100 eggs are laid 2-3 times per season. Olive ridleys feed on crabs, fish, jellyfish, clams, snails and algae.

Family Dermochelyidae

Leatherback (*Dermochelys coriacea*)

The leatherback is the largest living turtle. The carapace is distinguished by a rubber-like texture with seven prominent longitudinal ridges or keels which run from the head to the tail. The skin is made primarily of tough, oil-saturate connective tissue and coloration is predominantly black with variable degrees of white or paler spotting (Pritchard & Mortimer, 1999). The average carapace length is 155 cm and weight ranges from 200-700kg. The average number of eggs per clutch is 80 and females lay 4-5 times per season. They typically return to nest every 2 years (Miller, 1997).

The leatherback is a highly pelagic species, is capable of diving to great depths of up to several hundred meters, and regularly migrates 500 – 2,000km and occasionally 6,000km, at an average speed of 40km a day, in search of food (Meylan, 1995; Eckert, 1999). Leatherbacks have an unusually wide latitudinal distribution range and adults are able to withstand cold water. They have been recorded north to Alaska and south to the Cape of Good Hope. The most important nesting areas are on the western coasts of Mexico, French Guyana, Malaysia and Indonesia. They also nest in northern Natal in South Africa.

The main dietary preference of the leatherback is jellyfish, together with associated crustaceans and fish (Mortimer, 1995).

4. Review of marine turtle status and distribution in URT

Information on the status and distribution of marine turtles in Tanzania was gathered through: a review of available literature on turtle status and distribution as well as consultation with researchers and conservation practitioners; and a questionnaire survey conducted between April and June 2003 by the Tanzania Turtle & Dugong Conservation Programme (*unpublished*). During the survey, 420 interviews were conducted in 57 villages in coastal Tanzania, including Zanzibar and Mafia to determine the status, distribution, uses of, and threats to turtles in Tanzania.

Most species of marine turtle breed every two or more years and females typically lay more than one clutch of eggs within a nesting season. Nest counts are used as an index of abundance and to detect population trends (Gerrodette & Taylor, 1999), but variations in nesting from year to year and from one stretch of beach to another, mean that nest data are needed for more than one season to obtain reliable population estimates (Meylan, 1995). It is important to note that nest data has only been

gathered from a few sites, representing approximately 30% of the coastline, and not consistently over time. As such, the figures given below are only estimates.

4.1 Nesting species

Two species of turtles nest in Tanzania: green and hawksbill. The information below provides a summary of the current information available on nesting records and distribution for each of these species, followed by information on overall nesting activity by species and location (district).

4.1.1 Green

4.1.1.1 Nesting populations and key nesting sites

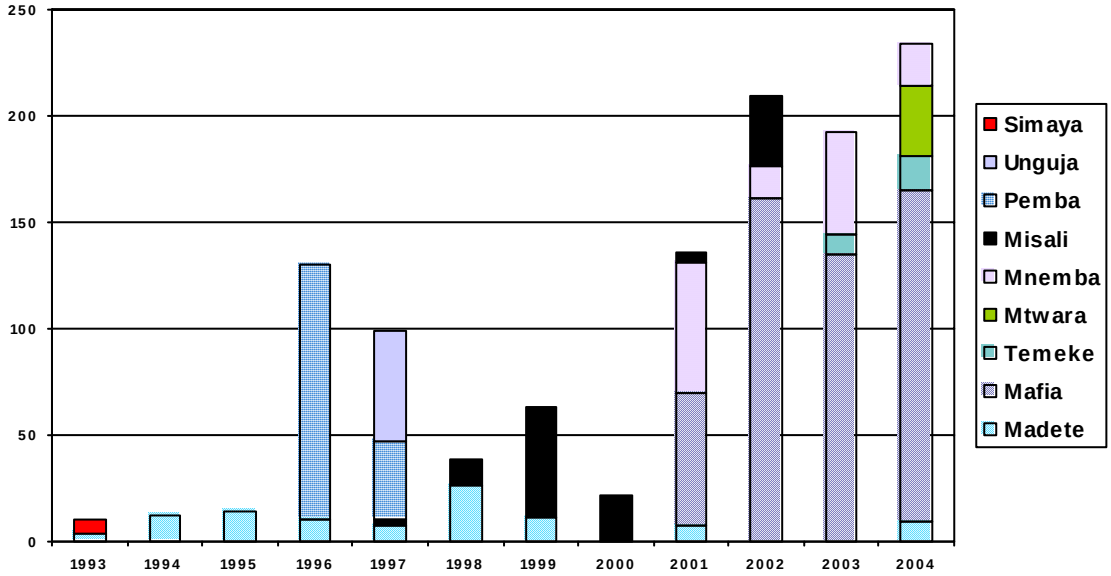
The green turtle is the most common nesting species in Tanzania. Population size estimates from the mid 1970s put the total number of nesting green turtles in the whole of Tanzania at approximately 300 (Frazier, 1976). The majority of these were thought to nest on a single island, Maziwe, 100km south of Tanga, which was considered the most important breeding ground for turtles in Tanzania and East Africa as a whole and the remainder on the small islands near Mafia (Frazier, 1976). In the 1980s, Maziwe Island submerged as a result of erosion and now exists as a shifting tidal sand bank on top of Maziwe reef (Howell & Mbindo, 1996). It is no longer a suitable nesting site (Howell, 1993) although local informants report that green turtles continue to nest on the sand bar but the nests are inundated during both spring and neap tides (pers. comms).

Quantitative nest data indicates that concentrated nesting activity occurs on Misali Island (Pemba), Mnemba Island (Unguja), Mafia Island (Juani Island and Kungwi), Madete and Mtwara (Msimbati and Litokoto and Kingumi Islands). Anecdotal reports also highlight a number of other important nesting sites on Zanzibar and along the mainland coast (Figure 4).

Figure 4. Main green and hawksbill turtle nesting sites in Tanzania

Figure 5 below shows green turtle nest records from specific sites in Tanzania made by past and on-going nest-recording programmes since 1993. The apparent inconsistency in nest records from year to year is a function of stop-start monitoring efforts by specific initiatives, rather than a reflection of the actual annual nesting numbers. The highest number of nests recorded in any one year was 225 in 2004 from 5 different sites: Mafia, Mnemba, Mtwara, Temeke and Madete.

Figure 5. Green turtle nests recorded in Tanzania: 1993 – 2004



In view of the fact that several reportedly important nesting sites along the Tanzanian coast have not yet been surveyed, it is impossible to determine whether nesting populations of green turtles have declined since Frazier's estimate of 300, 30 years ago. Table 3 provides annual nesting estimates from sites where nests have been recorded over recent years.

Table 3. Estimates of annual nesting populations at specific sites in Tanzania

Location	Est annual nesting population
Pemba	35-50
Unguja	12-15
Mafia	50
Madete	5
Mtwara	10-20
Temeke	5

On **Pemba Island**, 157 nests were recorded between November 1995 and March 1997 by local village contacts from 9 villages situated around the island (Slade *et al.,* 1997). Of these, 120 nests were counted over the 12 month period from December 1995 to November 1996. Based on this survey, Slade *et al.,* (1997) estimated that the average number of nests laid per year is in the region of 100 – 150, giving an annual nesting population on Pemba of approximately 35 – 50.

Specifically on **Misali Island** off west Pemba, 123 green turtle nests were recorded between 1998 and 2002. The mean number of nests per year was 25, although this varied greatly from year to year, ranging from 8 to 66 (Pharoah *et al.,* 2003). The nests were recorded from 5 beaches on the island, the two most important of which are Mpapaini (95 nests) and Tiwani (35 nests). The mean incubation was 77.8 days.

On **Unguja Island**, 52 nests were recorded during a survey undertaken between March 1997 and 1998 (Khatib, 1998). More recent records for the whole island are not available. However, on **Mnemba Island** in the north east, 194 nests have been recorded since 1996. Annual nest data since 2001 indicates that on average 36 nests are laid a year. Based on these figures is it estimated that 12-15 turtles nest on Unguja a year.

At **Madete** on the mainland, 93 nests were recorded between 1993 and 2001 with an average of 10 nests per year. It is estimated that the annual nesting population at this site is approximately 5.

On **Mafia Island**, 62 green turtle nests were recorded during the first year of monitoring in 2001. This figure is considered to be an underestimate as not all nesting beaches were monitored initially. More reliable data were collected between January 2002 and December 2004. During this period 452 nests were recorded with an average of 153 nests a year, indicating an annual nesting population of about 50. Since monitoring began on Mafia, 30,819 young turtles have hatched successfully. The average incubation period is 56.7 days.

Monitoring of turtle nesting activity in **MBREMP** (Mtwara) started in April 2004. 33 nests were recorded between April and December 2004 with the successful hatching of 2,031 young green turtles representing a success rate of 63.5%. The average incubation period of nests in MBREMP is 54.2 days (Mahenge, 2004).

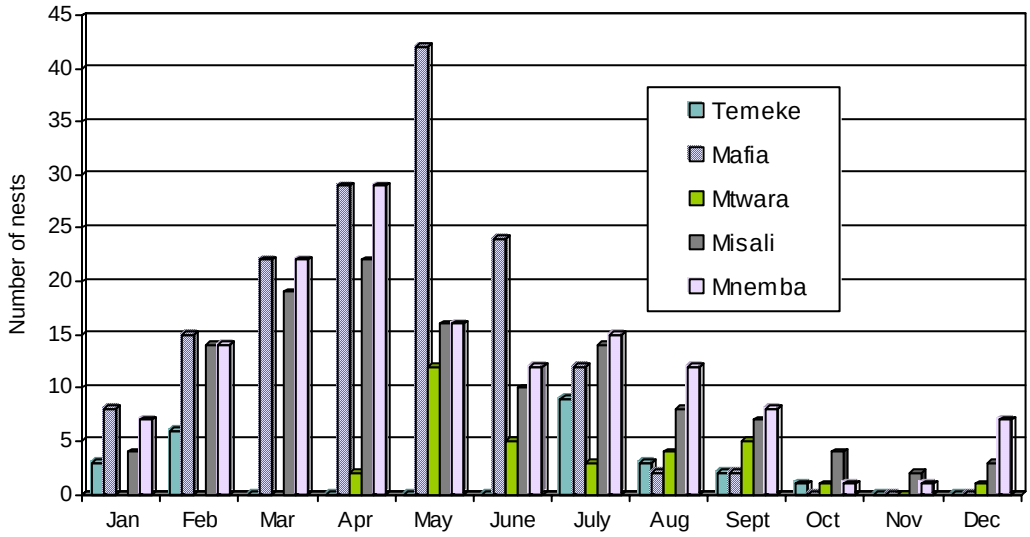
Along the coast south of Dar es Salaam in **Temeke** district, 9 nests were recorded at Yale Yale Puna in 2003 and 15 between July and December 2004 at Ras Dege (1 nest); Amani Gomvu (6 nests) and Buyuni (8 nests).

Frontier-Tanzania recorded 6 turtle nests on **Simaya Island** (Rufiji) in July 1993 together with 4 carapaces, 5 plastrons, 3 skulls and numerous bones. In 1996, the carapaces of 6 green turtles were observed on the island (Darwall, 1996). Frontier also reported that Ukuza Island in the **Songo Songo archipelago** provides ideal nesting conditions for turtles with steep sloping beaches and signs of nesting were reported in August 1995 (Darwall & Choiseul, 1996). However, no systematic monitoring has been conducted in the archipelago.

4.1.1.2 Nesting seasonality

The main nesting season by green turtles in Tanzania is predominately during the southeast monsoon (*kusi*) between February and July. Few turtles nest between September and December. Figure 6 shows the seasonal distribution of green turtle nesting activity at 5 locations in Tanzania.

Figure 6. Seasonal distribution of green turtle nesting activity in Tanzania



Site specific nesting data on Mafia indicates that more nests are laid on the east coast during the southeast monsoon, whereas nesting on the west side of the island occurs during the northeast monsoon months between December and March (Muir, 2004).

No data on seasonality is available for Madete but local residents in the area report that nesting occurs predominately during the months of June and July (southeast monsoon).

4.1.1.3 Tagging and tag returns

The highly relevant regional dimension to turtle movement is fundamental to conservation strategies, especially in the context of the Convention on Migratory Species, and flipper tags are used to

determine turtle movements as well as inter-nesting frequency (no. of times a female nests per season) and re-migration intervals.

21 green turtles have been tagged on Mnemba (Butchart & Roche, 2003). Of 11 turtles tagged during 2001/2002, 5 (45%) returned to nest four times on average every 17 days. The remainder were observed returning to nest on one occasion, after an average stay of 16 days (O'Grady & Muhindini, 2002).

On Mafia 12 green turtles have been tagged. Only 2 of these have been observed returning to nest.

On mainland Tanzania, 25 titanium flipper tags were recovered by the *Tanzania Turtle & Dugong Conservation Programme* between 2001 and 2004 (C Muir, *pers. comms*.). All of the turtles were caught in gillnets at sites along the coast from Pangani to Mtwara. The tags were from green turtles that had travelled from Kenya (1), Seychelles (11), Comoros (10), Mayotte (1) and South Africa (2).

In Zanzibar, 15 tags were recovered between 2001 and 2002 from nesting females tagged in the Seychelles (7), Comoros (9) and South Africa (5) (TCMP, 2003).

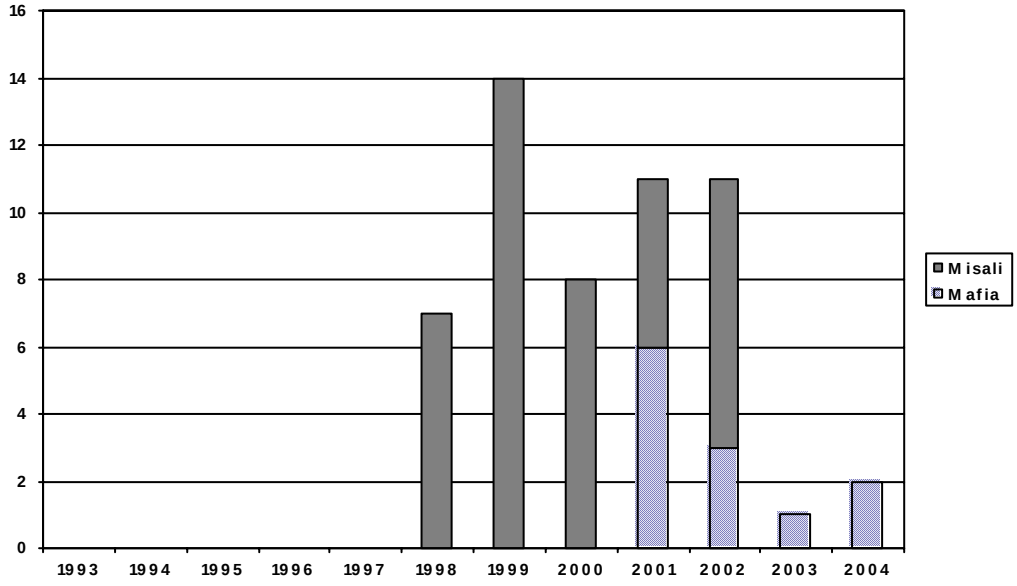
4.1.2 Hawksbill

4.1.2.1 Nesting populations and key nesting sites

There are few records of hawksbill nests in Tanzania. All those that have been recorded have been on offshore islands including Misali, Mnemba, Mbudya, Mafia and Songo Songo. No nests have been recorded on the mainland coast (Figure 7).

On Misali Island, 42 hawksbill nests were recorded between 1998 and 2002, peaking during the month of March, while on Mafia Island, 12 hawksbill nests were recorded between 2001 and 2004, of which 10 were laid on Shungi-mbili Island and 2 on the east coast at Bambaro beach.

Figure 7. Hawksbill turtle nests recorded on Misali and Mafia Islands: 1993 – 2004



Additional anecdotal / opportunistic information on hawksbill nesting activity is as follows:

During the 1995 – 1997 survey on Pemba, two hawksbill nests were reported at Misali Island and Mivumani. On Unguja, hawksbill turtles have been observed nesting on Mnemba Island and Makunduchi (Khatib, 1998).

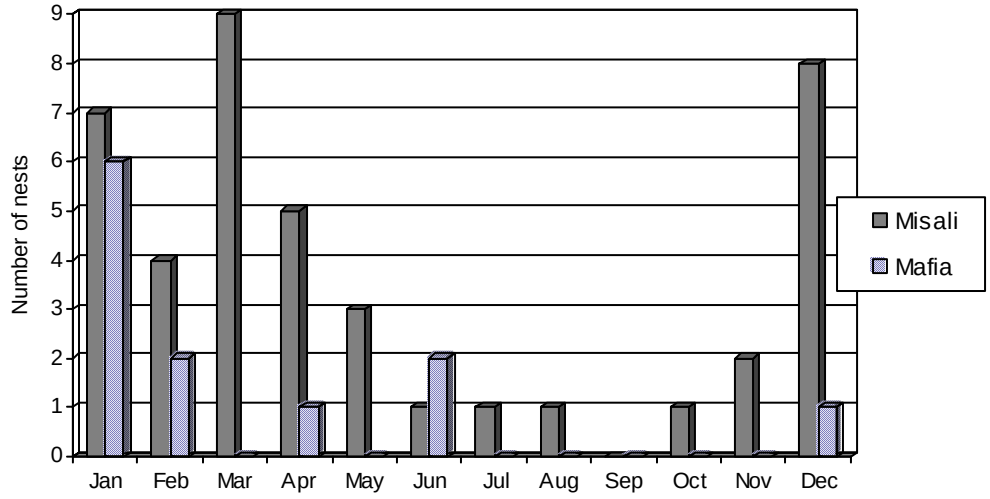
Two hawksbill nests were recorded on Mbudya Island (off Dar es Salaam) in May and June 2002 (MPRU, *pers. comms*.). No nests have been observed since.

In 1995 a fisherman reported finding a nesting hawksbill turtle on Songo Songo Island. He removed the scutes while she was nesting but did not take the eggs (Darwall & Choiseul, 1996).

4.1.2.2 Nesting seasonality

The main nesting season for hawksbills is during the northeast monsoon, from December to March (*kaskazi*), although nesting has been observed at other times of the year. On Misali Island nesting increased between December and April, with a peak in March (Figure 8) while on Mafia, nesting is concentrated in January (Figure 8). However, the two nests recorded on Mbudya Island were laid in May and June during the southeast monsoon.

Figure 8. Seasonal distribution of hawksbill turtle nesting activity on Misali and Mafia Islands

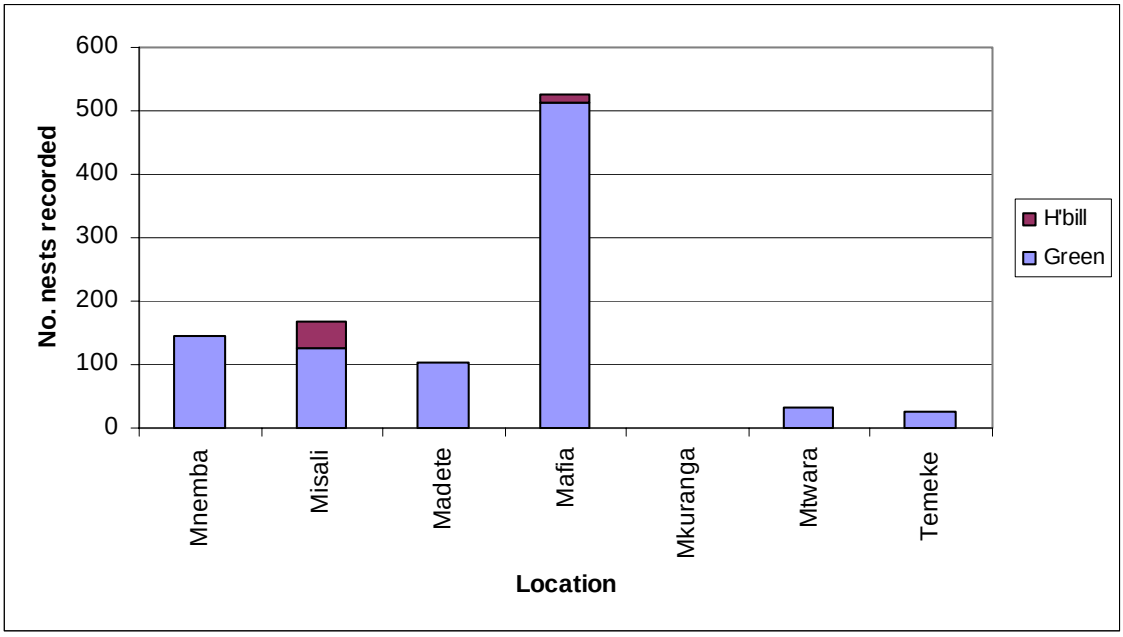


4.1.3 Overall nesting activity

Figure 8 below summarises information on nesting activity by green and hawksbill turtles at each of the sites currently being monitored to put into context the relative importance of nesting at different locations along the coast. It should be noted that the extent of available nesting beach differs at each location, as does the level of monitoring effort.

No nests have yet been recorded in Mkuranga district which includes the offshore island of Mapanya. Historically this was reported to be an important nesting site, but a large fisher camp is believed to be disrupting nesting activity on the island.

Figure 9. Overall nesting activity by species and location at monitoring sites



4.2 Other Species

4.2.1 Olive ridley

Little is known about the status of olive ridley turtles in Tanzania although they are no longer reported to nest. Local fishers note that they are occasionally accidentally caught in gillnets along the Tanzania coast. Reports of olive ridley net captures were confirmed in MBREMP in 2003 when several dead animals were photographed.

Probably the most important nesting area in the region is at Kiunga, north of Lamu, in Kenya where 9 nests were recorded between 2000 and 2003 (Church & Palin, 2003).

Olive Ridley turtles caught in gillnets in Mtwara District (D Obura)

4.2.2 Loggerhead

Loggerhead turtles are relatively rare in Tanzania and there is no indication that they nest. However, evidence from tag returns indicate that southern Tanzania and the Mafia area are important foraging grounds for this species. Three tagged animals were caught in southern Tanzania in 1976. One animal swam a distance of at least 2,640km in 66 days between its release in Natal and its capture at Kilwa Masoko and a second animal accomplished a similar feat (Frazier, 1976). Since 2001, tags have been recovered by TTDCP from 5 loggerhead turtles caught in gillnets: 3 at Jibondo Island off southeast Mafia, and 2 off Songo Songo Island. All were tagged while nesting in Tongaland and Natal in South Africa (Muir, 2003).

4.2.3 Leatherback

Very little information is available on leatherback turtles in Tanzania because they are so rarely sighted and because indigenous knowledge is limited. Although the leatherback was noted as nesting in Zanzibar in the 1970s (Frazier, 1976), there have been no further records of this species nesting in Tanzania. Two leatherback turtles were caught in offshore waters on Pemba Island in 1997 (Slade *et al.*, 1997) and three were washed up on Mafia beaches in 2002 and 2003 (C Muir, *pers. obs*.). This suggests that they may feed in the area or are migrating to nesting sites in Natal.

4.3 Foraging & developmental grounds

Very little is known about the main turtle foraging and developmental grounds in Tanzania. However, Tanzania harbours extensive seagrass beds and coral reefs which can support considerable numbers of turtles (Howell & Mbindo, 1996).

The extensive seaagrass beds off the southern Rufiji Delta (*Kichinja Mbuzi & Toshi*) including Mohoro Bay (*Fungu ya Kasa*) are reported by local residents to be important feeding grounds for green turtles.

On Mafia Island, immature and adult green and hawksbill turtles are seen regularly by recreational divers in Chole Bay and along the east coast of Juani Island where seagrasses and corals occur. Off Ras Kisimani on the west coast of Mafia, green turtles have been observed digging pits in the sand at a depth of 10-15 meters where they appear to rest (C Muir, *pers. obs*.). These areas are within the boundaries of Mafia Island Marine Park.

In Mtwara, records of turtle sightings from dive surveys and questionnaire surveys indicate that important turtle foraging habitats exist in Mnazi Bay and off Msimbati (Guard et al., 1997; Muir, 2003).

In Zanzibar, green and hawksbill turtles are regularly sighted by divers at Nungwi and the coral reefs around Mnemba Island. The main turtle developmental habitat, where small and immature green and hawksbill turtles concentrate, is Uroa in the Central District of Unguja. The area comprises seagrasses, corals and algae and is unprotected (Khatib et al., 1996). The reefs off Zanzibar are also reported to be important feeding grounds for loggerhead and leatherback turtles (Khatib et al., 1996).

4.4 Uses and myths

Turtles and their eggs have been used for domestic consumption and a source of income for centuries by local coastal communities in Tanzania (Frazier & Rodgers, 1974; Frazier 1980). There has also been a long history of exploitation of hawksbill turtles and Zanzibar was one of the world's major clearing houses for tortoiseshell, exporting mainly to Japan and Hong Kong. In 1979, when exports to Japan reached their highest levels, annual exports averaged 3,600kg (Frazier, 1980; Mack & Wells, 1995). However, with the closure of the centre for international trade in hawksbill shell, banning of international trade through CITES; the closure of the Tanzania and Kenya markets; and the ceremonial burning of turtle shells in Zanzibar in 1995, trade in tortoiseshell and other turtle products has all but ceased (Thiagarajan, 1991).

Current information on turtle uses and myths in Tanzania is based on questionnaire surveys conducted in Pemba and Unguja between 1995 and 1998 (Clark & Khatib, 1993; Slade et al., 1997; Khatib, 1998), a national questionnaire survey (450 respondents) conducted between April and June 2003 by the TTDCP (Muir, *unpublished data*) and direct observations.

Many Tanzanians enjoy eating turtle meat and the sale has traditionally provided a valuable source of local income. However, some claim that they do not eat turtle meat because it is prohibited in the *Koran*. However, the status of turtles in Islamic religion appears to be a matter of personal interpretation and the meat and eggs are eaten by many Muslims, not only on Zanzibar, where they comprise 95% of the population, but also in other predominately Islamic locations (e.g Mafia) (Khatib *et al*., 1996).

On Zanzibar, and elsewhere along the mainland Tanzania coast, local communities admit to eating turtle meat although they are aware that killing turtles is illegal. Meat of the green turtle is most favoured, while that of hawksbill and loggerhead is often avoided as it is believed to be poisonous. During the 2003 survey, 60% of respondents from Pemba Island reported that turtle meat was no longer consumed. This was attributed mainly to an incident in March 1996 when two cases of poisoning through consumption of hawksbill turtle meat occurred, resulting in the death of 37 people (Slade *et al*., 1997). Deaths from turtle meat poisoning have also been reported from Kwale Island, Songo Songo Island and Kilwa, but the number of deaths has not been confirmed.

Turtles are typically sold whole for between TSh 10,000 - 40,000 (US$ 10-40) depending on size, or between TSh 500 - 1,000 per kilogram of meat. The local trade in turtle meat in Mtwara district appears to be a particularly important and lucrative business.

Turtle eggs are also an important source of protein and nest raiding is widespread in Tanzania but not seen as contravening the law. In comparison to meat, turtle eggs have significantly less economic value. During the 2003 survey, 84% (378) of respondents reported that turtle eggs are collected for domestic consumption and are only occasionally sold, either per egg (TSh 20 – 100) or per slice of omelette (TSh 50 – 100).

On Zanzibar, Clark & Khatib (1993) report that many residents believe turtle products (meat, oil, eggs, shell, skin and internal organs) have medicinal properties and use them to treat a wide range of diseases. During the 2003 survey, 14% (63) of respondents mentioned uses for turtle oil, most commonly as a cooking fat (33%). In Tanga, oil is used mainly as a cure for earache and in Mtwara turtle oil is applied to the skin to heal burns and rashes. In other parts of Tanzania, oil is used to treat asthma, hernias and muscle ache and is occasionally used to waterproof traditional wooden dhows (Muir, unpublished).

In 1995 a successful campaign to halt local trade in turtle products, particularly tortoiseshell, culminated in the symbolic burning, by the government, of many turtle shells and other products. These items are no longer openly sold in Zanzibar. The rapid growth of tourism on Zanzibar in early 1990s created a new souvenir market for turtle shells and turtle products such as jewellery, and may have encouraged hunting of them. Such souvenirs were sold in Zanzibar Stone Town and on the east coast of the island. However, this trade has now ceased following the collection and burning of 657 turtle products from curio shops in 1995 (Khatib et al., 1996).

Painted carapaces on sale in Kilwa District (J Rubens)

There is no evidence to suggest that illegal international trade in turtle shells or other products continues. However, a local market for turtle shells remains. In 2002, painted shells of both green and hawksbill turtles were observed on sale in Kilwa market for between TSh 500 – 1,000 each, but this is believed to service the local market (C Muir, *pers. obs*). The sale of turtle shells has also been recorded in Mtwara market (Darwall, *et al*., 2000). Similarly, at other sites along the mainland coast, shells of turtles caught in nets or killed while nesting are often dried and cleaned for use as household ornaments. In Rufiji district, turtle shells are sometimes used as an alternative to traditional thatch roofing (C Muir, *pers. obs*.).

4.5 Community knowledge of population trends

55% of respondents interviewed in 2003 reported that turtle populations, in particular nesting numbers, have declined significantly over the past 10-20 years. This downward trend was attributed to capture in gillnets and prawn trawlers (49%), habitat disturbance from fisher camps and trawlers (23%) and poaching of meat and eggs (18%). Out-migration and natural causes were also cited as reasons for population declines.

Of the 36% of respondents who reported upward population trends, over 70% did not give a reason, 19% thought this was due to natural causes, notably a high fecundity rate, and 7% cited greater law enforcement and regulations as the reason for population growth.

Only 4% thought turtle populations had remained constant over recent years and 5% were unable to give an answer.

5. Threats & issues

The major threats to marine turtles in Tanzania include: subsistence harvesting of turtles and their eggs; incidental capture in gillnets and commercial prawn trawlers; disturbance of nesting beaches from tourism development and seasonal fisher camps; damage to seagrass and coral reef habitat from trawling and destructive fishing gears such as seine nets and dynamiting; lack of adequate protection and enforcement; and coastal erosion and non-human predation.

5.1 Over-exploitation

5.1.1 Egg harvesting

Traditionally, turtle egg collection has been ubiquitous along the Tanzanian coast, and, unlike the killing of turtles themselves, is not generally perceived to be contravening the law. Turtle tracks left in the sand during nesting show clearly the location of the nest and the eggs are normally found using a sharpened stick. Evidence of egg collection has been observed along the coast at Saadani, Temeke, Mapanya Island (Mkuranga), Rufiji, Kilwa and Mtwara.

However, at sites where effective monitoring and conservation education are underway, the threat of egg harvesting has been significantly reduced. On Mafia Island, for example, 49% of nests recorded during the first year of monitoring were poached by local fishers. However, in 2002, following the implementation of beach patrols, the introduction of an nest protection incentive scheme and a public awareness campaign, the incidence of poaching fell to 8% and has declined further to less than 1% in 2003 and 2004 (Muir, 2004). A similar change in behaviour has been recorded in MBREMP where the number of nests poached fell from 100% in 2003 to 0% in 2004 following initiation of a turtle conservation programme (Mahenge, 2004). In Temeke district, since monitoring began in July 2004, only 1 (6%) out of 16 nests recorded has been poached.

5.1.2 Slaughter of nesting turtles

Nesting females are highly susceptible to human exploitation as they struggle ashore to nest and since they are slow to reproduce, the effects of removing females from a population may not be realized for decades by which time it may be too late for the population to recover. Since turtles tend to return to nest on the same beach several times during a single nesting season, the risk of slaughter is very high, particularly if local “turtle hunters” are patrolling the beaches nightly during the main nesting season. Furthermore, if turtles are failing to reproduce (due to egg poaching), traditional nesting beaches will soon cease to be important nesting sites because there will be no juvenile or mature female turtles alive to return to nest. Protection of nesting habitats and nests is thus fundamental as a conservation measure.

Turtle meat for the pot on Nyororo Is, Mafia (C Muir)

Turtle meat seized in Mafia District (C Muir)

In Tanzania, dedicated turtle hunters are known to wait for turtles to emerge to nest in Mtwara, Kilwa (Lushungi beach) and Mapanya Island. Elsewhere along the coast, slaughter of nesting turtles occurs but is probably opportunistic.

5.2 Destruction or disturbance of habitats

Sandy beaches are vital to the survival of marine turtles. The disruption of nesting activity by residential, recreational and business use of beaches (e.g. artificial lights, vehicular traffic, physical barriers) has been well documented (Hirth, 1971; Witham, 1995). The availability of suitable nesting sites in Tanzania is decreasing as a result of coastal development and the emergence of fishing camps at key nesting sites, particularly on small offshore islands (Table 4). On Zanzibar for example, tourism and hotel development has contributed to the destruction of many traditional turtle nesting grounds and there has been a marked decline in turtle nesting in some areas such as Kiwengwa beach on the northeast coast of Unguja (TCMP, 2003). Many hotels do not adhere to the 30m set back limit and beach lighting is a potential problem to nesting turtles and hatchlings. Tourist development is less of an issue along the mainland coast where the industry is less developed.

Similarly, the growing number of seasonal and permanent fisher camps at key nesting sites, particularly small offshore islands, has had an impact on turtle behaviour and nesting frequency. Beaches where nesting is now rare or has ceased altogether include: Nyororo and Mbarakuni islands off northwest Mafia; Simaya Island (Rufiji) and Nyuni, Okuza and Songo Songo islands in Kilwa.

Marine turtles depend on a healthy marine environment, particularly coral reefs and seagrass beds which provide food and refuge for green, hawksbill, olive ridley and loggerhead turtles, as well as numerous other marine fauna. In Tanzania, illegal and destructive fishing practices, such as beach seine nets and dynamiting, have severely damaged coral reef habitats along the coast and seagrass beds are being destroyed by commercial prawn trawlers (Semesi *et al*., 1998).

Table 4. Level of disturbance of main (& potential) nesting sites in URT

Location	Level of disturbance	Cause
Misali (Pemba)	Not at all disturbed	
Unguja (incl. Mnemba Is.)	Significantly disturbed	Tourists & tourism development
Nyororo / Shungi-mbili Islands (Mafia)	Heavily disturbed	Permanent & makeshift fisher camps
Rest of Mafia	Slightly disturbed	Local residents
Madete (Bagamoyo)	Slightly disturbed	Local residents / fishers
Mapanya Is (Mkuranga)	Heavily disturbed	Fisher camps
Simaya Is (Rufiji)	Heavily disturbed	Fisher camps
Songo Songo archipelago (Kilwa)	Significantly disturbed	Fisher camps
MBREMP (Mtwara)	Slightly disturbed	Local residents / fishers

5.3 Fishery-related threats

5.3.1 Gillnets

Gillnets, with a mesh size of 5-6" (*jarife*) and 12+" (*sinia*) pose a major threat to all species of turtles (adult and sub-adult) in Tanzania. Most captures are incidental. However, at some key known foraging grounds, nets are set deliberately to catch turtles. Such sites include Ras Fikirini (west Mafia); Matanango and Nanano reefs off Msimbati in MBREMP; and Kimbiji (Temeke district).

Turtle drowned in gillnet (D Obura)

Hawskbill turtle drowned in gillnet, Mafia Island (J Rubens)

The problem of incidental capture in nets has been well documented for the Mafia Island gillnet fishery where in the 1990s annual capture rates were estimated to be approximately 200 per year (Horrill & Ngoile 1991; Darwall, 1996). More recent estimates for the whole Mafia area suggest annual capture rates of between 1,000 and 2,000 turtles (Muir, 2002).

In Songo Songo, 30 turtles (green, hawksbill and loggerhead) were caught on 76 fishing trips recorded during a catch monitoring survey by Frontier in 1996 (Darwall, 1996b). Assuming that the capture rate remains fairly constant throughout the year, an extrapolation of catch rates for Songo Songo for all jarife fishing boats is estimated to be in excess of 810 turtles per year.

A survey of turtle by-catch in gillnets in Mtwara in 1996 indicated that turtles are caught in a third of all fishing trips (Darwall *et al*., 2000) and in 2003, fishers from Mtwara reported that the average number of turtles caught accidentally in nets ranged from 2-3 per month in Mnazi Bay to as many as 2-3 per day at Litikoto (Muir, 2003). Many turtles were also said to be caught during fishing forays to northern Mozambique for sale in Mtwara town.

Gillnet fishers interviewed from Pombwe (Rufiji) and Somanga Ngolwe (Kilwa) stated that they occasionally catch 10 turtles a day, notably in the seagrass beds in Mohoro Bay, but the average figure is 2-5. In October 2003, 5 fresh turtle carcasses were observed at Somanga Ngolwe which gillnet fishers admitted were caught in their nets. Frontier conducted a 4 days survey on incidental turtle catch around Simaya Island in 1996 during which 10 turtles were captured in gillnets. Of these, 5 were drowned, two were sold and three were released (Darwall, 1996).

In Mafia, a turtle catch monitoring programme was initiated by TTDCP in April 2004 in Mafia Island Marine Park. The information gathered to date indicates that turtles are caught on 45 – 60% of fishing trips by gillnet fishers) in and around Chole bay on the east side of the island (Muir, 2004. These preliminary results confirm that gillnets, particularly bottom set nets, pose a significant threat to turtles.

Turtle carcasses washed up on the beach along the coast south of Dar es Salaam are reported regularly by local fishers and tourists. Beach monitoring along this stretch of coast was initiated in July 2004 by TTDCP. Between July and November 2004, 105 turtle carcasses were recorded washed up on Buyuni beach alone. Local fishers report that mortalities are caused by incidental capture in both gillnets and commercial prawn trawlers. The relative threat of gillnet and trawler fishing gears is unknown, but studies have shown that beach strandings are highly correlated with prawn trawling activity (Hillestad *et al.,* 1995).

5.3.2 Commercial trawling

Incidental catch in prawn trawl nets is widely recognized as a major factor of turtle mortality. Trawling is concentrated primarily in near-shore shallow waters and many of the most intensively trawled waters are adjacent to major turtle nesting beaches of feeding grounds. Worldwide trawling is believed to capture more turtles than any other commercial fishery and it is estimated that 150,000 turtles die in shrimp nets each year (Hillestad et al., 1995; Oravetz, 1999). The proportion of non-target species (large fish, turtles, marine mammals) caught in trawl fisheries can be very high (Kescom, 1996). In US coastal waters, annual mortality of loggerhead and Kemp's ridley turtles associated with prawn trawling is estimated at between 5,500 – 55,000 (Oravetz, 1999). In Kenya, trawling is reported as a major cause of green turtle mortality along the coast (Wamukoya *et al,.* 1996).

Trawling is also believed to threaten turtles indirectly through destruction of seagrass habitats which not only support sizeable populations of green turtles and other endangered species such as the dugong (*dugon dugon*), but which are important nursery, breeding and feeding grounds for many commercially important finfish and shell fish (Ochieng & Erftemeijer, 2002). Furthermore, dragging trawl nets across the ocean floor physically uproots seagrass plants and increases water turbidity thus reducing the ability of seagrasses to photosynthesise.

Mud trail behind prawn trawler (C Coucoulis)

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 Tanga region, trawling is unrestricted. Prawn hotspots exist at Mchungu and Jaja off the Rufiji delta and at times when good prawn concentrations are found, a maximum of 14 vessels might be fishing this area.

Trawler in Mkuranga district (C Muir)

Currently there is no data on the magnitude of the incidental capture of marine turtles in trawl nest on the Tanzania coast. However, given the number of trawlers operating and the documented threat, it is likely that trawling poses a significant threat to turtles and their habitat in Tanzania.

5.4 Lack of adequate protection and enforcement

Although marine turtle conservation legislation is provided for in the Fisheries Act, 2003, the legislation is inadequate in scope and does not include reference to protection of turtle nesting or foraging grounds, or the compulsory use of Turtle Excluder Devices (TEDs) in trawl nets. Furthermore, reference of obligatory release of endangered species is made only in the case of trawlers and does not include gillnets which pose a significant threat.

The Fisheries Division lacks the capacity to effectively enforce laws relating to turtle conservation in Tanzania. Limited personnel and equipment such as vehicles and patrol boats, particularly in rural areas, also hampers enforcement and as such the law is rarely applied.

5.5 Land-based activities and pollution

Rapid coastal population growth, urban expansion and industrial and recreational development leading to high levels of pollution and declining water quality are expected to rise (Pratap, 1988; Ngoile, 1988). The discharge of untreated or semi-treated sewage, industrial effluents and agrochemicals can lead to sedimentation and eutrophication which can in turn cause seagrass and coral reef mortality thus threatening turtle foraging habitats (Gibson & Smith, 1999). 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

(Lugendo *et al.,* 1997). The effect of sewage, heavy metals and chemicals on marine turtles has not been studied in Tanzania.

Marine debris such as discarded nets, traps, packaging materials or plastics are a threat to turtles which easily become ensnared or entangled and drown. In addition, plastics are mistaken for food sources, particularly jelly fish by leatherback turtles, and once ingested, animals risk death from intestinal blockage. In Pemba, at least two leatherback turtles were reported choked by plastic bags during the 1995/7 survey (Slade *et al*., 1997). On Mafia, large quantities of flotsam and jetsom (plastics, glass, driftwood) accumulates on beaches on the east of the island. These create large walls of debris which turtles are unable to traverse. Consequently most nests are laid below the high tide mark.

5.6 Beach erosion & non-human predation

Natural beach erosion and accretion can lead to turtles experiencing difficulties nesting and eggs can be uncovered, inundated or swept away (Witherington, 1999). The threat of erosion is illustrated by the case of Maziwe Island which submerged in the 1980s, and in Zanzibar, a study commissioned by the Department of Environment, indicates that the coastline is being eroded at a rate of 1-3 meters a year. The areas most threatened in Unguja include Nungwi, Bwejuu, Jambiani and Mnemba Island (Khatib, 1998).

Since 2001, the island of Shungi-mbili has been severely eroded, partly from natural causes and partly due to felling of vegetation by fishermen to supply firewood and to cure sea cucumbers. This has led to the creation of very steep beach walls which turtles have difficulty climbing to nest, and an increase in the general level of activity on the island with reduced space available for fishers to camp. This has resulted in a reduction in the number of turtles that nest on Shungi-mbili Island, and those that do, typically lay their eggs below the sand wall where the eggs are inundated.

Beach erosion at Mapanya Island (C Muir)

Development and survival of turtle hatchlings are threatened by natural predators such as monitor lizards, mongooses, sea otters, termites and feral dogs (pers. obs). Ghost crabs, Indian house crows and other birds prey on hatchlings as they emerge from the nest, and many are eaten by large fish such as barracuda, sharks and groupers when they reach the sea.

6. Turtle conservation & management options

6.1 Habitat protection

Management of both terrestrial (nesting) and marine (foraging, developmental, migratory) habitats is critical to the survival of marine turtles. Two broad types of marine habitat are important to marine turtles: seagrasses and coral reefs. Once these habitats are destroyed, by fishing activity (trawling, long lining, seine netting, dynamiting), anchoring, pollution and beach development they require many decades to fully recover.

The most obvious management option is to identify and protect critical habitats, through establishment of sanctuaries, reserves or parks. With regard to beaches, measures to reduce disturbance to nesting turtles include closing beaches to vehicular and foot traffic during the main nesting season and minimizing the effect of artificial beach lighting by shielding lights or turning them off during the nesting-hatching season (Witherington, 1999).

Globally, several marine protected areas have been declared specifically for the protection of marine turtles and/or their habitats. For example, Gahirmatha Marine Sanctuary was declared to protect olive ridleys and their breeding habitats in Orissa, India; in Costa Rica the Ostional Wildlife Refuge was created only for protecting olive ridleys (*arribadas*) and Playa Grande National Park was established

to conserve leatherbacks; and in Baja California, Mexico, several marine protected areas play a prominent role in turtle conservation.

On mainland Tanzania, several important turtle nesting beaches and seagrass and coral reef habitats are included in marine protected areas. These include: Chole Bay, Juani, Kungwi, Baleni and Ras Kisimani in MIMP; Msimbati, Litokoto and Kingumi in MBREMP; and Mbudya, Bongoyo and Maziwe Island Marine Reserves. Madete beach has been included in the boundaries of Saadani proposed National Park.

On Zanzibar, Kiwengwa Controlled Area (Unguja) was established because of its nesting turtle population although no recent nests have been recorded probably because of the extensive hotel development. Mnemba Island Marine Conservation Area (MIMCA), a partnership between local communities, tourism operators and the government, was created in 2003, and supports an important green turtle nesting population, as does Misali Island Conservation Area in Pemba.

Another increasingly popular approach to the protection and sustainable management of coastal is integrated coastal zone management which provides a framework within which many different sectors can work together and plan for multiple use of coastal areas, developing marine protected area networks, promoting environmental education, identifying needs for legislation and policies and conducting research and monitoring programmes (Gibson & Smith, 1999).

6.2 Nest protection (eggs & hatchlings)

Various management options are available for reducing threats to turtle eggs and hatchlings from human and non-human predation, erosion and coastal development. The least intrusive, lowest risk and least expensive technique is to protect the eggs *in situ*. This involves patrolling nesting beaches, disguising nests (e.g. covering turtle tracks and digging false nests) and protecting eggs from natural predators by placing netting or mesh over the nest.

Translocating nests which are at risk from inundation, predation or erosion, is another relatively low risk option and can be highly effective as shown in the US Virgin Islands where annual reproductive success of the leatherback population has doubled using this technique (Boulon).

Relocation of eggs to an enclosed hatchery is another option but is not generally recommended unless *in situ* protection is impossible or if egg depredation by people or animals is so intense that mortality reaches 100% (Mortimer, 1999). Hatchery programmes have some serious limitations which include: high costs (human and financial); relatively low success rates; skewed sex ratios; and high rates of hatchling mortality if not properly released.

Head-starting, whereby hatchlings are raised to a size at which they are deemed to be less vulnerable to predation, has become a common practice among commercial turtle farmers and some government conservation agencies. However, unless a less intrusive technique is available, head-starting is not generally recommended as it can lead to an increase in mortality from aggressive behaviour and disease (Ehrenfeld, 1995).

6.3 Incidental catch

Management options to reduce incidental take of marine turtles in fisheries, notably trawlers and gillnets, include the use of excluder devices, reducing tow or soak times, and restricting use of threatening fishing gears in important turtle habitats.

Bycatch reduction devices (BRDs) are physical modifications to fishing gear that reduce the catch of non-target organisms. These devices can alleviate waste and reduce mortality in many fisheries, thus increasing yield and stability. Examples of BRDs include Turtle Excluder Devices (TEDs), which are designed to allow sea turtles and debris to escape from prawn nets. TEDs are panels of large mesh webbing or metal grids inserted into the funnel-shaped trawl nets. As the net is dragged along the bottom, prawns and other small animals pass through the TED and into the cod end of the net. However, turtles, sharks and fish too large to pass through the panels are deflected out an escape hatch. In Tanzania, commercial trawlers are not obliged to fit excluder devices to their nets.

Results from a study on TED use by semi-industrial trawlers on Sofala Bank in Mozambique indicated that employment of TEDS in the semi-industrial fleet could prevent the incidental capture of up to 5,000 turtles a year (Gove *et al.,* 2001). The study also indicated that TEDS do not impact the quantity of shrimp caught or the time spent in sorting catches, but may improve the quality and commercial value of catch by preventing damage by large marine organisms such as rays, excluded by the TED. Larger size TEDs (mesh size 130.9 x 99.8cm) was shown to be most appropriate for trawling in central Mozambique. In October 2003 Mozambique approved legislation making it compulsory for trawl nets to be fitted with TEDs. The new law will take effect from January 2005

In the US, use of TEDs in shrimp trawlers has been in force since 1998, and has proved successful in Florida where there have been no reported losses in shrimp catches.

Measures to reduce the incidental take of turtles in gillnets include: setting nets in areas where turtles are unlikely to occur; restricting use of nets in important turtle habitats; limiting the number, length and depth of the nets; using mesh sizes that are less likely to catch turtles; and reducing the soak time of nets (Oravetz, 1999).

6.4 Conservation education

Around the globe, many people are unaware of the threats to turtles or of the ways in which their actions may be affecting their long-term survival. Education and awareness about the value of coastal resources and the survival of endangered species at all levels, ranging from policy-makers to school children, can therefore play a critical role in marine turtle conservation (Gibson & Smith, 1999). Public awareness campaigns should accompany conservation action, target relevant stakeholders and embrace all the available avenues of communication including print and electronic media, school curricula, local gatherings such as festivals, fisher meetings and public displays (Eckert, 1999).

Turtle education campaigns have already proved highly valuable as conservation tools in Zanzibar, Mafia and Mtwara (Slade *et al*., 1997; Muir & Abdallah, 2003; Mahenge, 2004).

6.5 Community-based conservation (CBC)

Involvement of, and support by, local communities that interact with turtles and their habitats is fundamental for realistic, long-term turtle conservation and bottom-up approaches to conservation are becoming increasingly popular (Frazier, 1999). There are few standard procedures to CBC but generally it involves social integration and cultural sensitivity, time, community participation, development of acceptable alternatives and training.

On Zanzibar and Mafia, involvement of local communities in nest protection, monitoring, data collection and awareness raising has played a key role in reducing threats to turtles. The provision of financial incentives is a conservation option, and is practiced in some areas in the region. There are of course dangers associated with incentive-driven conservation, the most important of which is financial sustainability. However, in areas where mortality (through turtle and egg poaching) has reached critical levels, financial rewards may be the only realistic short-term solution. In the longer-term it may be possible to generate revenue to fund turtle conservation through turtle tourism and park entry fees.

On Zanzibar, cash incentives have been found to be counter-productive to obtaining committed public participation (Khatib *et al*., 1996). However, in Mafia and Mtwara modest incentives, averaging US$7 and US$3 per nest respectively, have proven highly effective in involving local communities and in protecting nests. As regards sustainability, at Watamu in Kenya for example, a highly successful “Adopt a Turtle Nest” scheme has been developed whereby tourists are invited to adopt a nest for $14. In return for their donation, adopters receive a certificate and details on the hatching success of the adopted nest. Tourists also pay ($7) to see turtles being released from fishing nets (R Zanre, *pers. comms*.).

6.6 Regional cooperation

Marine turtles are a shared global resource that cannot be managed by a single range state in isolation. Management actions for turtle conservation need to account for all stages of their lives which are spent in different habitats and spread across international boundaries. Due to their diverse life history and migratory nature, a regional focus to turtle conservation is essential to cover the ranges of distinct breeding groups or populations. Without regional cooperation, conservation effort in one country may be negated by activities affecting the same population in another range country. Transnational cooperation and management has been developed in the South Pacific, Caribbean, Southeast Asia and Indian Ocean, and Philippines.

In the Western Indian Ocean region, considerable efforts have been made to promote regional collaboration and to address regional issues relating to turtle conservation. The Sodwana meeting in 1995 resulted in the WIO Marine Turtle Conservation Strategy (IUCN/UNEP, 1996). In 2001, an informal Eastern African meeting was held in Mombasa to discuss progress since the Sodwana meeting and priorities for future work. In June 2001, Tanzania signed up to the *Memorandum of Understanding on the Conservation and Management of Marine Turtles of the Indian Ocean and South-East Asia (IOSEA),* the overall goal of which is to protect, conserve, replenish and recover marine turtles and their habitats of the Indian Ocean and SE Asia. In 2004, A WIO Region Marine Turtle Workshop was held in Kenya to: bring together marine turtle experts and relevant stakeholders in research and conservation within the WIO region; share experiences and discuss networking options and opportunities; identify and prioritise regional turtle research and management needs; and draft a regional proposal to address research needs for consideration for funding under the Marine Science for Management Grant (MASMA) administered by WIOMSA. The workshop proceedings are currently being prepared by KESCOM.

7. Recommendations

Due to their life cycle, nesting biology and longevity, studies on marine turtles ideally need to be a decade or more in duration to provide a dependable source of information on population numbers and trends and for effective recovery and management. Therefore, long-term planning and commitment is necessary in the planning of turtle conservation, research and management efforts.

7.1 Research and monitoring

In Tanzania, information concerning turtle populations and habitats is incomplete. Knowledge of developmental and foraging habitats is poor and little is known about the extent and level of human actions on turtle populations at different states in their life cycle. This information is fundamental to the conservation and management of different breeding populations and in prioritizing resources and personnel in their protection and in the conservation of critical habitats.

Recommendations for research and monitoring include:

7.1.1 Studies on reproduction and nest biology

Initiate monitoring at key nesting sites previously un-surveyed (e.g important nesting beaches in Muheza, Pangani, Bagamoyo, Rufiji, Kilwa and Lindi districts) and continue monitoring at sites where conservation programmes already exist (e.g. Zanzibar, Madete, Mafia, Temeke, Mkuranga and Mtwara) to:

- Document nesting activity including key locations, species nesting, intensity and nesting trends;
- Calculate hatch success;
- Record annual mortality.

7.1.2 Studies on foraging habitats

- Identify and map critical foraging habitats, particularly focusing in unprotected areas.

7.1.3 Tagging

Currently tagging is underway in Unguja (Mnemba), Mafia and Mtwara (MBREMP), using titanium flipper tags with the series TA 001 – TA 400.

It is recommended that a coordinated ***national tagging programme***, using both flipper tags and satellite telemetry, is initiated to:

- Identify turtle movement patterns;
- Identify important foraging & developmental grounds;
- Determine inter-nesting and remigration intervals (to calculate size and status of turtle populations).

7.1.4 Quantify threats

Conduct detailed quantitative studies on:

- incidental turtle catch in gillnets and prawn trawlers;
- the effect of trawling on seagrass habitat;
- the impact of land-based activities on critical turtle habitats;
- the threat of human and non-human predation on nests.

7.1.5 Population identification

Currently, ***genetic studies*** are being conducted in Mafia and MBREMP. It is recommended that similar studies be initiated elsewhere along the coast and on Zanzibar to:

- determine the degree of female natal homing;
- identify discrete breeding populations on the nesting beaches and in corresponding feeding habitats.

7.2 Conservation and Management

The following conservation and management initiatives are recommended:

7.2.1 Habitat protection

Some key turtle nesting sites in Tanzania, namely small remote offshore islands, are threatened by the disturbance from large semi-permanent fisher camps which are contributing to disrupted turtle nesting behaviour and, in some areas, severe erosion from tree-cutting. Similarly, unregulated coastal tourist hotel and industrial development is threatening several key nesting habitats. The following measures are therefore recommended:

- Create ***turtle sanctuaries*** or community protected marine areas in important nesting/foraging habitats currently unprotected;
- Enforce coastal development regulations and ensure independent Environmental Impact Assessments (EIAs) are undertaken prior to any development;
- ***Regulate human activities*** (fisher camps) at key nesting sites particularly the small offshore islands of Nyororo, Shungi-mbili and Mbarakuni (Mafia district), Simaya (Rufiji district) and Nyuni and Ukuza (Kilwa district) through **complete protection** or the designation of **"closed" fishing periods** to correspond with the main nesting season.

7.2.2 Reduce the threat of incidental catch

- Control or ban use of threatening fishing gears (e.g. gillnets and commercial trawlers) in areas where turtles are known to feed and breed;
- Include compulsory use of **TEDs** by all commercial shrimp trawlers operating in Tanzania in the national fisheries regulations.

7.2.3 Strengthen national legislation relating to turtles

- Tighten the current legislation to include conservation of critical turtle habitats and strengthen regulations related to marine turtles such as specifying that live endangered species caught in **all** fishing gears (not only trawlers) must be returned to the water immediately, and that all trawlers must be fitted with **Turtle Excluder Devices** before a license will be issued;
- Strengthen capacity of government conservation authorities to enforce relevant legislation through training and provision of transport (vehicles, boats) and communication equipment.

7.2.4 Promote community participation in turtle management

- Initiate integrated surveys, monitoring and management with local coastal communities. A useful means of achieving this could be through "*Beach Management Units*" as defined in the 2003 Tanzania Fisheries Act;
- Consider alternatives and incentives;
- Conduct training (e.g. data collection, conservation issues and techniques, nest translocation).

7.2.5 Sensitisation and education

- Initiate a comprehensive nation-wide turtle education campaign to coincide with the IOSEA ***2006 Year of the Turtle*** focusing on national and international regulations and legislation, turtle biology and conservation status, targeting all stakeholders;
- Promote responsible turtle tourism in Zanzibar, Saadani, Temeke, Mafia and Mtwara through turtle / hatchling viewing or an "adopt a nest / turtle" programme.

7.2.6 Promote national & regional cooperation

Under the direction of the National Turtle Conservation Committee:

- Develop a ***National Turtle Recovery and Action Plan*** and coordinate implementation of activities through existing conservation programmes in Zanzibar and mainland Tanzania;
- Standardise research and monitoring methodologies;
- Develop a ***national data base*** (to include nests, strandings and tagging) to be housed at a relevant government institution such as the University of Dar es Salaam / Institute of Marine Sciences;
- Encourage sharing of data and information between on-going research and conservation initiatives in Tanzania and elsewhere in the region;
- Promote attendance of managers and scientists at relevant international and regional symposia to share ideas and experiences and gain exposure – e.g annual Sea Turtle Symposium.

7.2.7 Encourage funding for marine turtle conservation

- Seek to secure long-term funding for turtle conservation activities in Tanzania;
- Incorporate turtle conservation activities within existing work plans of government institutions (e.g. Marine Parks & Reserves Unit) and non-government organisations (NGOs).

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