DISTRIBUTION AND STATUS OF COASTAL HABITATS AND RESOURCES IN TANZANIA

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Executive summary

The most important coastal habitats, such as mangroves, coral reefs, estuaries, important bird areas and turtle nesting sites in Tanzania have been described and mapped. Mapping of seagrass beds is still pending. Fishery is the first parameter to be considered in case of gas and oil spills or any other pollutant along the Tanzania coast. Detailed introduction to fisheries and associated resources has been provided. The location of important fishing grounds (demersal, small and large pelagic, prawn fishing grounds, trawlable and non trawlable areas and fish aggregations) have been described and mapped. Fin-fish resources (demersal fish, small and large pelagics, etc) as well as lobsters, octopus, shelled molluscs have been described. The distribution and or sighting of Important non-fishery resources, sometimes so called charismatic species such as dolphins, coelacanths, dugongs, turtles, sharks whales has been described and mapped. Information on coastal infrastructure, e.g., fish landing sites and facilities, as well as tourist attractions and/or facilities, e.g. historical sites, dives sites, sport fishing sites and coastal Hotels/Resorts have been listed and/or mapped. The location of Oil and gas exploration or extraction sites have been described and mapped (to approximate locations). The important ocean currents which influence the coastal waters of Tanzania, i.e. South Equatorial Current (SEC), the East Africa Coastal Current (EACC), and the Equatorial Counter Current (ECC) have been mapped, for both southeast and northeast monsoons. While the main water circulation pattern is fairly known, there is knowledge gap in shallow water circulation patterns, especially the reversing tidal currents. Knowledge on hydrography is extremely important in managing oil spills and other pollution disasters along the Tanzania coast. To allow for easy access to specific habitat or resource information or map, detailed descriptions are provided in separate pages as appendices. The appendices are formatted in such a way that they can be accessed separately from the main document (Table 2).

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1. INTRODUCTION

The coastline of the United Republic of Tanzania and its adjacent intertidal and subtidal habitats form the back-borne of various social and economic activities of coastal communities. Most of the fisheries resources (specifically demersal fish stocks) in mangroves, coral reefs, and sea grass beds occur in the inshore (shallow) waters. The highest primary productivity occurs in the shallow waters, mainly because of synergistic effects of benthic and water column productivity and high rates of nutrient recycling from re-suspension of sediments. These vast resources and biodiversity in these near shore zones support more than 25% of the total country's population. The accessibility of coastlines and shallow water habitats make them vulnerable to anthropogenic disturbances besides natural disasters. Most of the coastal resources are already showing signs of degradation from over-exploitation, destructive fishing practices and pollution from land based sources. Fishing, eco-tourism, mining, port developments, coastal transport and trade, upland agriculture along river banks, are the main basis for economic development and sources of livelihoods of coastal communities, but they also are potential sources of degradation of coastal zones. Most of the major urban centers and about 75% of industrial facilities are located along the coastline, somehow increasing pressures on coastal resource. Other threats to coastal environment and its resources includes: anchor damage and trampling from fishers and tourists, beach goers, etc. Oil and gas exploration and extraction activities are new and important economic undertakings that also are a potential threat which deserves special attention.

The oil and gas development and maritime transport are among the important economic activities that are necessary to abate the existing poverty in Tanzania. The vision of energy sector in Tanzania is "to effectively contribute to the growth of the national economy and thereby improve the standard of living for the entire national in a sustainable and environmentally sound manner". This vision is encouraging a growing interest of the international oil and gas companies to engage in the exploration an exploitation of oil and gas in Tanzania. It is also the mission of energy sector in Tanzania to create conditions for the provision of safe, reliable, effective, cost-effective and environmentally appropriate energy services to all sectors on a sustainable basis. Big reserves of gas have been discovered at Songosngo archipelago, Mafia Island, Mkuranga and Mnazi bay in Mtwara and just recently at Nyuni Island north of Songosongo island. Massive exploration campaigns are ongoing or planned in most offshore areas. If not well managed, oil and gas development may present a major threat to biodiversity and livelihoods of the coastal communities in the region.

In addition, there is also considerable concern over the transportation and storage of oil and gas in the region. Spills from ships or fixed and floating platforms could cause monumental damage to the marine ecology. High fleet of oil tankers in the region and delivery to Tanzania cities, make accidental spills more likely now than in previous years. Therefore oil and gas related industry is one of the most threatening industries, specifically in coastal and marine environment.

The WWF-EAME programme which is the largest holistic approach to conservation of coastal and marine resources in Eastern Africa has taken a keen concern on potential damages likely to occur from oil and gas industry. The main question being asked is: i) what type of environment and resources exists along the Tanzania coast? ii) in case of an oil or gas accidental spills at any point along the Tanzania coast, which specific areas deserve special attention? iii) what type of biological and economical loss is expected?

One way of getting quick answers is to have maps and information base on the distribution of important coastal habitats and its resources, fishing ground and tourist recreation facilities as well as important social and economic facilities, including coastal towns, industries and infrastructures. It is the wish of WWF-EAME programme to see to it that oil and gas based economic development in Tanzania is sustainably undertaken and areas prone to damages likely to arise from oil and gas development are known and maped. This initiative is geared towards achieving the EAME vision of having a healthy marine and coastal environment that provides sustainable benefits for present and future generations of both local and international communities, who also understand and actively care for its biodiversity and ecological integrity.

2. OBJECTIVES

The main objectives of this consultancy service are:

1. to collect and assess the most relevant data and information which reflects marine biodiversity of the coastline of Tanzania
2. to format and digitise environmental and resource data with purpose of producing habitats and resources distribution maps that will assist in the production of oil and gas sensitivity map

This activity has an added value in that other useful data for Integrated Coastal Management (ICM) will be generated in the process. Maps produced and the database will broaden the scope of the subject to many Tanzanians.

3. MATERIAL AND METHODS

Various published and unpublished documents with information on the distribution and abundance of coastal habitats and resources were reviewed. Coastal habitat and resource experts, managers, fisheries officers, fishers and coastal community leaders were interviewed. Fisheries Division and Institute of Marine Sciences coastal resource databases were very helpful in providing data used in this report. More information will continue to be obtained to update existing databases and maps. Mapping is a never ending activity as it involves capturing of new events and replacing the old ones.

Data, information and a map for each habitat and/or resource was compiled in a separate page, which is searchable (from this main report). This format has the advantage that each resource data and map can be retrieved and assessed independently.

For each habitat and/or resource effort was directed towards obtaining information around the following key issues:

a) A short introduction to the habitat/resource under consideration
b) Mapping the location and extent of distribution of the resource/habitat. The scale of the map and the amount of details was guided by many factors around the habitat or resource under consideration.
b) Utilisation patterns, opportunities, threats, Management actions and current status of the resource.
d) Recommendations for future conservation.

Calibration, verification, digitization, spatial analysis and mapping of features were done according to standard procedures developed at Institute of Marine Sciences, which are

similar to those developed elsewhere. Preliminary maps and resources information were presented for comments and calibration at the meeting of selected expert stakeholders held on 30th June 2008. Views expressed by participants were incorporated in the final digitisation and map settings. Since the interest is on whole of Tanzania, some compromises on scale and presentation style were necessary. The target was to represent the entire set of more than 30 habitats and resources (features) mentioned below in separate maps before combining features into few carefully selected thematic maps. Limitation on the number of maps (combinations of features) depended on the type and amount of data availability as well as presentation designs and scales.

The table below (Table 1) gives a summary of methods used in gathering data and information for each corresponding habitat and resource.

Table 1: Data gathering methods

SN	Resource	Data gathering methods
I	**Coastal habitats** 1) Mangroves	Interviews and literature reviews. Reference was made to existing mangrove distribution maps produced by Mangrove Management Project (1991), TCMP – (Wang et al., 2001) and IMS database.
	2) Coral reefs and status	Interviews and literature reviews. Reference was made to existing coral reef distribution maps produced by UNEP World Conservation Monitoring Centre. Coral reef monitoring database at the Institute of Marine Sciences was also consulted.
	3) Sea grass beds	Interviews and literature reviews. Only few sites have data on the distribution of sea grass beds. Mapping of this feature require critical analysis of suitable satellite images. Attempt to map sea grass beds were carried out in few sites, e.g. North and South Dar es Salaam Marine Reserve Systems, Chwaka Bay and Mnemba areas.
	4) Estuaries	Important estuarine areas were deduced from existing coastal maps at Institute of Marine Sciences. Their status was evaluated through Interviews and literature reviews.
	5) Important Bird Areas	Most data was gathered from literature reviews. Additional data was obtained from interviews with respective experts
Ii	**Fishing grounds** 6) Demersal fishing grounds	Map of the demersal fishing area was based on 20 m depth contours – digitised from bathymetric charts. Other information was obtained from Fisheries Department (Dar es Salaam and Zanzibar).
	7) Trawlable (where commercial trawlers operate) and non-trawlable grounds	Trawlable areas were deduced from Kangwe et al. 2007 report and MV Mafunzo trawl maps at Mbegani Fisheries Development Centre. Coral reef and mangrove dominated areas as well as open deep waters are part of the non-trawlable areas
	8) Prawn fishing grounds	Information on Prawn fishing grounds for both

		commercial and artisanal fishers was deduced from commercial fish trawler owners at Mbegani Fisheries Development Centre, TAFIRI, Fisheries Division and local fishers in Rufiji, Pemba and Tanga
	9) Small and large pelagic fishing grounds	Data was collected from Fisheries Division. Additional information was obtained through interviews and literature reviews.
	10) Major fish breeding/ aggregation areas and seasons	Fish breeding and aggregation sites were deduced from existing habitat distribution maps and high biological productivity areas. Fishing grounds are usually good reflection of fish aggregation sites. Analysis of factors determining fish distribution and abundance also provided clues on the location of such aggregation areas.
	11) Turtle nesting / breeding sites	Existing information was collected from turtle experts in Dar es Salaam and Zanzibar. Additional information was collected through interviews and literature reviews.
Iii	**Fisheries Resources distribution**	Data on coastal resources distribution, abundance and composition was collected from Fisheries Division and other institution dealing with coastal resources management, including Marine Parks and reserves unit, NEMC, TCMP, as well as WWF, IUCN, etc. Additional data was gathered through interviews and literature reviews
	12) Selected Demersal and Pelagic finfish (including tuna)	Data on fin fish, Tuna and tuna like distribution, abundance and composition was gathered from Fisheries Division
	13) Coelacanths	Data on coastal resources distribution, abundance and composition was collected from Fisheries Division and Marine Parks and Reserve Unit. Additional data will be gathered from ACEP project reports.
	14) Sharks (including whale shark)	Data on Shark resources distribution, abundance and composition was collected from Fisheries Division
	15) Octopus and squids	Data on Octopus and squids resources distribution, abundance and composition was collected from Fisheries Division
	16) Lobsters	Data on Lobster resources distribution, abundance and composition was gathered from Fisheries Division
	17) Prawns	Data on coastal resources distribution, abundance and composition was collected from Fisheries Division
	18) Ornamental and edible shelled molluscs (gastropods and bivalves)	Data on coastal resources distribution, abundance and composition was collected from Fisheries Division, Tourism Division and National Museums of Tanzania.
	19) Dolphins and Purposes	Data on Dolphin resources distribution, abundance and composition was collected from Sea sense reports, Fisheries Division and Institute of Marine Sciences.
	20) Dugongs	Data on Dugond resources distribution, abundance and composition was collected from Marine Parks, National Meuseums and Fisheries Division

	21) Whales	Data on Whale resources distribution, abundance and composition was collected from Fisheries Division
V	**Coastal infrastructure, tourism and facilities**	Data was gathered from the Institute of Marine Sciences database as well as interviews with district authorities.
	22) Fish landing beaches/Markets	Data was collected from Fisheries Divisions in Dar es Salaam and Zanzibar. Corresponding fish landing statistics will also be collected (where it exists).
	23) Coastal hotels and resorts	Location of hotels was deduced from existing hotels database in Tourism Division. Distribution of sandy beaches was deduced from existing coastal maps at Institute of Marine Sciences. Dive sites and coral gardens data was deduced from Institute of Marine Sciences
	24) Historical sites 25) Snorkelling and Dive sites	Location of Recreational and tourist attraction sites was obtained from Tourism Division and Fisheries Division and specialised stakeholders
	26) Sport fishing	Location of spot fishing was obtained from sport fishing companies (e.g. Msasani Slipway, Yatch club, Mafia Lodge, etc.
	27) Marine Managed Areas – Parks, reserves and conservation areas.	
	28) Other threats to coastal environment and resources	Data on coastal threats was obtained from coastal resources database at Institute of Marine Sciences. Addition data was gathered through interviews and literature reviews.
Vi	**Hydrography** 29) Ocean Currents	Ocean currents during Northeast and southeast monsoon was mapped according to existing standard references.
Vii	**Oil and Gas exploration** 30) Oil and Gas	Oil and gas exploration locations and data for mapping were obtained from TPDC Homepage.

4. RESULTS

Detailed data and information on the distribution (location and extent), utilisation pattern and status of the main coastal habitats (mangroves, coral reefs, estuaries and important bird areas), fishing grounds (demersal, small and large pelagic, prawn fishing grounds, trawlable and non trawlable areas and fish aggregations), non-fishery marine resources (dolphins, coelacanths, dugongs, turtles, sharks whales) and fishery resources (finfish, Lobsters, octopus, shelled molluscs) are provided in separate pages as appendices. The appendices are formatted in such a way that they can be accessed separately from the main document (Table 2).

The Table below give a summary of the main findings for habitats and resource covered in this report. It also provide links to the respective appendices (pages) containing detailed information, data and distribution maps of coastal habitats, fishing grounds, biological resources, fisheries investments, tourism facilities and Hydrography.

Table 2: Summary of results and links to habitat and resource details (Appendices)

Ser	Result pages	Main findings and comments
I	**Main coastal habitats** 1) **Mangroves** (Appendix 1a)	- For Management purposes mangroves were grouped in Blocks. - Many institutions are involved in their management - Maximally utilised and in danger of overexploitation in many areas. Big mangrove trees are seen in restricted remote areas - Potential sites for aquaculture industry - Mapping data was obtained from existing mangrove distribution maps produced by Mangrove Management Project (1991), TCMP (2001) and IMS database.
	2) **Coral reefs** and **status** (Appendix 1b)	- Coral reef priority areas have been mapped - Coral reefs are managed by Fisheries Division as part of the marine environment. - MMA have been established to ensure conservation in some key areas, e.g. marine parks (MIMP, MBREMP), marine reserves (e.g. Mbudya, Bongoyo, Makatombe, Sinda, Maziwe, etc), Conservation Areas (Misali, Menai Bay, etc), Collaborative management (e.g., Tanga). - Coral bleaching and crown-of-thorns starfish are the most important natural threats. Anthropogenic threats include: destructive fishing, overfishing, anchor damage, coral mining, sedimentation and pollution from land based sources - Mapping data was obtained from IMS database Institute of Marine Sciences, Zanzibar. Coral reef monitoring database at Institute of Marine Sciences was also consulted. - a link to the current (2008) status of coral reefs by Muhando and Mwaipopo (2008) is given
	3) **Seagrass beds** (Appendix 1c)	- Despite its importance in fisheries, only few sites have data on the distribution of seagrass beds. - Only few satellite sensors can pick sea grass signals, seagrass maps not easily mapped. - Existing sea grass distribution maps (e.g., KICAMP, DMRS-south, Chwaka Bay and East coast of Unguja Island) were constructed from GPS based field survey data. - Mapping of sea grass remains an important pending activity.
	4) **Estuaries** (Appendix 1d)	- Estuaries are associated with major rivers. - The value of estuarine is enhanced by the presence of mangroves.

		- Important fisheries are associated with estuaries, e.g. prawn fishery - Location of estuarine areas were deduced from existing coastal maps at IMS and from Well et al 2004 report (part of MACEMP initiation reports)
	5) **Important Bird Areas** (Appendix 1e)	- Important Bird Areas (IBAs) were designated by Birdlife International through a widely accepted scientific process. - Ten priority IBAs have been designated along the coast (Baker and Baker, 2002)
ii	**Fishing grounds** 1) **Demersal fishing grounds** (Appendix 2a)	- Demersal fishing grounds include all shallow waters less than 20 m deep. This zone includes mangroves, coral reefs, estuaries and other sea areas between these habitats. - In this zone Fisheries stocks are supported by both benthic and water column primary productivity. All small scale fishing takes place in this zone. - Map of the demersal fishing area was based on 20 m depth contours digitised from bathymetric charts.
	2) **Trawlable** (where commercial trawlers operate) **and non-trawlable grounds** (Appendix 2b)	- Trawlable areas include all sites where bottom or mid-water trawl nets have been operated. - Data for mapping trawlable fishing areas was deduced from Kangwe et al. (2007), RV. Dr. Fridjof Nansen and MV. Mafunzo trawl routes. - Coral reef and mangrove dominated areas as well as open deep waters are part of the non-trawlable fishing grounds
	3) **Prawn fishing grounds** (Appendix 2c)	- Prawn fishing grounds are associated with major rivers and estuaries. - The major trawling grounds for prawns have been zoned into three zones. Zone 1: includes the areas between Pangani, Saadani and Mbegani in Bagamoyo; Zone 2: is includes the inshore areas around Kisiju, Bwejuu, Mafia Island and the northern part of Rufiji areas. This is the most productive of the three zones; and Zone 3: includes the southern part of Rufiji areas and Kilwa.
	4) **Small and large pelagic fishing grounds** (Appendix 2d)	- Small pelagic fish are constituted by dagaa, mackerel, sardines and few small scads. Most of these are caught by purse seine nets involving light attractions. This activity is concentrated near urban centres, although recently it has been introduced on the west coast of Pemba. - Fishery of schooling fish off coral reefs by local fishers using modified seine nets was not considered as genuine small pelagic fishery – this can be debated.

	5) **Major fish breeding / aggregation areas** (Appendix 2e)	- There has been no specific research on fish spawning / breeding or feeding aggregations in Tanzania so far. - According to the literature, aggregation areas are predictable through existence of factors favourable for fish distribution. Such factor includes availability of food, absence of predators, availability of refuge – safety of young, etc. - Fishers normally target fish aggregation sites. - From experience, fish breeding and aggregation sites include mangroves, coral reefs and seagrass beds. Places with a combination of these habitats becomes a better aggregation site.
	6) **Turtle nesting / breeding sites** (Appendix 2f)	- There were more records of nesting sites compared to previous studies. This could be accounted by more awareness, and hence more reporting rather than actual increase of nesting sites. Chances of successful nesting appear to decrease mainly because of human induced interferences and destruction of nesting sites – through predation of eggs, degrading habitats, limit to access beaches through construction and/or presence of lights.
iii	**Fisheries Resources** **General Fisheries information** (Appendix 3.1)	- Fishery is probably the first parameter to be considered in case of gas and oil spills or any other pollutant along the Tanzania coast. The contribution of fishing as an employer and fish products in the coastal economy and culture is very high and has cascading impacts in all fields of life in the coastal zone. - Detailed introduction to Fisheries in Tanzania is given in Appendix 3.1
	Marine Fisheries Resources (Appendix 3.2)	- The marine waters have diversified fish types. The larger fish groups include the bony fishes, sharks, and Rays. Other groups include the lobsters, shrimps, cephalopods and gastropods. - Holothurians, marine mammals and marine turtles are legally barred from fishing. - Trends in number of fishers, fishing vessels, gears, and total yearly catch for 1984-2001 is given.
	1) **Demersal fish** (Appendix 3a)	- Demersal fish contributed about 58 % of the total fish catch in Tanzania mainland (according to Fisheries data of 1993-1996 - Besides mixed demersal fish group which contributes about (15 %), the most important demersal fish groups in the catch were Lethrinids/scaventures (Changu), rays and skates (Taa), rabbit fish (Tasi) and Parrot fish (Pono). - There has been a general agreement that

		demersal fisheries are probably already overfished. - The relative contribution of demersal fishery may be much lower today (2008) than it was in 1996 due to habitat degradation and overfishing.
	2) **Small pelagic fish** (Appendix 3b	- Small pelagic fish include sardine, anchovy, and mackerel, while large pelagic fish include tuna, sail fish, kingfish, sword fish, sharks - Small pelagic fish are caught using mainly purse seine nets involving light attractions. - Fishery of small pelagic contributed more than 25 % of total fish catch in 1993-1996 and is increasingly becoming more important. - An increase in fish catches is likely to come from expanded fishery of small pelagic rather than demersal fishery or large pelagic fish. - The main limiting factors of this fishery are preservation and market access. The highest landings are registered at towns of Tanga, Zanzibar and Dar-es-Salaam because they offer the best opportunities for rapid sale of these highly perishable fishes.
	3) **Large Pelagic fish including Tuna** (Appendix 3c)	- Large pelagic fish include tuna, sail fish, kingfish, sword fish, dolphins and sharks. The most sought after fish in this category are yellowfin and bonito tunas, sailfish rainbow runner (Carangidae), skipjack (Katsuwonus) and Kingfish (Scomberomorus). - The large pelagic are fished in open waters beyond the reefs. - The preferred fishing method is drift netting at night. Some fishermen use pressure lamps at night to attract baitfish to their lift nets and dip nets. - Some trolling is carried out by ngalawa boats, and occasionally by mashuas. - The Ngalawa are the principal boats used for fishing outside the fringing reefs. - Tuna fishery is dominated by foreign purse seine and Long liner vessels which targets three main species of tropical tunas; skipjack, yellowfin and bigeye.
	4) **Lobsters** (Appendix 3d)	- Six species of panulid Lobsters occur in Tanzania. However, fishery of lobsters is based on Rocky lobster *Hommarius spp* and spiny lobsters *Panulirus spp*. Sandy lobsters *Thennus spp* and deep sea lobster *Nephros spp* are also common - Lobsters are collected from artisanal fisher (in Tanga, Dar es Salaam, Kilwa and Mafia) and sold to tourist hotels and companies

		that process them for export purposes. Only few are supplied to local market - Nowadays lobster fishers use powered boat and scuba diving equipment as stocks dwindles due to overfishing.
	5) **Prawns** (Appendix 3e)	- Prawn fishery in Tanzania is based on shallow water penaeid shrimp. - The rich fishing ground is found around the Rufiji Delta and the Wami and Ruvu River entrances in Bagamoyo - Pangani - The most abundant and marketable types of prawns/shrimps include *Penaeus monodon, Penaeus semisulcatus, Penaeus indicus(*white shrimp*)* , *Penaeus japonicus (* flower shrimp*)* and *Metapeneus monoceros* (brown shrimp) - The major trawling grounds for prawn/shrimp have been zoned for management purpose into three zones. Zone 1 is located between Latitudes 5' 25' and 6' 30' S and includes the areas between Pangani, Saadani and Mbegani in Bagamoyo. Zone 2 is between Latitudes 7' and 8' S and includes the inshore areas around Kisiju, Bwejuu, Mafia Island and the northern part of Rufiji areas.
	6) **Ornamental and edible shelled molluscs** (Appendix 3f)	(gastropods and bivalves) - Although edible mollusks do not contribute much to commercial fishery, they are harvested for food, for medicinal use and, as a source of lime - The species that are involved include mapanga chaza (*Ostrea amasa, Pinctada sp., Saccostrea cucullata*), *Anadara antiquata* and *Terebralia palustris (or suka*) - Harvesting of colourful shells, e.g. the trumpet and helmet shells, tiger cowries *Cypraea tigris, Cyprae acassis rufa,* shells of *Chicoreus ramosus* and *Pleuroploca trapezium*is contribute to income of many coastal families.
iv	**Charismatic marine species (endangered, rare, or threatened)** 1) **Coelacanths** (Appendix 4a)	- The Coelacanth, a fish species thought to have become extinct some 65 million years ago along with Dinosaurs, came to world centre stage, when it was caught off the Indian Ocean waters, South Africa in 1938. - The first coelacanth was caught in Tanzania at Songo Mnara in Kilwa in 2003. - So far more than a total of 35 Coelacanths have been caught, in Tanzania, mostly in the deep-set shark gill nets 'jarife' - More than 20 specimens have been caught off Kigombe – Mwarongo area alone. - Other sites reporting Coelacanths catch in

		Tanzania are mapped - Conservation management efforts are ongoing
	2) **Dugongs** (Appendix 4b)	- The dugong (*Dugong dugon)* commonly known as Sea cow are marine mammal - They are found in shallow waters and graze on sea grasses. - They are very rare; at one time they were considered locally extinct in Tanzania - They have been sighted in only a few areas particularly in the Rufiji Mafia Kilwa area, around Muheza and Zanzibar channel
	3) **Sharks** (including **whale shark**) (Appendix 4c)	- As apex predators, the life history characteristics of sharks are typified by slow growth, late maturity and low rates of reproduction. These traits make these animals particularly vulnerable to human exploitation - Areas known to have relatively higher concentrations of sharks include Tanga, Dar es Salaam, Unguja Island, Nyuni Island and Kilwa area - Whale shark is the largest living fish. They filter plankton through its gill rakers and any fish drawn in are eaten. - Globally, catches have been depleted by artisanal and commercial fisheries. They are fished for their liver oil for waterproofing and their Fins and meat for food as a delicacy - In Tanzania, they aggregate in groups of 5 – 20 off the west coast of Mafia Island, and are occasionally sighted in Zanzibar
	4) **Dolphins and Purposes** (Appendix 4d)	- Eight species of dolphin have been recorded and are often caught accidentally in tuna/billfish/marlin nets, particularly off Nungwi (Unguja) (Amir *et al*., 2002). - The commonest species are probably the Indo-Pacific bottlenose dolphin *Tursiops aduncus*, the Indo-Pacific humpback dolphin *Sousa chinensis* and the spinner *Stenella longirostris*. - Menai Bay has a significant population of about 150 resident bottlenose and 75 humpback dolphins. - Other areas with significant population of dolphins include Latham Island. Mafia Island Marine Park, Moa bay in Nkinga, Rufiji delta and Mnazi bay. Few sightings are reported around Dar es Salaam Marine Reserves, Mzinga Creek at the Harbour entrance and Saadani.
	5) **Whales** (Appendix 4e)	- Humpback and other whale species pass through Tanzanian waters on migration (and may calve in Mnazi Bay). - Whales are protected through out their

		range and the Indian Ocean is a Sanctuary for Whale. They are threatened by being stranded in shallow water due to high tidal range
v	**Coastal infrastructure, tourism and facilities**	
	1) **Fish landing beaches/Markets** (Appendix 5a)	- Fish landing sites are an important part of the fishing industry as they play a major role in the fish marketing chain. - According to Fisheries Frame survey of 2007, there are over 200 permanent fish landing sites along the coast in the Mainland Tanzania. - Attempts to map the landing sites on the Tanzania mainland coast were unsuccessful because most of the names of the landing sites lacked geo-references. - A map of the landing sites of Unguja and Pemba Islands exist
	2) **Coastal hotels and resorts**	- Tourism is one of the fast growing sectors of the country economy. Coastal tourism is also picking up and shows a promising future as evidenced in the number, variety and diversity of accommodation facilities that have been constructed or are planned along the Coast. - A list of important coastal hotels and resorts in the different coastal Districts is given. - Mapping the location of Hotels and Resorts for the whole coastline was not possible due to lack of spatial references of most hotels.
	Recreational and tourist attraction sites	
	3) **Historical sites**	- The Tanzanian coast and islands are rich in cultural heritage resources. There is several surviving physical evidence of a long history of settlement - At the same time it has coastal and marine resources that are regionally outstanding and some that are of global significance. This combination makes Tanzania one of the important ecotourism sites in the world.
	4) **Dive and Snorkel sites**	- The main diving sites in Tanzania have been described. The list provided is far from complete - Mapping of the dive sites for the mainland coast has not been completed due to lack of accurate geo-references of most sites - Dive sites for Zanzibar and Pemba have been mapped
	5) **Sport fishing sites**	- Sport fishing or game fishing is based on

		large fish especially the Marlins, Barracudas, Sharks and jacks - The best sport fishing areas are Mafia, Latham Island, Pemba channel and off Mnazi bay
vi	**Marine Managed Areas** 1) **Parks, reserves, conservation and community managed areas**	- Tanzania mainland coast has two Marine Parks, One National Parks (Saadani) and eleven marine reserves - Zanzibar has one National Park, three marine reserves and four conservation areas - Both mainland and Zanzibar has several community based managed areas.
vii	**Hydrography** 1) **Ocean Currents**	- Three currents, the South Equatorial Current (SEC), the East Africa Coastal Current (EACC), and the Equatorial Counter Current (ECC) influence the coastal waters of Tanzania. - The north-flowing EACC is a steady current, strongest during the southern monsoon when surface currents can exceed 3 metres per second, especially when southerly winds are strongest. - Knowledge on hydrography is extremely important in managing oil spills and other pollution disasters along the Tanzania coast. - While the main water circulation pattern is fairly known, there is a knowledge gap in shallow water circulation patterns, especially the reversing tidal currents.
viii	**Oil and Gas activities** 1)**Gas and Oil seep sites**	- The occurrence of hydrocarbons in Tanzania is represented by gas fields, oil and gas shows in wells, oil seeps and bitumen outcrops. - Gas Fields: Songo Songo and Mnazi Bay - Gas and Oil Shows: Gas shows have been encountered in most of the deep wells in offshore and onshore Coastal Basin. Biogenic gas has also been reported in some shallow bore holes in the Msimbati area, Ruvuma Basin. - Oil shows have been reported in several wells, e.g., Mita G-1and Mbate-1 wells, in the Mandawa Basin. SongoSongo wells, Mafia-1, Makarawe-1, Mnazi Bay-1, Mandawa-7 and Pemba-5. - Bitumen staining are reported in Wingayongo-1, Kisangire-1, Mtwara-1.

Aquaculture is an important activity along the Tanzania coast line. In the effort of finding alternative supply of fish resources, physical alteration and destruction of habitats could occur. Thus, aquaculture practices could potentially cause significant environmental degradation. Though mapping of aquaculture sites was not considered, it remains a fact that aquaculture activity deserves special mapping attention.

4.1.1 Mangrove Forests in Tanzania

Introduction:
Mangroves are salt-tolerant forests or swamp ecosystems that occur along tropical and subtropical coastlines, usually in sheltered bays and around river mouths. In Tanzania they are found on the sheltered shores of deltas, alongside river estuaries, and in creeks where there is an abundance of fine-grained sediment (silt and clay) in the upper part of the inter-tidal zone.

Occurrence:
The largest continuous mangrove areas are to be found on the coasts of Tanga district in the north, the delta of the Rufiji River, in Kilwa and Lindi districts, Muheza Bagamoyo, Kisarawe and in Mtwara, where the Ruvuma River forms an estuary close to the Mozambique border in the south (Map 1).

The mangrove forests cover an area approximately 108,138 hectares mainland Tanzania. But when the area covered by the salt crust areas is included the mangrove areas should be around 111,817 hectares (Table 2). Mangroves are also well represented on the coasts of the main islands, Zanzibar, Pemba, and Mafia. On Pemba mangroves cover an area of 12,146 ha, while on Zanzibar there are 6,073 ha under mangroves.

Ten species of mangroves are found in Tanzania (Table 1): One species, *Pemphis acidula,* is found only in Zanzibar. Of these, *Avicennia marina, Rhizophora mucronata*, and *Ceriops tagal* are predominant, while *Xylocarpus mulleccensis* is rare (Semesi and Adelaida 2000). All mangrove forests in Mainland Tanzania are gazetted as forest reserves. Conservation and management of these forests are guided by Forestry policy and Forestry Act of 2003 of the mainland and Environmental policy for Zanzibar.

TABLE 1: Mangrove Tree Species in Tanzania

No.	Tree species	Family	Local name
1	*Avicennia marina*	*Verbenaceae*	Mchu
2	*Bruguiera gymnorrhiza*	*Rhizophoraceae*	Msinzi or muia
3	*Ceriops tagal*	*Rhizophoraceae*	Mkandaa
4	*Heritiera littoralis*	*Sterculiaceae*	Msikundazi or mkungu
5	*Lumnitzera racemosa*	*Combretaceae*	Kikandaa or mkandaa dume
6	*Rhizophora mucronata*	*Rhizophoraceae*	Mkoko
7	*Sonneratia alba*	*Sonneratiaceae*	Mililana
8	*Xylocarpus granatum*	*Meliaceae*	Mkomafi
9	*Xylocarpus molluccensis*	*Meliaceae*	Mkomafi dume
10	*Pemphis acidula*	*Lythraceae*	Mkaa pwani

The importance of Mangrove

Mangrove forests have substantial commercial value primarily in terms of timber produced. However; this value extend to many other non-wood products that include for example, extractives (gums, fibres, dyes, etc), plants and animals for ceremonial, medicinal or decorative use, as well as recreational use.

MAP 1: DISTRIBUTION OF MANGROVES IN TANZANIA

Source: Wang et al, 2001; IMS database; URT, 1989 – 1:50,000 Topographic maps.

Mangroves are permanent or temporary habitats for many aquatic organisms. As the tide rises and submerges the mangrove flats, numerous fish move in to find food and shelter. Yellow fin bream, silver biddy, gobies, mullet *Valamugil saheli* and the seven-spot herring *Hilsa kelee*.are common inhabitants.

Associated with mangroves are lagoons and estuaries, which are important habitats for aquatic organisms. Mangrove communities play an important ecological role, providing habitat for a range of threatened or endangered species as well as nursery areas for the juvenile stages of commercially important fishery species (e.g. prawns and reef fish). Mangrove forests function as irreplaceable feeding and nursery grounds for many ecologically and economically valuable fish, shellfish, prawn, and crab species. (*Y. Wang et al.2002)*

The floor of the mangrove forest is a habitat for extensive numbers of invertebrates, each square metre of sediment can hold up to a hundred of them. The most common are crabs and molluscs. Three commercially important crustaceans, king prawns, blue swimmer crabs and mud crabs, live in mangroves. The mangrove ecosystem is rich in molluscs, several species of which are gathered by local women and form an important source of protein in the diet of villagers. Mangroves also provide breeding grounds for various other types of open sea fish types moving into these areas for food, shelter and cooler temperatures.

Commercial fisheries of crabs and prawns as well as fish are directly dependent on the mangrove ecosystems. Due to large mangrove areas, the Rufiji Delta is the most important prawn fishing grounds in Tanzania, from which about 80 % of the total commercial prawn catch is obtained (Annual Fisheries Statistics Reports 1993, 1994, 1995 & 1996; Semesi 2000).

Through the action of its roots, a mangrove forest recycles nutrients and traps land-based debris, sediments, and suspended particulate matter carried to the coast by rivers. Similar to coral reefs, mangroves are considered critical habitats with high productivity – producing large quantities of organic matter that serve as food for many organisms. Fishes such as the silver biddy and flat-tail mullet settle into the mangrove habitat from the plankton stage (the small animals and plants that float in the water column). Small juvenile silver biddies can be seen sheltering amongst mangrove roots and feeding on plankton. Schools of flat-tail mullet swim in mangrove creeks. As they grow, both species eventually move to other habitats.

Other potential uses of the mangrove ecosystem of relevance to fisheries, but not yet fully exploited include aquaculture, prawns and algae

A source of food

The abundant plant material produced by mangroves is a source of food for estuarine animals. However, most animals do not graze directly on the mangroves; instead they feed on the detritus (decomposing plant material).
Microscopic fungi and bacteria first break down the mangrove litter. Then detritus feeders such as mullet, prawns and crabs eat this decomposing material.

A single square kilometre of mangrove forest contributes about 600 tonnes of plant material each year to the estuarine food chain. Mangrove forests hence form nutrient rich environments, which promote a variety of food chains, and therefore function as feeding and nursery ground to many species of finfish, shellfish, prawns and crabs. For example the Mangrove forest of the Rufiji delta is said to provide 80% of the nursery grounds for prawn and shrimps.

Foreshore buffering

Mangroves grow between the estuary and the surrounding land, and act as a visual screen along developed shorelines. But they also buffer the waterway from the direct effect of run-off waters, by filtering pollutants from the land run-off. Thus mangroves help maintain estuarine water quality and reduce siltation in the waterways.

By stabilizing soils and reducing erosion losses, forests limit sedimentation of streams, reservoirs and the coastal near shore areas. Forests also play a significant role in stabilizing the local climate, particularly in terms of influencing rainfall patterns, as well as improving air quality and enriching soils through nitrogen fixation. In addition, mangroves trap sediments, thus playing a vital role in coastal protection by reducing erosion.

The forests and the roots secure the land, preventing shoreline erosion. The natural embankment formed by Mangrove forests act as self-regenerating barriers against coastal erosion, believed to be, in some ways, superior to manmade structures that have to be rebuilt if broken down.

Mangroves are also important for the health and water quality of near-shore ecosystems such as sea grass beds and coral reefs that develop best in clear waters. (Semesi et al 1999)

TABLE 2 Comparison of Mangrove Areas (in Hectares) Between 1990 and 2000

	1990 mangroves		2000 mangroves	
Coastal districts	Mangrove vegetation	*If salt crust areas added*	Mangrove vegetation	*If salt crust areas added*
Tanga and Muheza	9,217	*9,221*	9,313	*9,336*
Pangani	3,799	*3,799*	3,879	*3,879*
Bagamoyo	5,039	*5,039*	5,051	*5,051*
Dar es Salaam	2,494	*2,494*	2,516	*2,516*
Kisarawe	4,159	*4,261*	4,092	*4,167*
Rufiji	49,799	*50,968*	48,030	*50,391*
Kilwa	21,826	*22,546*	21,755	*22,552*
Lindi	4,034	*4,055*	4,044	*4,065*
Mtwara	9,226	*9,409*	9,458	*9,860*
Total	**109,593**	***111,792***	**108,138**	***111,817***

Source: Wang et al., 2001

MANGROVE ISSUES AND STATUS

Economically mangroves are a source of firewood, charcoal, building poles, construction materials, boat building, fish traps, fishing stakes, tannin and traditional medicines. Large numbers of mangroves trees are removed from surviving stands as timber for

housing construction as well as for fuel wood used domestically and for smoking fish (Semesi, 1993).

Although Tanzania experienced a small decrease in the overall mangrove coverage between 1990 and 2000 (Tanzania Coastal Management Partnership 2003), particularly in the Rufiji, Kilwa, and Mkuranga Districts; coastal and mangrove forest ecosystems however; are being altered by uncontrolled human activities, mainly through over-exploitation of resources therein, and clear cutting of substantial areas of mangroves for solar saltpans, agriculture/aquaculture (e.g. rice/shrimp farming/), industries , urban and hotel developments, (Francis, Wagner et al. 2002),

Dramatic changes in water movements – either fresh or seawater that take place in Mangrove ecosystem. These changes can be caused by humans or occur naturally for example through flooding, changes in river courses, strong wave actions, tsunami and drought.

In some places like Pangani river mouth Mangroves ecosystem are experiencing increased salinity especially during the dry season. This is attributed to damming activities in the upstream reaches of rivers due to reduced amount of water and sediment load to mangroves. Mangrove destruction may also lead to increased siltation of coral reefs and coastal erosion.

Mangroves also receive untreated wastes discharged to rivers, as well as oil and industrial pollution in some places, silt from erosion, and pesticides contained in runoff.

THREATS TO MANGROVE RESOURCES:

Threats to the continued existence of mangrove forests do exist and they have been enhanced by population growth in the coastal zone and the accompanying demand for residential and industrial developments. They include:

a) Over-harvesting for firewood, charcoal, building timber, poles, tannin and traditional medicines. However, this threat from community utilization has been reduced through sensitization towards moderate harvesting and allowing for recolonization.

b) Large scale conversion to build ports, towns, urban settlements, industries, hotels, agriculture, garbage dumps and landfills e.g. in Bagamoyo, Zanzibar; Dar Es Salaam Port, Kunduchi, Rufiji deltaetc

c) Construction of evaporation ponds for solar salt production. This is said to be the greatest threat to Mangrove resources in Tanzania where 75% of the salt is by solar production and the salt pans are located in Mangrove areas.

d) Potential threats: due to oil pollution and oil spills; poorly planned mariculture (e.g. attempted acquisition of part of the Rufiji delta for prawn culture).

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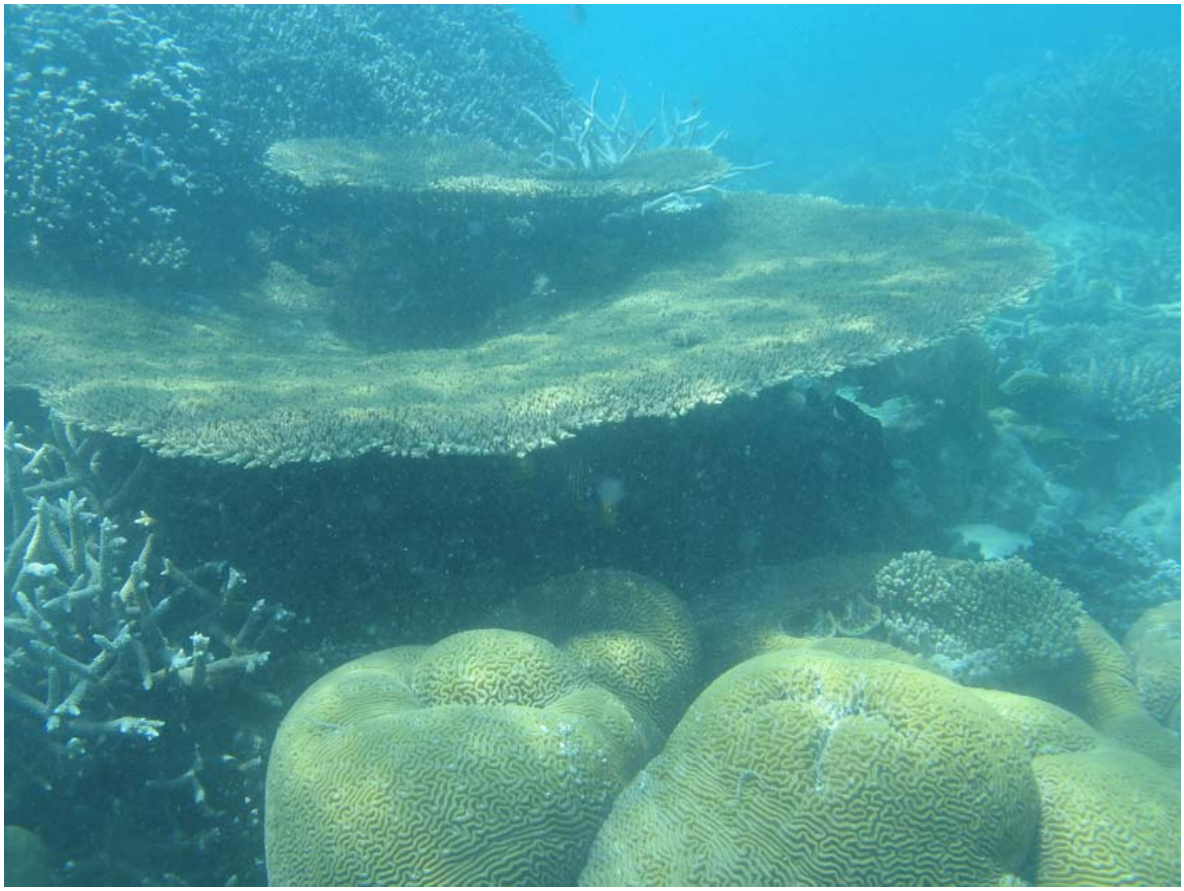
4.1.2 Coral reefs and associated biophysical environment

Reef-building (hermatypic) corals that produce calcareous skeleton contain symbiotic algae called zooxanthellae. Zooxanthella derives their food resources from photosynthesis, transferring some of these resources to the coral polyp, which fuses calcium with carbon to form the calcareous skeleton. Bright sunlight and clear waters are therefore critical to the development of coral reefs and they are consequently restricted to depths of less than 25 metres or so. Consequently, reefs usually occur along coastal margins or in areas where the seabed is shallow. The coral reef ecosystem comprises of reef-building corals themselves as well as a vast array of other organisms that depend on habitats provided by the reef. A variety of commercially important fish and invertebrates reside on coral reefs. Reefs protect the inshore areas from wave action and erosion, and therefore play an important role in coastal defence as well as in determining patterns of sediment transport. Destructive fishing practices notably dynamite and bottom dragged nets (e.g., Kigumi or Muroami), overfishing, sedimentation and pollution constitute the main human induced sources of Physical Alteration and Degradation of Habitats on coral reefs. Recently, natural processes, specifically elevated seawater temperature caused massive bleaching and mortality of corals in the Western Indian Ocean. Other natural threats include hurricanes, sedimentation loads (from eroded inland sources), floods (excessive freshwater intrusion), pollution (nutrient pollution causing eutrophication), outbreak of predatory species (e.g. crown-of-thorn starfish, coral eating crabs) and algal blooms and other competing species.

Abundant and health coral reefs are found in many places along the entire coastline of Tanzania (Map 1). Most of the coral reefs are composed of fringing reefs (originating from mainland, Islands or raised sea bottom). Patchy reefs occur on shallow sandy habitats. High concentrations of coral reefs or coral priority areas include Tanga-Pangani zone, West Pemba zone, west Unguja zone, north Unguja zone, North Dar es Salaam (Kunduchi) zone, West and South Mafia zone, Songosongo zone and Mikindani-Mnazi Bay zone (Map 2).

The Status of Coral Reefs of Tanzania – 2008 report is attached as an annex to coral reef chapter for your reference. Images of coral reefs, reef fish and macro-invertebrates are also linked to this document for your information.



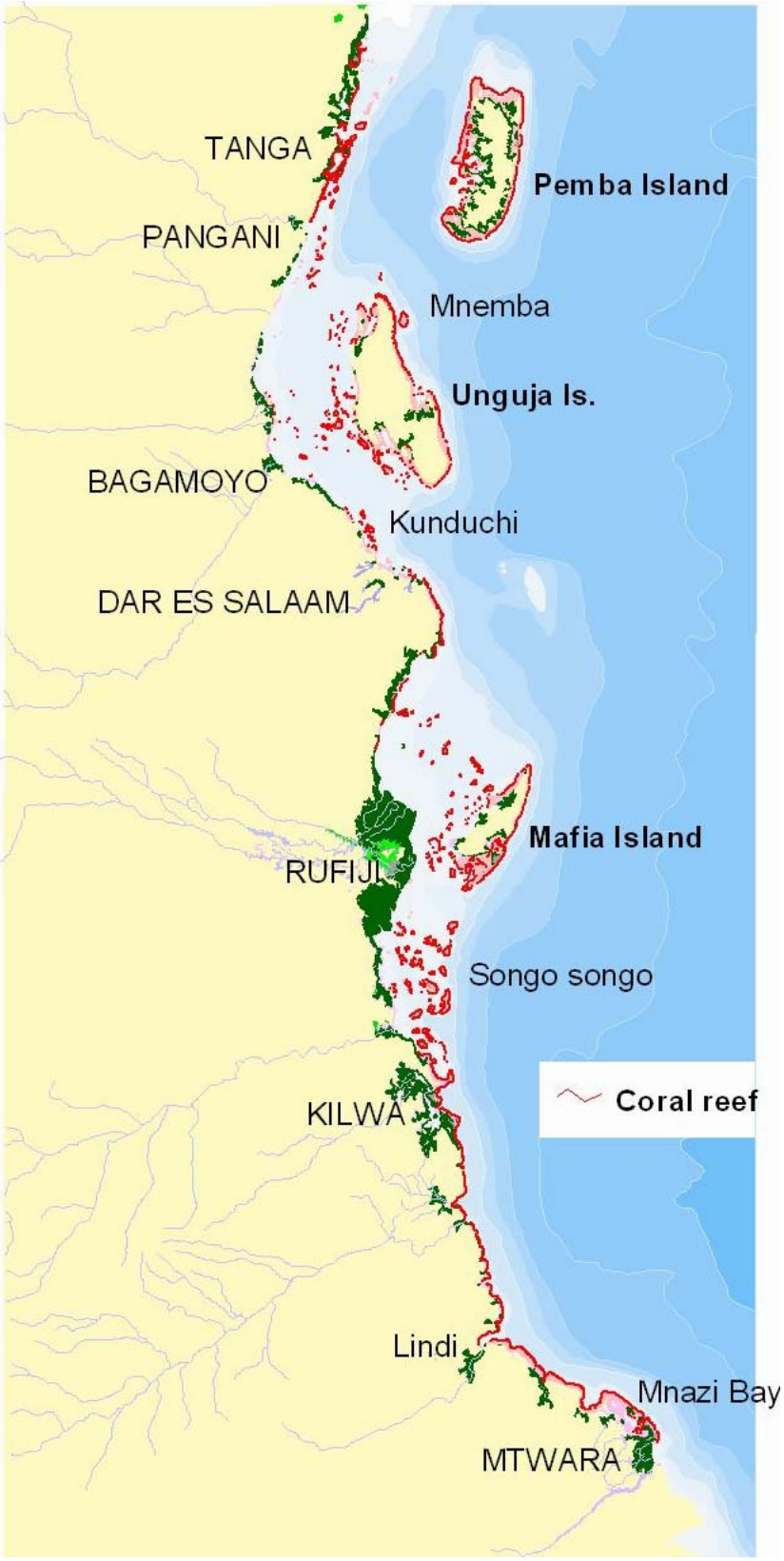
Images of Reef coral

Images of Reef invertebrates

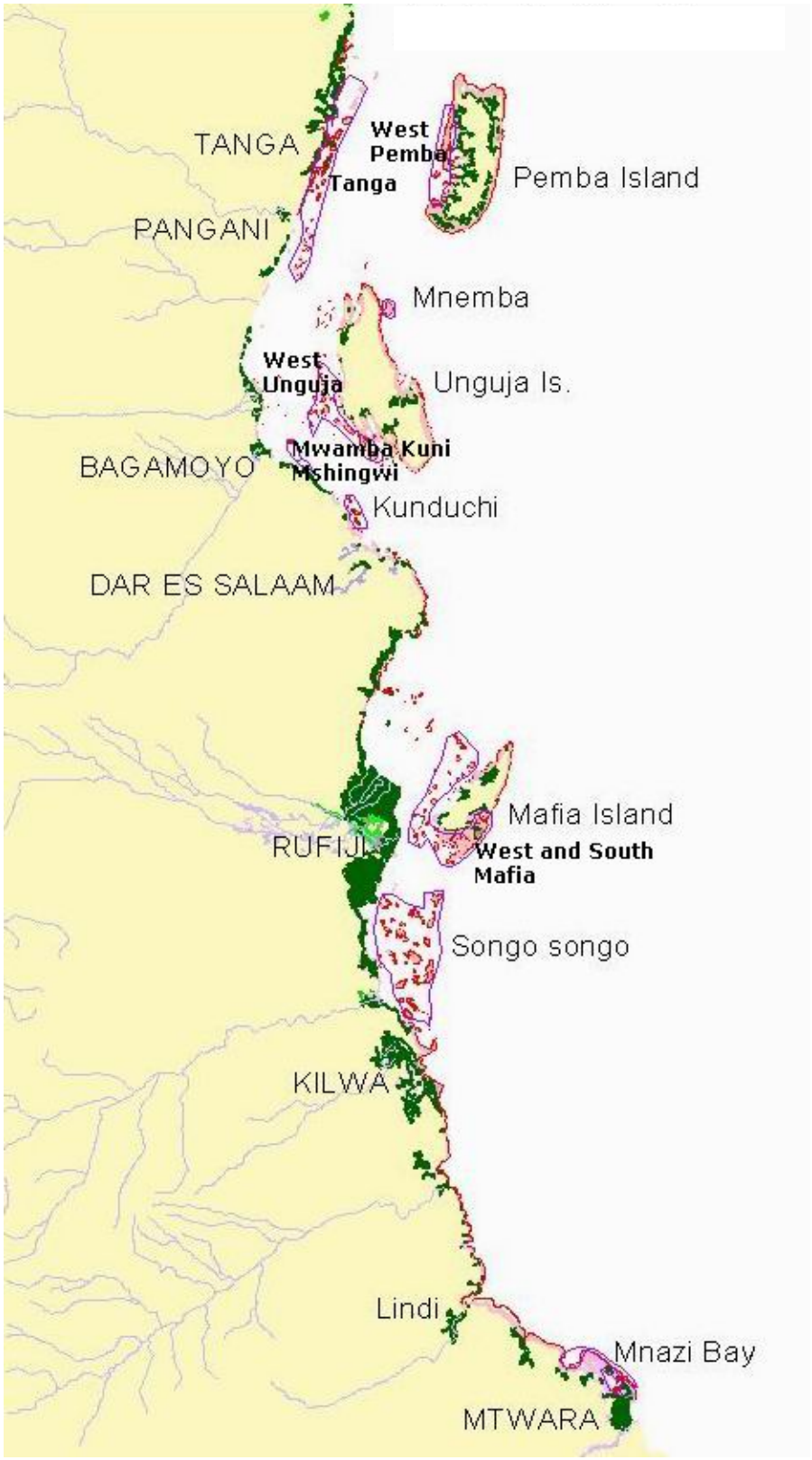
Images of Reef fish

Tanzania Coral Reefs Status Report - 2008

Map 1: The distribution of coral reefs in Tanzania



Map 2: Coral Reef Priority Areas



Appendix 1c

4.1.3 SEAGRASS BEDS

Sea grasses are marine flowering plants (Fig 1), which occur in shallow waters and estuaries. They grow best in lagoons and protected areas on stable sandy substrates up to 25 m depth where sufficient light penetrate to facilitate photosynthesis.

Fig. 1: Seagrass bed

Sea grasses form dense beds that cover large areas of sandy or muddy coastal bottom, a common feature in subtidal and intertidal mud and sand flats, coastal lagoons, and sandy areas around the bases of shallow fringing and patch reefs. In the vicinity of coral reefs, seagrass is linked to reefs physically and in terms of energy flows. They interact closely with other marine ecosystems especially Mangrove. They are highly productive areas and are high in species diversity and numbers of individuals (Semesi et al., 1999) and serve many ecological functions. For example, sea grasses tap the nutrient associated with Mangroves converting them into lush plant biomass. Extensive sea grass beds stabilize sediment by the roots thereby reducing suspension and lateral movement of sand and mud. They support complex food webs through living and dead biomass. However, a considerable amount of sea grass productivity is exported in the form of particulate material derived from the fragmentation of dead and decaying plants. This material plays a central role in many coastal food webs and is utilised by a variety of filter-feeding organisms.

Within the sea grass normally exists an animal community that includes members of the phylum Echinodermata that include sea cucumbers, starfish and sea urchins; mobile molluscs such as Cowries (*Cypraea spp*.) plus various buried bivalves and crustacean such as crabs and shrimps. Many of these animals as well as some fish lay egg masses on the sea grass and algae within sea grass beds. Thus sea grass beds provide breeding, nursery, and feeding areas for many invertebrate and vertebrate species including

commercially important species of finfish and shellfish; and shelter and refuge for resident and transient adult animals such as Dugong, green and hawksbill turtles. Some species of sea urchins feed on detritus from sea grasses. Additional ecological functions of sea grass include the trapping of sediments, which reduces sedimentation over coral reefs and the dissipation of wave energy, which also provides protection to the beaches and therefore protects shorelines. Furthermore sea grass provides substrates for epiphytic algae. In sea grass beds nitrogen fixing micro-organisms are common.

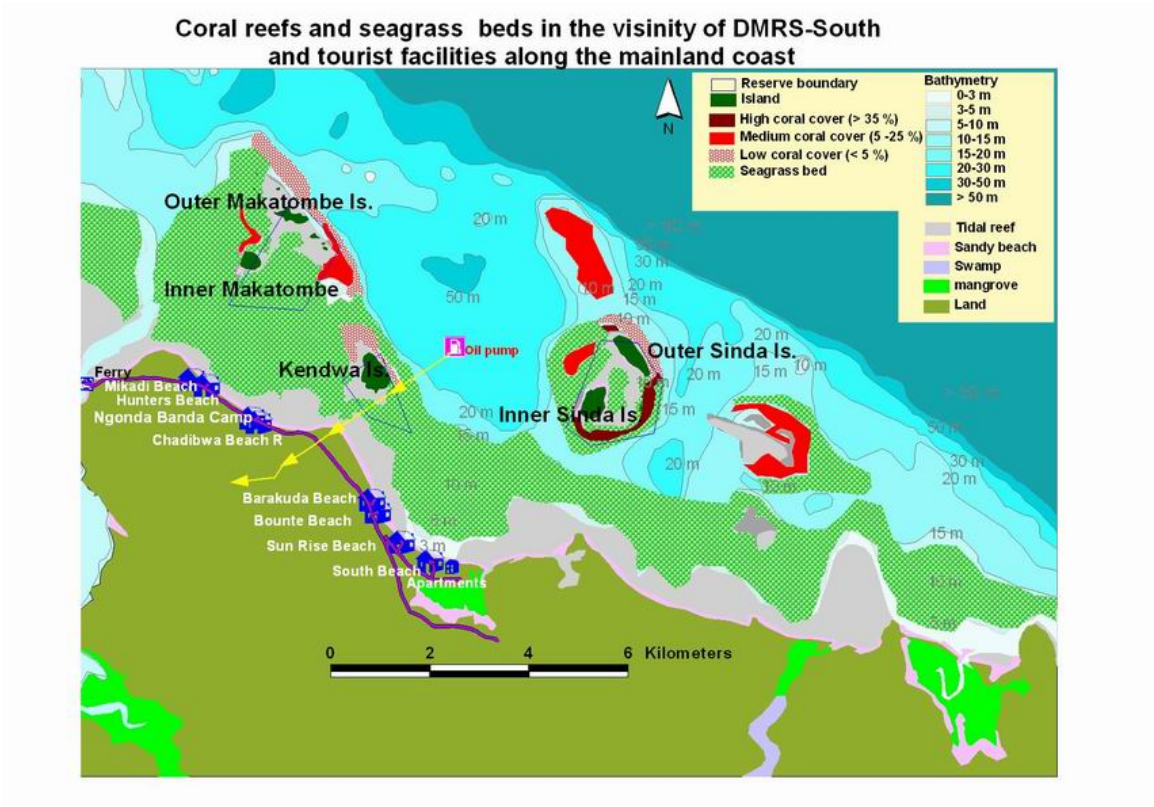
Seagrass species recorded in Tanzanian coastal waters include: *Cymodocea rotundata, Cymodocia serrurata Hallodule univervis Hallodule wrightii, Halophila minor, Halophila ovalis, Halophila stipulaceae, Halophila cuinervis, Syringodium isoetifolium, Enhalus acoroides, Thalassia hemprichii and Thallasodendron ciliatum* (TCMP 2001, Mgaya 2000). Extensive sea grass beds are found in shallow (0-25 m) and sheltered areas of the coast around Mnazi Bay,.Kilwa, Rufiji, Ruvu and Moa. They also occur extensively on the western side of Pemba, Unguja and Mafia islands. Seagrass are stressed in areas with excessive sedimentation in some estuarine environments.

Seagrass mapping in Tanzania coastal regions has not been carried out as yet, mainly because of complications in eliminating water column errors inherent in common satellite sensors. However, using GPS and Reef Viewers, the University of Dar es Salaam (Institute of Marine Science) has mapped some few areas particularly around Northern (Map 1) and Southern Dar es Salaam Marine Reserves (Map 2), East coast of Zanzibar, and in Menai Bay Conservation Area.

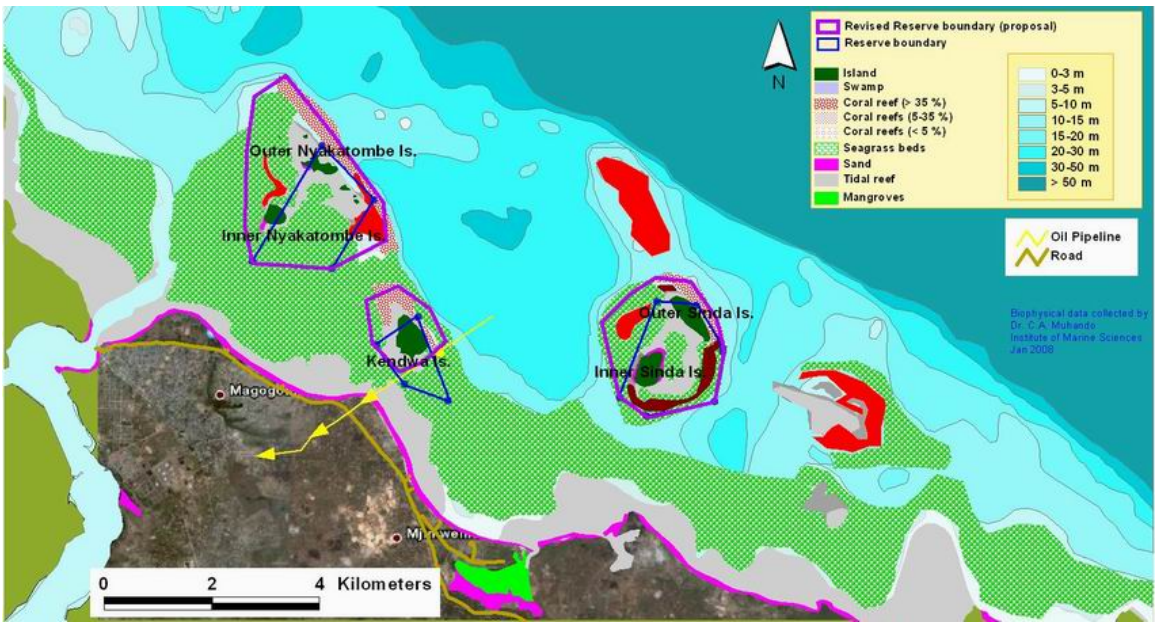
In northern and southern Dar es Salaam Marine Reserve systems, Muhando et al (2007a 2007b) reported that Seagrass was the most extensive habitat found in these reserves. Seagrass was estimated to cover more 1217.1 ha (35 %) and *** ha (35%) of the reserve areas. In these zones, the distribution of sea grass beds was influenced by a combination of wave action and tidal current strength, bottom characteristics, sediment re-suspension/ deposition patterns and water depth. The deepest range of sea grass growth was observed on the less turbid areas (e.g. western side of Fungu Yasini), where seagrass were found to grow up to 20 m deep. Healthy stands were found in the subtidal areas from 1 to 10 m deep. Due to high sedimentation and turbidity, sea grass depth range was less than 7 m off Kunduchi beach. Interviewed fishermen suggested that fishery in the area is probably sustained by seagrass beds rather than coral reefs. Field analysis revealed that most of the fishing takes place in and around seagrass beds rather than on coral reefs. A combination of high cover of seagrass beds and coral reefs, coupled with remoteness (little destructive activities), appear to be responsible for in attracting fish spawning and or feeding aggregations.

Distribution of seagrass beds from the few mapping areas so far agrees with the general assumption that all shallow waters (less than 20 m deep) have seagrass beds as the main habitat. They grow on sandy intertidal before coral reefs as well as beyond the reef slopes, in most areas. Seagrass bed is highly correlated with demersal fisheries just like coral reefs. Songosongo, Kilwa and Mafia area are probably the most important seagrass areas, followed by Zanzibar channel and Tanga. Development of seagrass beds just north and in the vicinity of Rufiji river is interrupted by sediment load from land based sources.

Map 1: Distribution of seagrass beds in Northern Dar es Salaam Marine Reserves



Map 2: Distribution of seagrass beds in Sluthern Dar es Salaam Marine Reserves



Recent studies in Mnazi Bay Marine Park have shown that both the intertidal and sub tidal sea grass beds are in good condition with luxuriant growth and high diversity. Nine species of sea grass that have been reported in Mnazi Bay Ruvuma Estuary Marine Park (MBREMP): *Thalassia hemprichi, Halodule uninervis, H. wrightii, Halophila stipulacea, H. ovalis, Thalassodendron ciliatum, Cymodocea rotundata, Cymodocea serrulata, Syringodium isoetifolium.* Though not validated Zostera capensis is likely to occur in MBREMP.

THREATS

The fish and shrimp communities associated with sea grass beds are important to both the artisanal and industrial fishery. Because sea grass beds are mainly found in shallow water close to shore, they are very vulnerable to pressure from human activities. Major threats to the survival of sea grass beds come from excessive sedimentation from land based activities. Increased turbidity cut down the light penetration and negatively influences seagrass health. In some areas, concerns have also been expressed about the effects of inshore seine nets and intensive trawling activities on the seabed, which destroy sea grass beds. Seaweed farming in some areas involves removal of sea grass beds as well as producing growth inhibiting substance that prevent sea grass from growing in farmed areas. Intensive trampling on seaweed farms and adjacent areas (including passages) has been observed to cause physical alteration. Also frequent dynamite blasts kills sea grasses.

Wherever coral reef, sea grass beds and mangroves occur adjacent to each other, biological linkages and ecological dependence usually occurs. Thus, management of the coastal areas should take into consideration management of all key habitats, i.e. Island vegetations, intertidal areas, sea grass beds, mangroves, coral reefs and other physical condition along the coastline.

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Appendix 1d

4.1.4 Estuaries in Tanzania

An estuary is a partially enclosed body of water formed where freshwater from rivers, streams, and groundwater flows to the ocean, mixing with the salty seawater. Estuarine are areas of influence to the marine environment as they discharge freshwater, sediments, silt, nutrients and even pollutants and other runoff from terrestrial environment. Nutrient rich sediments and water make estuaries very productive. Although influenced by the winds and tides, estuaries are protected from the full force of ocean waves, winds, and storms by the reefs, barrier islands, or fingers of land, mud, or sand that define an estuary's seaward boundary. Estuaries are thus defined by salinity rather than geography and are often associated with high rates of biological productivity. All major estuaries in Tanzania are associated with mangrove stands as well.

The importance of Estuaries
Estuaries are critical to the survival of tens of thousands of birds, mammals, fish, and other natural world. Many different habitat types are found in and around estuaries, including shallow open waters, freshwater and salt marshes, sandy beaches, mud and sand flats, rocky shores, oyster reefs, mangrove forests, river deltas, tidal pools, sea grass beds, and wooded swamps. Being protected from strong waves and currents, they are function as recreational and educational sites. Boating, fishing, swimming, windsurfing, and bird-watching are just a few of the many activities people enjoy in estuaries. Estuaries serve as nursery grounds for many commercial fish and shellfish. Estuaries are also home to ports and harbours that support shipping and other industrial and commercial activities.

Some Impacts on Estuaries
Some typical impacts on estuarine systems include loss of habitat due to development, loss of recreational opportunities due to poor water quality, and loss of economic resources due to shellfish bed closures and a reduction in fisheries.

Pollution of coastal watersheds poses a threat to estuaries. Pollutants enter waterways through storm drains; industrial discharges; runoff from lawns, streets, and farmlands; discharges from sewage treatment plants; and atmospheric deposition. These pollutants or substances can be toxic or harmful to marine life even can have detrimental effect to the ecological set up or biological system with long lasting effect through generations. Pollutants can also have visual impacts on estuarine environment.

Estuaries are vulnerable to the introduction of a wide variety of *toxic substances*. Metals, such as mercury, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and pesticides can concentrate in the water, sediment, and inhabitant aquatic organisms. Bottom-dwelling organisms like shellfish are exposed to these chemicals and can pose a risk to human health if consumed. Marine life and aquatic plants and animals can also be harmed through the consumption of contaminated fish and water.

In the case of excessive nutrients from land based or point source can adversely affect estuarine systems. Excessive nutrients in estuaries can result in accelerated eutrophication and algal blooms. As the algae die, they decay and rob the water of oxygen. The algae also prevent sunlight from penetrating the water. Fish and shellfish are deprived of oxygen, and underwater sea grasses are deprived of light and can die. Organisms that depend on sea grasses for food or shelter leave the area or die. In addition, the excessive algae growth can result in brown and red tides and other harmful blooms. Increased algae can also cause foul odors and decrease aesthetic value.

Pathogens are disease-causing microorganisms such as viruses, bacteria, and parasites and can be a result of inadequately treated sewage released into estuaries by faulty or leaky septic systems and sewage treatment plants, runoff from urban areas and animal operations, medical waste, boat and marina waste, combined sewer overflows, and waste from pets and wildlife. They can pose a health threat to swimmers, divers, and seafood consumers. Fish and shellfish concentrate pathogens in their tissues and can cause illness in people consuming them.

Habitat alteration such as the filling of marshes and tidal flats, and reconstruction of shorelines to accommodate the needs of development, transportation, and agriculture, can degrade estuaries. Wetland loss and degradation have limited the amount of habitat available to support healthy populations of wildlife and marine organisms. The clearing of land to obtain timber, the construction of homes and roads, and other development projects completed without properly re-vegetating the area can lead to excessive sediments being washed into the estuarine environment. These sediments muddy the water, preventing sunlight from reaching aquatic vegetation and making the water unappealing to swimmers. Sediments can also carry excess nutrients, pesticides, and toxic substances, causing additional water quality problems.

Intentional or accidental introduction of invasive species can often result in unexpected ecological, economic, and social impacts on the estuarine environment. Through predation and competition, introduced species have contributed to the loss of some native populations and the drastic reduction of others. Overpopulation of some introduced herbivorous species has resulted in overgrazing of wetland vegetation and degradation and loss of marsh habitat. Other impacts include increased erosion and interference with sport and commercial fishing and beach use

Marine debris enters an estuary by washing in from storm sewers and with the tide. Marine debris is one of the more widespread pollution problems threatening estuarine and coastal systems. Debris comes from many sources, including improper disposal of trash on land, storm water runoff and combined sewer overflows to rivers and streams, ships and other vessels, and offshore oil and gas platforms. Once litter gets into the estuarine environment, it seriously affects wildlife, the environment, humans, and our economy. Coastal communities lose considerable income when littered beaches must be closed or cleaned up.

Threats to estuaries

Estuaries are an important component of the complex and dynamic coastal watershed. Estuarine are prone to habitat alteration due to coastal development, dredging activities in the harbour, Sedimentation, and filling.

The economy of many coastal areas so is Tanzania relies on the natural beauty and bounty of estuaries. When those natural resources are imperilled, so are the livelihoods of the many people who live and work along the coast. As our population grows, the demands imposed on our natural resources including land for space increase and protecting these resources for all their natural, economic, and aesthetic values becomes even more important.

Location of estuaries in Tanzania

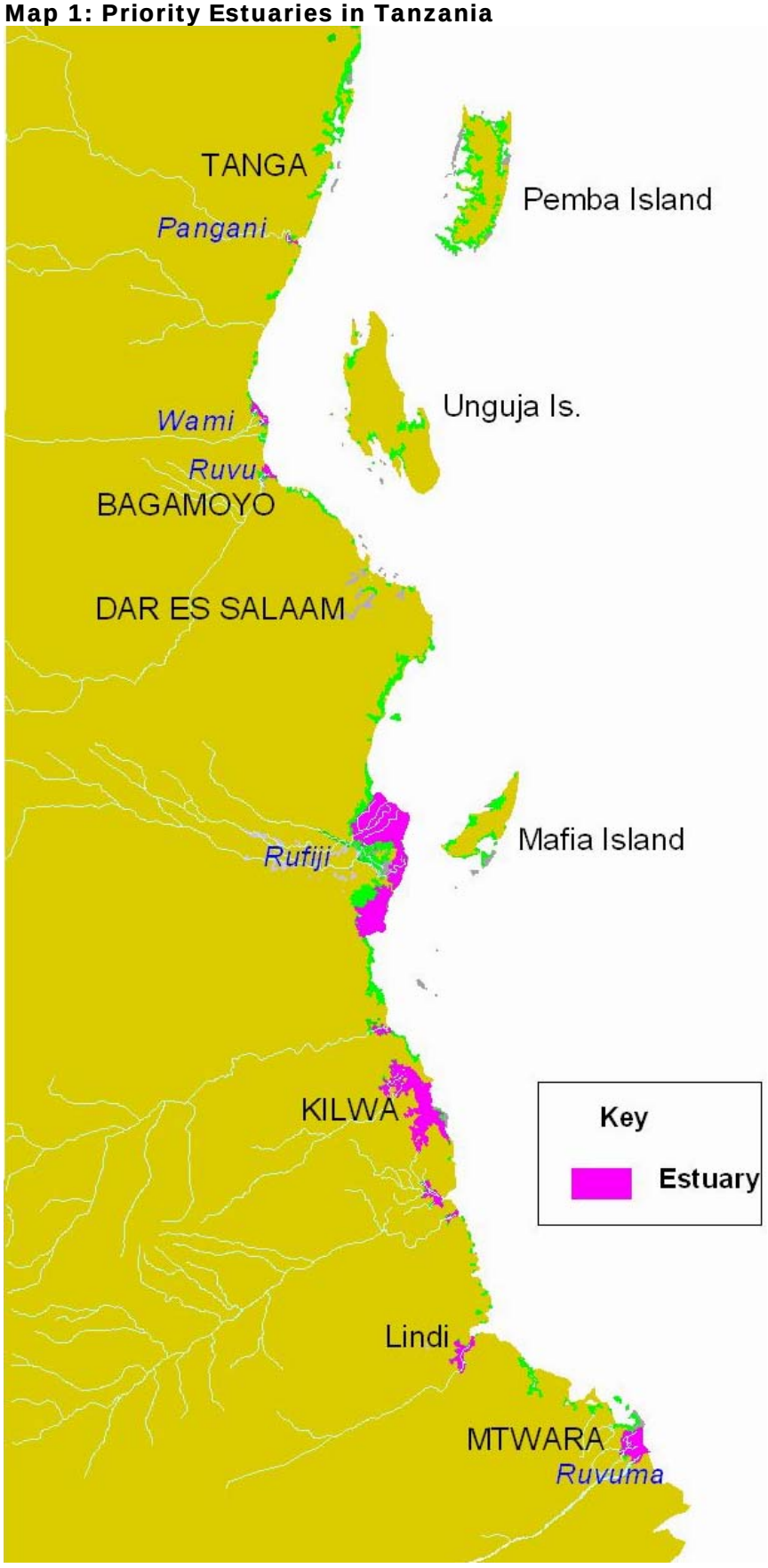
The main rivers and estuaries include (Map 1):

- Pangani – it has a funnel shaped river mouth, bounded by cliffs on one side and a sandy beach on the other; mangroves are found further up the river where it widens. It receives mean annual runoff of 627 mill m^3 (at Hale) from river pangani;

- Mlingasi
- Msangasi
- Wami – is a fairly wide, mangrove dominated tidal estuary with mean annual runoff of 3,280 mill m^3 (at Mandera),
- Ruvu - mean annual runoff of 1,370 mill m^3 (at Morogoro bridge)
- Rufiji – Has a deltaic formation. The delta extends some 24 km inland (tides influence the river for some 40 km upstream) and has eight major branches. With an annual discharge of 1133m^3/s it is one of the largest rivers in Africa, and contributes 50% of the surface runoff of the Indian Ocean Drainage System (the largest drainage basin in Tanzania), having the second greatest input into the Indian Ocean after the Zambezi River in Mozambique. It receives runoff from Rufiji river. The river with its branches Ruaha Mkuu which is about 750 km long; Rufiji, 640km long, mean annual runoff of 22,250 mill m^3 (at Stiegler's Gorge); The Rufiji transports some 500,000 tons of sediment daily during the flood season (Richmond et al., 2002)
- Matandu
- Mbwemburu
- Lukuledi
- Ruvuma, - has a deltaic formation made up of tidal creeks rather than river tributaries. Is the second largest estuary in Tanzania with a large area of mangroves, sand banks and mud flats, and many channels and tributaries It receives run off from River ruvuma which is about 640 km long.

There are no major rivers on Mafia, Pemba or Unguja, but these islands as well as some mainland coastal areas are formed of porous fossil reef and have extensive ground water systems with under water seepages that may have a considerable influence on inshore waters. These systems have been little studied.

Map 1: Priority Estuaries in Tanzania



Appendix 1e

4.1.5 Important Bird Areas

A wide variety of coastal birds and seabirds are found in URT, particularly in mangrove forests, intertidal flats and on rocky cliffs. Open water areas such as the Zanzibar and Mafia channels and Indian Ocean itself provide rich feeding grounds for true seabirds such as terns, gannets, brown noddies and boobies. Waders and shorebirds visit URT in large numbers each year between August and May to feed, particularly on intertidal flats at low tides.

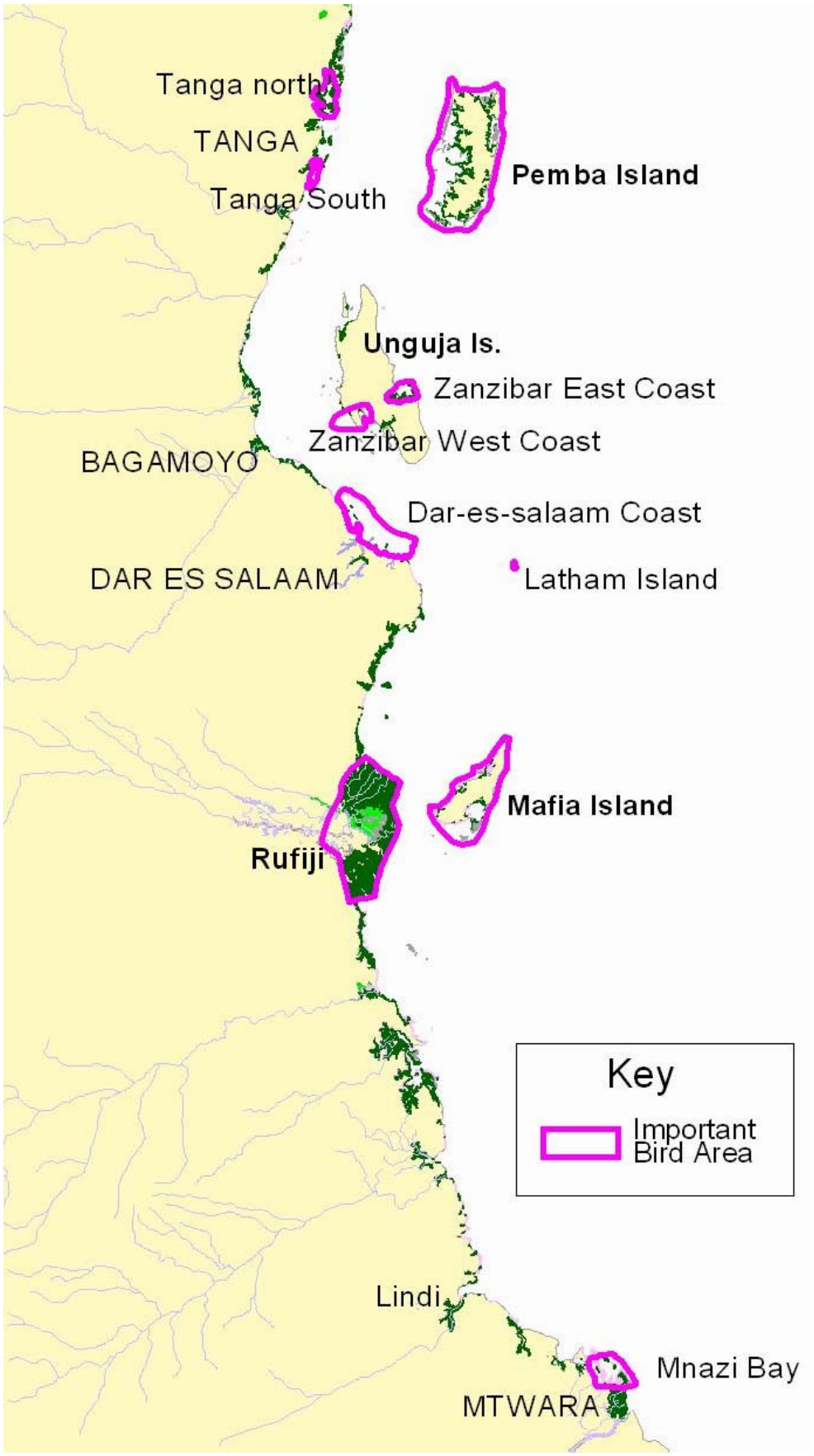
Important Bird Areas (IBAs), designated by Birdlife International through a widely accepted scientific process, provide an indication of priority bird conservation areas. Ten IBAs have been designated along the coast (Baker and Baker, 2002) (Map 1):

1. Tanga North (IBA 35) – Kibo salt pans, south-west of Moa village; surveyed only once but important populations of greater sandplovers and curlew sandpipers
2. Tanga South (IBA 36) – south of Mtangata Bay; salt pans, beach and mangroves important for greater sandplovers and crab plovers
3. Dar es Salaam (IBA 21) – intertidal mud flat (up to 25 sq km in area), with salt pans, mangroves, river inlets and small islets ; tidal range of up to 4m ; important for crab plovers, roseate terns, saunders terns and numerous migrants in the northern winter
4. Rufiji Delta (IBA 32) - recognized locally and internationally as an important wintering ground for migrant birds and likely to be important for numerous wetland and water birds, but poorly known.
5. Mafia Island (IBA 12) provides staging ground for various Palearctic migrant species. Mafia Marine park in particular provides feeding grounds for a variety of wading birds. It also act as nesting areas for open-billed storks *Anastomus lamelligerus* and fish eagles *Haliaetus vocifer* (Board of Trustees, 2000*)*
6. Mnazi Bay (IBA 28) – important area for migratory birds with salt pans and mangroves on small islands that provide major wader roosts;
7. Zanzibar South Coast (IBA 44) – important roseate tern colony on small islet off Chumbe Island; crab plovers and terek sandpipers and other waders in Kiwani and Kombeni Bays
8. Zanzibar East Coast (IBA 45) – Chwaka Bay is a key area for crab plovers and greater sandplovers; up to 15% of the world population of saunder's tern may winter here
9. Pemba (IBA 76) – mainly important for endemic terrestrial species but large number of dimorphic egrets and crab plovers observed and the mangroves may provide important bird roost and feeding grounds
10. Latham I. (IBA 27) - critical importance for its masked booby colony, and also an important breeding site for sooty terns, brown noddies, swift terns, and black-naped terns; considered the most important seabird island off the coast of East Africa.

References

Baker and Baker, 2002;
Wells et al., 2004

MAP 1: Important Bird Areas in Tanzania



Appendix 2a

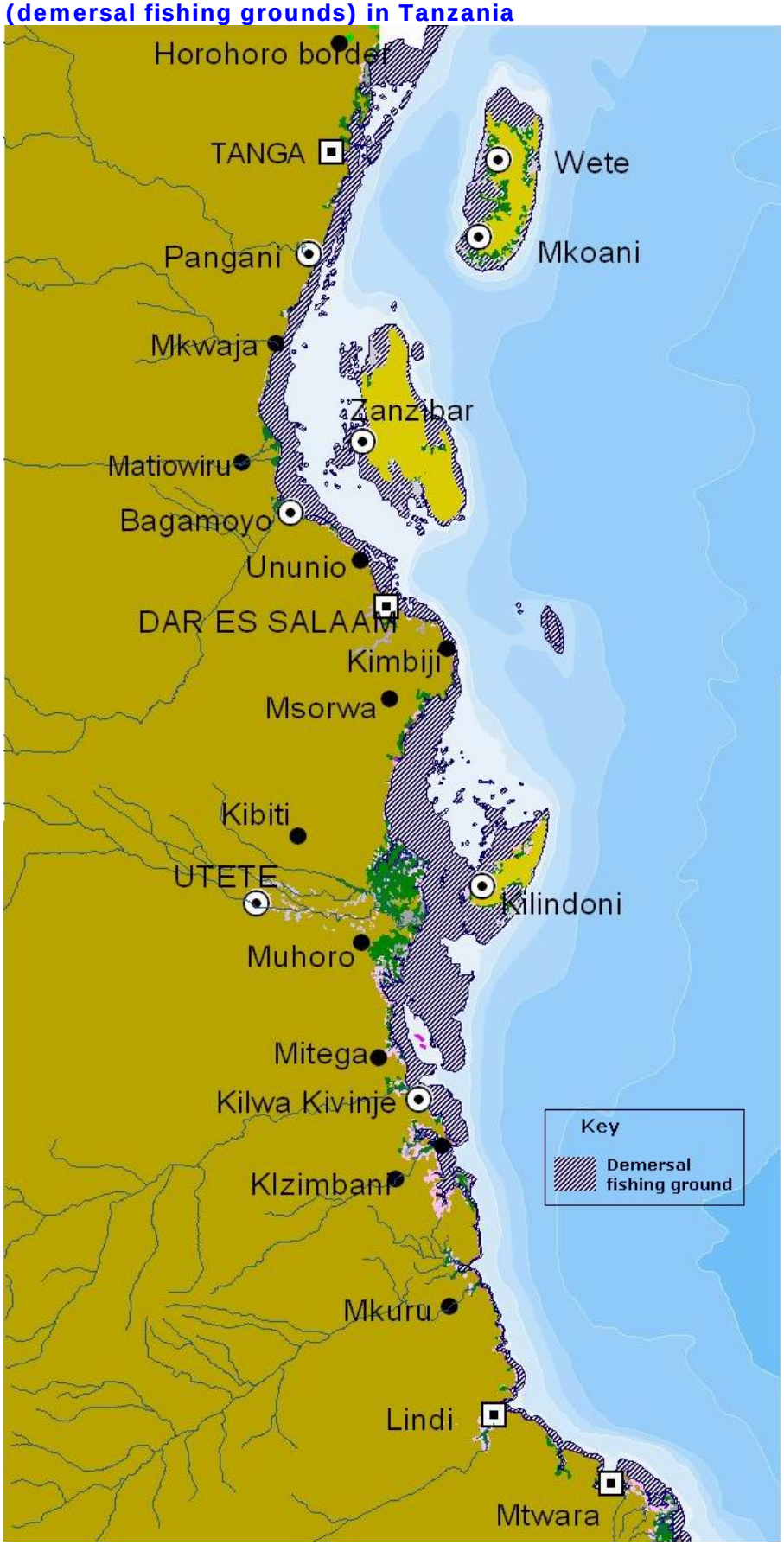
4.2.1 Demersal fishing grounds

Demersal fishing in this report includes all fishing activities conducted in shallow waters less than 20 m depth. This type of fishing is done along the whole coast line in shallow waters less than 20 m deep. In this zone, fish stocks are supported by a combination of benthic and water column primary productivity. The high benthic productivity on shallow habitats like coral reefs, sea grass beds and mangroves attracts corresponding high secondary (zooplankton and zoobenthos) and tertiary (mostly fish and invertebrates) productivity. It is in this zone that we find the highest concentration of artisanal fishing activities.

Coral reefs, mangroves, sea grass beds, estuaries and rocky tidal zones comprise the demersal fishing grounds. Highest productivity is observed in shallow waters where mangroves, sea grass beds and coral reefs are found adjacent to each other. Highest invertebrate productivity (shelled molluscs) is found on shallow intertidal zones. Generally, rocky subtidal zone is richer in species diversity than sandy or muddy shallow water habitat. Occurrence of small islets and sand banks also protected the inshore waters from strong waves and currents. Thus, a combination of high benthic productivity and wave protection has made it possible for all fishers to access this zone using small crafts or even without. Octopus fishery in some places is conducted without using vessels. On the other hand, accessibility has made the inshore waters to be vulnerable to abuse and over exploitation of its resources. Almost all the destructive fishing practices are associated with demersal fishery in this zone. Major demersal fishing grounds are found in the Mafia Channel and Zanzibar Channel. However; occurrence of small islets and sand banks have increased the total area of demersal fishing ground in areas like off Zanzibar, Pemba, Tanga coast, Songosongo and Mafia archipelago, Mikindani, Mnazi Bay and Latham island (see map below). Small islets and sand banks also protect the inshore waters from strong waves and currents. Thus, a combination of high benthic productivity and wave protection has made it possible for all fishers to access this zone using a range of crafts from big to small crafts or even without. For instance Octopus fishery in some places is conducted without using vessels. On the other hand, accessibility has made the inshore waters to be vulnerable to abuse and over exploitation of its resources. Almost all the destructive fishing practices are associated with demersal fishery in this zone.

The introduction of deep set gillnets and deep water trawlers has expanded the scope of demersal fisheries as well as complication in the management and regulating the fishery.

Map showing the location of important and extensive shallow water areas (demersal fishing grounds) in Tanzania



Appendix 2b

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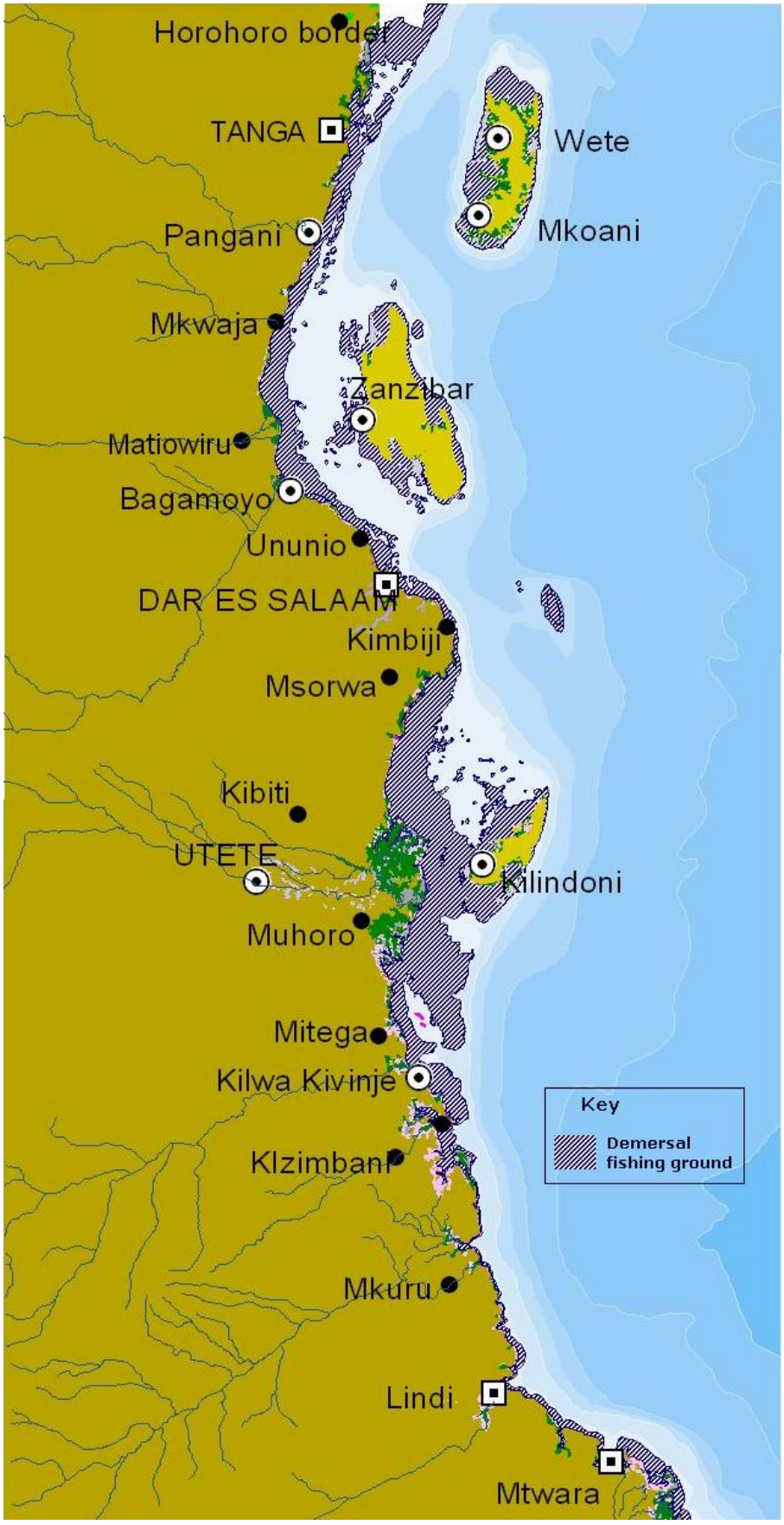

Horohoro border
TANGA
Wete
Pangani
Mkoani
Mkwaja
Zanzibar
Matiowiru
Bagamoyo
Ununio
DAR ES SALAAM
Kimbiji
Msorwa
Kibiti
UTETE
Kilindoni
Muhoro
Mitega
Kilwa Kivinje
Klzimbani
Mkuru
Lindi
Mtwara
Key
Demersal fishing ground

Appendix 2c

4.2.3 Prawn Fishery

Prawns and shrimps are crustaceans. They have short life cycle and are found in brackish water environment associated with mangrove ecosystem and adjacent sea areas. Prawn fishery is predominately shallow water and target penaeid shrimp. Life history of prawns involves migration from shallow brackish water environment to deep waters where mature female lay eggs. After hatching the juvenile undergo various stages and move to the brackish waters in the deltas, estuaries and creeks where they grow until they attain maturity before moving to the deep waters for spawning. The cycle usually last between twelve to eighteen months. The spent female individuals normally die after spawning. When young are males and when they grow big they can change sex to become females. Prawns are nocturnal and spend the day time in burrows and are short lived animals. They are detritus feeder and therefore are found associated with muddy environments in mangroves and estuaries.

The rich prawn fishing grounds are found around the River mouths and estuaries as well as in adjacent waters; e.g. Rufiji Delta, Wami and Ruvu, Pangani, Ruvuma estuaries. The most abundant and marketable types of prawns/shrimps include *Penaeus monodon* and *Penaeus semisulcatus (*tiger shrimp*), Penaeus indicus(*white shrimp*)* , *Penaeus japonicus (* flower shrimp*)* and *Metapeneus monoceros* (brown shrimp). The major contribution to the catches is composed of the white shrimp (65.9%), brown shrimp (15.1%) and tiger shrimp (11.0%); the contribution of the flower shrimp is lowest (6.7 %).

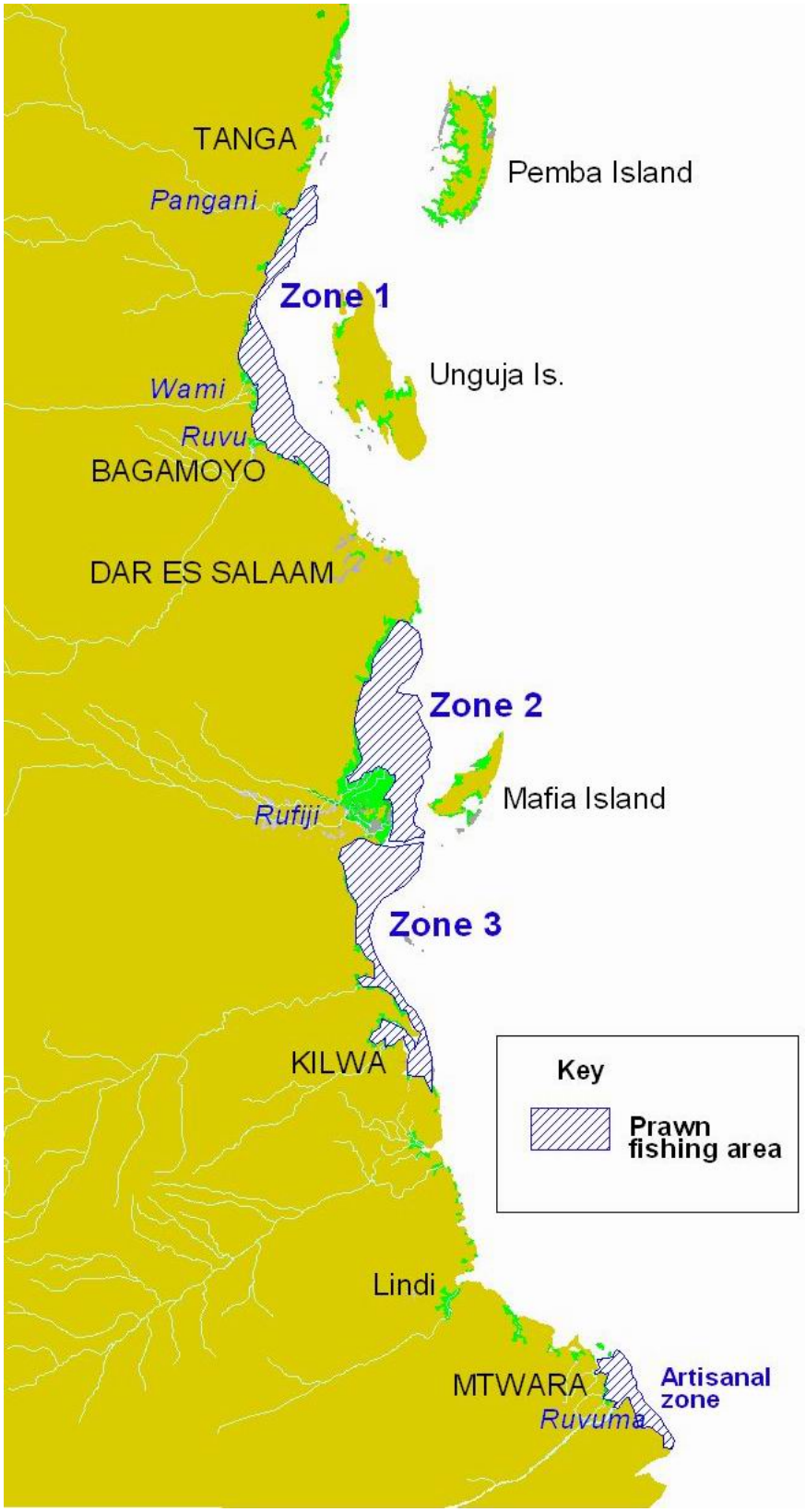
Important prawn fishing grounds are found around deltas and mangrove forest areas mostly around Rufiji and Bagamoyo. Most catch is collected in less than 20 m depth. Both local artisan fishers and semi industrial trawler are involved in the fishery which is basically for the export market; only a few prawns are sold locally in tourist hotels and restaurants. The major trawling grounds for prawn/shrimp have been zoned for management purpose into three zones (Map 1). Zone 1 is located between Latitudes 5' 25' and 6' 30' S and includes the areas between Pangani, Saadani and Mbegani in Bagamoyo. Zone 2 is between Latitudes 7' and 8' S and includes the inshore areas around Kisiju, Bwejuu, Mafia Island and the northern part of Rufiji areas. This is the most productive of the three zones. Zone 3 lies between Latitudes 8' and 10' S and includes the southern part of Rufiji areas and Kilwa.

Total catch from commercial prawn fishery fluctuated between 2,190 tons in 1988 caught by 13 trawlers to 1,119 tons in 1991 using same trawler effort. Currently there are about 23 prawn trawlers, but catches have not changed significantly, indicating over-fishing in the trawling areas.

For management purposes, the Department of Fisheries has instituted other Management procedures and regulations to control the activities of prawn trawlers operating in these designated areas. These include the enforcement of the prohibition of dumping by-catch from the prawn fishery overboard. Previous dumping of finfish by catch was causing pollution of inshore waters. Following the strengthening of the Government's monitoring through improvement in the enforcement of the Fisheries Act, by-catch dumping has been greatly reduced. The by-catch is brought to landing sites on shore for the local market or processing. They are to observe the regulation of fishing during the day time and stay at the anchor at night. Also to observe a three month closed period for Commercial fishing for prawns from 1st December each year and reopens on 1st March of the proceeding year. With dwindling of catches however the closed season has now been extended to six Month effective from September 1st every year to end of February of the following year. Interviews with some trawler operators have revealed that they are even willing to increase the closed period to allow the shrimp prawn to breed and stocks to recover from over fishing and overcapitalization.

Fishing under the artisanal fishing industry is allowed throughout the year. Conflict between artisanal fishers and trawlers occur

Map 1: Prawn Fishing Grounds in Tanzania



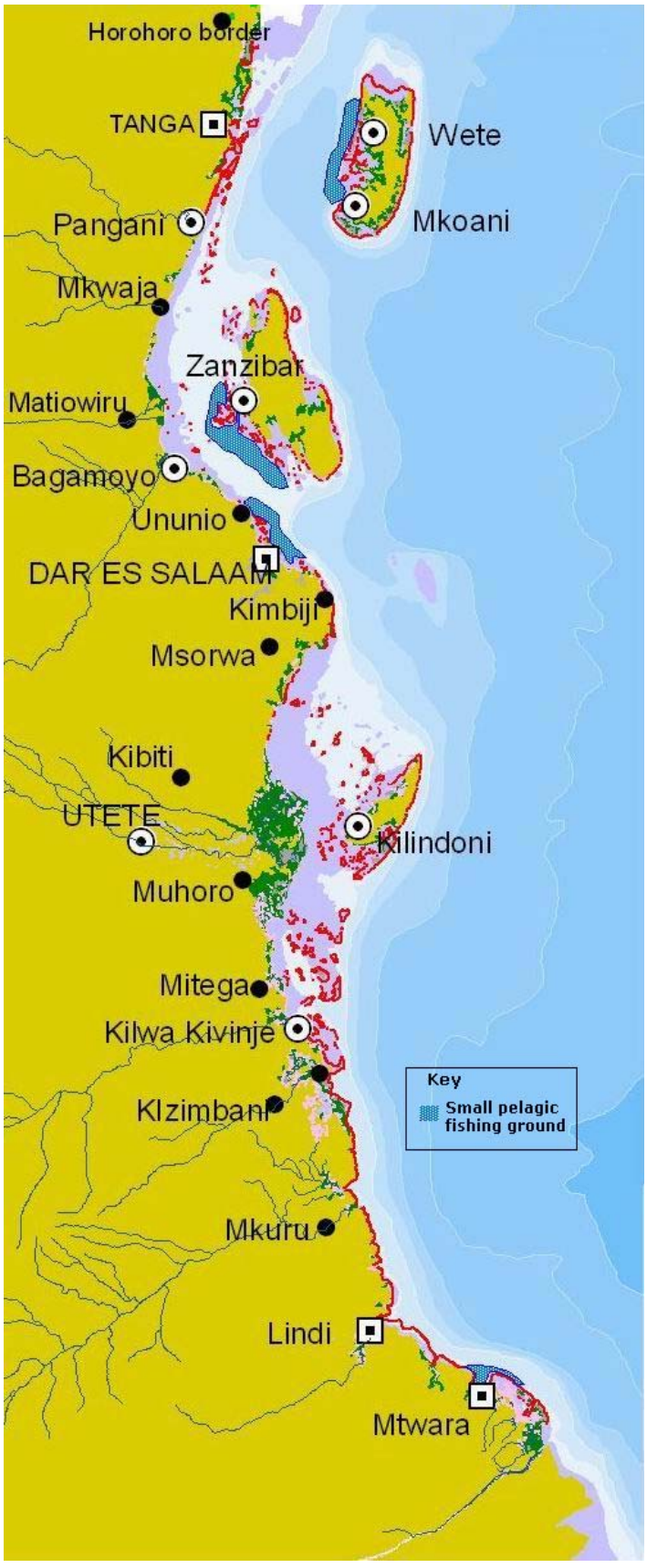
4.2.4 Small Pelagic Fishing Grounds

Small pelagic fish are constituted by dagaa, mackerel, sardines and small scads. Large scale commercial fishery of small pelagic fish is carried out mostly by purse seine nets involving light attractions. Important small pelagic fishery is concentrated near urban centres, Zanzibar and Dar es Salaam, although recently it has been introduced in the west coast of Pemba and Mtwara (Map 1). However, all along the coastline small scale fishers catch small quantities of small schooling pelagic fish, usually mixed with other finfish species, using modified small mesh gill nets or small seine nets just beyond coral reefs and in channels, but and they do not often use light attractions.

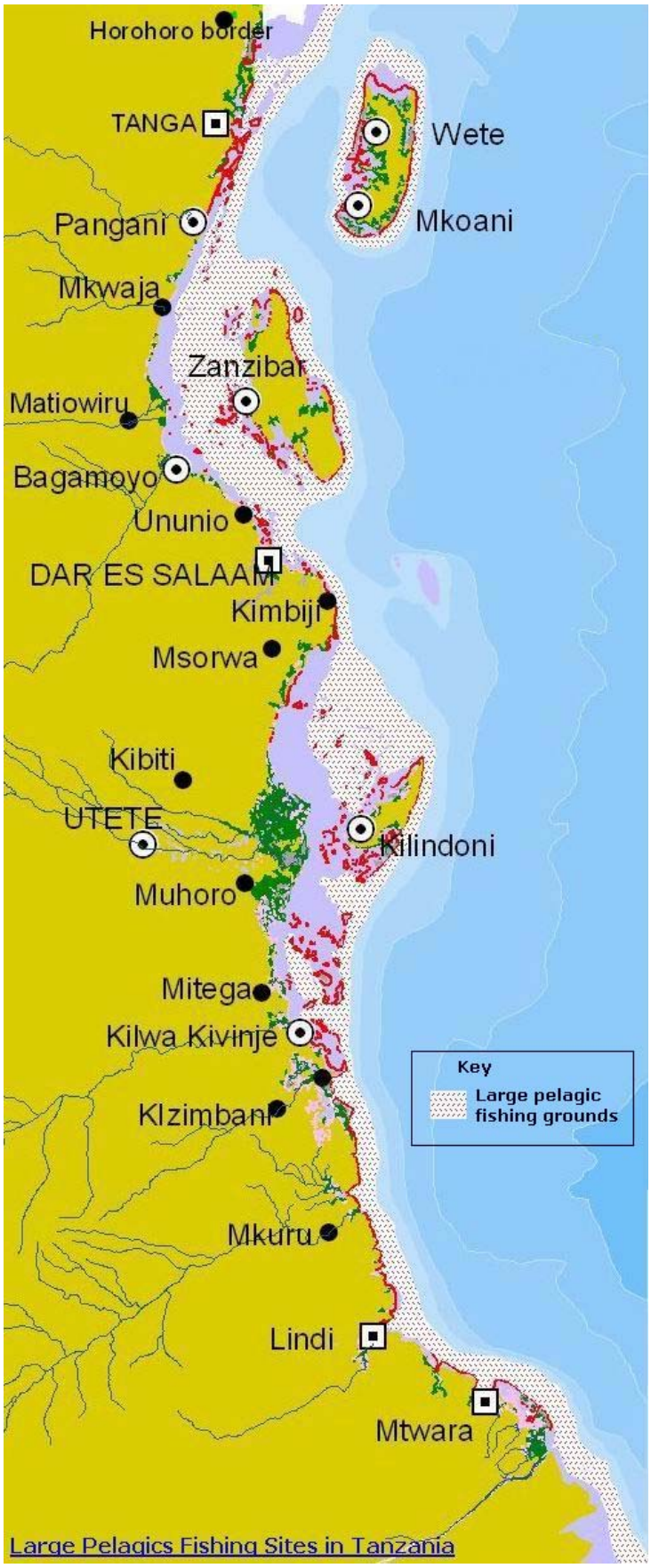
Large Pelagic Fishing Grounds

Large pelagic fish include tuna, sailfish, kingfish, large carangids, etc. they are caught in relatively deeper (open) waters using a variety of fishing gears including troll lines, hook and line, large mesh gillnets, large purse seines (with or without light attraction). Fishing grounds for large pelagics are located in relatively deeper waters (more than 40 m) beyond the range of small fishing crafts. In most cased large pelagic fish are caught using planked motorised boats, with large quantities of nets. Large pelagic stocks are constituted by schooling and migrating fish stocks hence its fishery is seasonal. Although it may appear predictable, changing ocean current patterns as well climate change induced glabal warming make prediction difficult. In general, fishery of pelagic stock is occurring in along the whole Tanzania coast in waters beyond the demersal fishing grounds (Map 2). Map 3 shows the combined distribution of small and large pelagic fish in Tanzania.

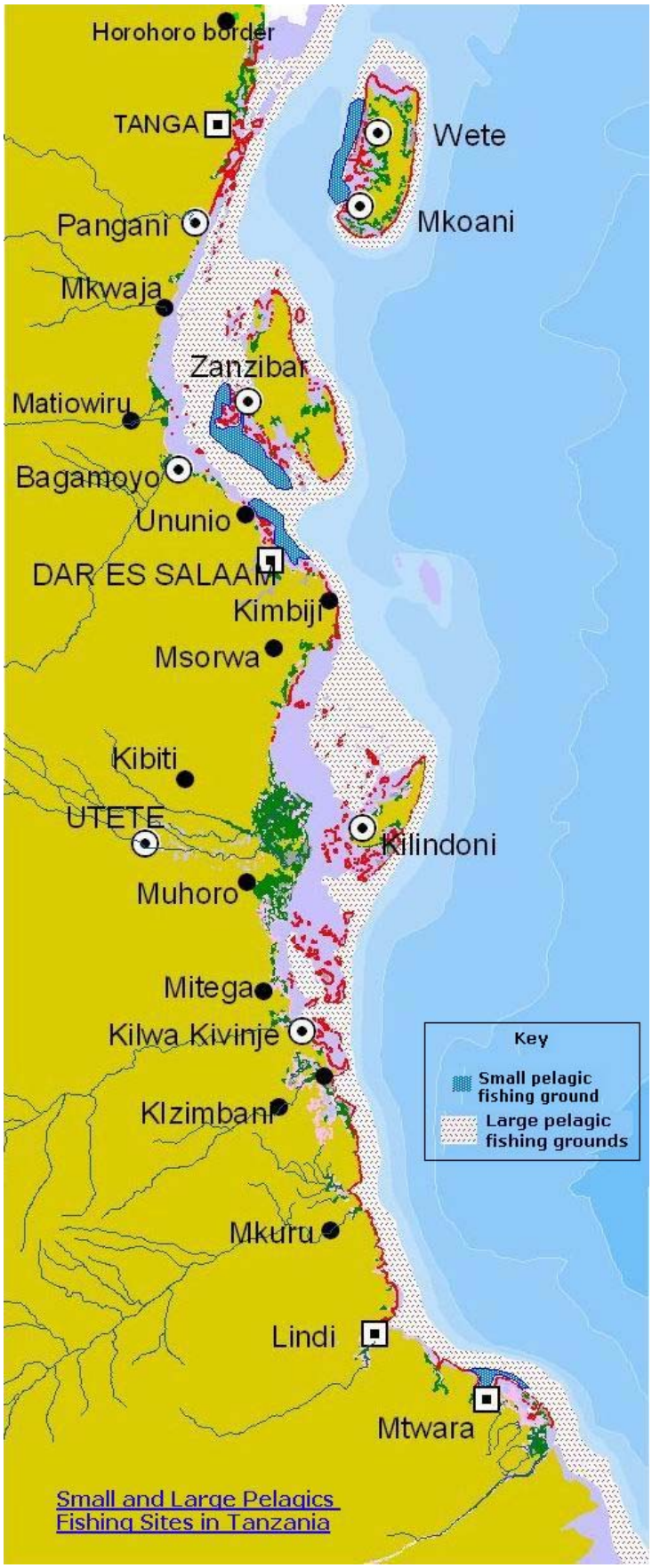
Map 1: Small Pelagic Fishing Grounds



Map 2: Large Pelagic Fishing Grounds



Map 3: Small and Large Pelagic Fishing Grounds



Appendix 2e

4.2.5 Major Fish Breeding and /or Aggregation Areas

Many reef fishes, such as groupers, parrotfish, wrasses, snappers, and surgeon fishes, form spawning aggregations. A spawning aggregation occurs when a large number of fish come together temporarily at specific sites to reproduce. There are two main types of spawning aggregations:

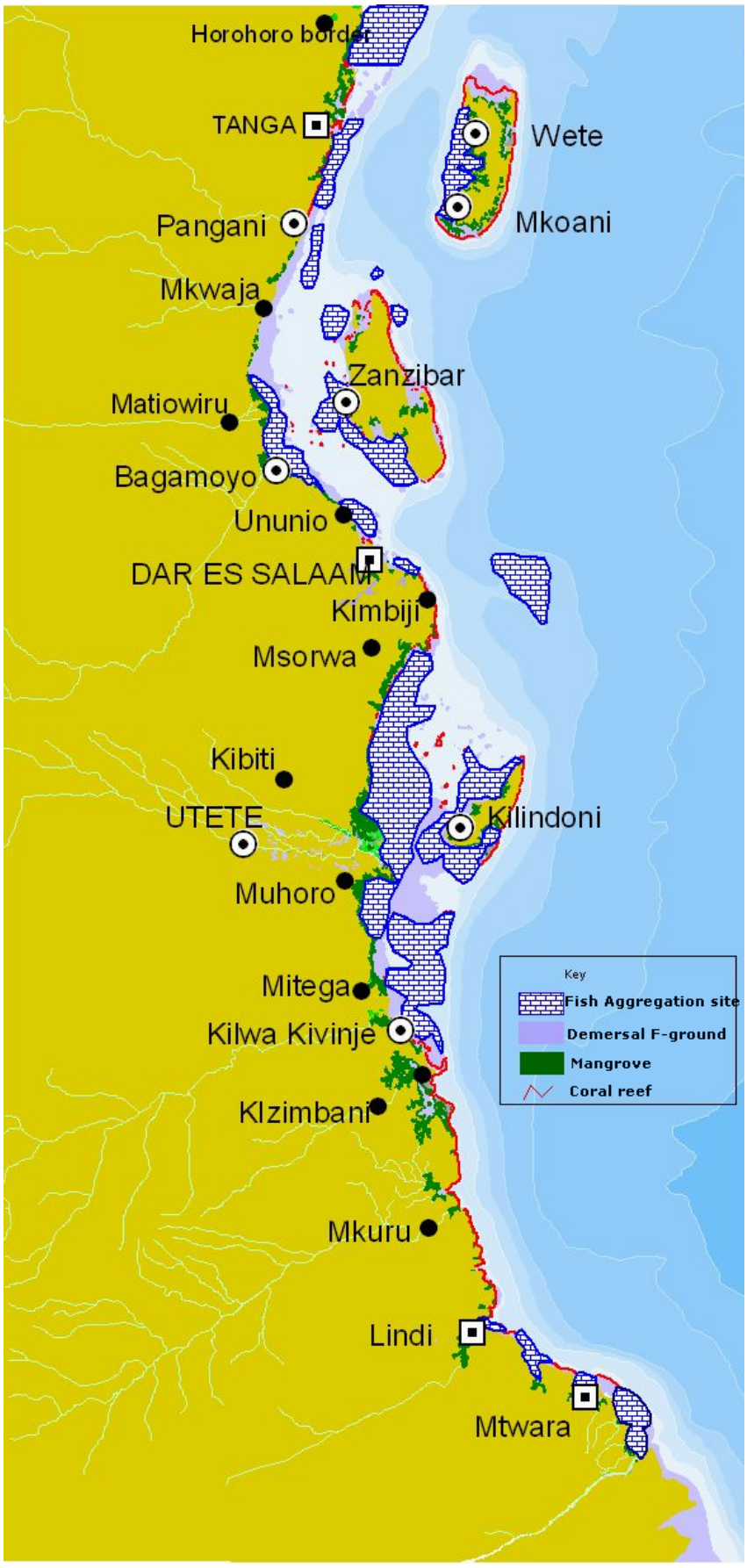
1. **Resident aggregations** – Fish tend to live near the aggregation site and only have to travel a short distance to get to the site. Resident aggregations form on a regular basis and tend to be formed by smaller fishes such as wrasses.
2. **Transient aggregations** – Fish travel long distances to aggregation sites.

Spawning aggregations tend to form at specific sites to which fish migrate year after year; however, there is evidence that specific sites may vary for some species. Additionally, many different species may use the same site concurrently or at different times of the year. Spawning aggregations may be the primary source of larvae that replenish local fishery populations. Since spawning aggregations tend to be predictable in location and time, they are highly susceptible to over fishing. Fishermen are able to catch a large number of fish in a short time. Intense fishing on these aggregations can result in the disappearance of aggregations all together. The decline in spawning aggregations ultimately results in the reduction of the population because fewer and fewer fish are reproducing each year.

There are no specific studies on fish aggregations in Tanzania. However, experience shows that fishers always fish where there are considerable fish aggregations, not necessarily for spawning purposes. Fish aggregations are in most cases determined by food availability, absence of predators, suitable hydrographic parameters. Depending on species under consideration, aggregations are found in and around coral reefs, sea grass beds, mangroves, estuaries, protected sides of oceanic mountains or islands, raised sea beds (sand banks, underwater mountains, etc.), bays etc.

Aggregations of pelagic stocks are influenced by seawater temperatures (thermocline - rates water mixing depths), and nutrients as well as primary and secondary productivity. Aggregation of pelagic stocks is seasonal and relatively less predictable compared to benthic fish aggregations. The map below gives a generalised representation of important benthic fish aggregation sites.

Fish aggregation sites in Tanzania



Appendix 3.1

4.3a Fisheries General Information

Fishery is probably the most important parameter to be considered in case of gas and oil spills or any other pollutant along the Tanzania coast. The contribution of fishing as an employer and fish products in the coastal economy and sociology is very high and has cascading impacts in all fields of life in the Tanzania coastal zone.

The United Republic of Tanzania is composed of Tanzania mainland (former Tanganyika) and Tanzania Island (Zanzibar). The later retains a semi- autonomous status within the union framework. Under the arrangement, the inland and inshore marine fisheries are not union matters, hence Zanzibar has full mandate over her respective inshore fisheries. On the other hand, however, fisheries management of the Economic Exclusive Zone (EEZ) is in the process of being placed under joint management between the Union government and that of Zanzibar through the Deep Sea fishing Authority Act of 1998 and the 2007 Amendments.

Tanzania mainland has total fish landings from both inland and marine capture fisheries estimated to be in the range of between 350,000 – 400,000 metric tons per annum. The later fishery produces about 20 percent of the total, which excludes the amount that is caught by foreign vessels in the Exclusive Economic Zone (EEZ). Fishing is predominantly artisanal, a sub-sector that lands more than 95 percent of fish from the territorial water.

The development and management of fisheries for the Mainland Tanzania is guided by the 1997 Fisheries Policy and strategic statements which provide guideline for the administration of the industry. The policy hinges around the country's central policy of economic growth and poverty reduction. The goal is to regulate, promote, conserve, develop and ensure sustainable exploitation and utilization of fish and other aquatic living resources. It focuses on providing food, employment, income, and earning of foreign exchange.

In addition to Fisheries Policy there are other tools providing operational guidance. This includes; Fisheries Act 2003, Fisheries Regulations of 2005 and a Master plan. While in Zanzibar the Fisheries Act of 1988 provides the legal framework upon which the sector is guided. According to the legal framework the directors of fisheries on both side of the union each has responsibility over the administration of the industry in their respective areas of jurisdictions.

Marine fisheries are predominantly subsistence and artisanal and concentrate in shallow waters (less than 30m). It is multiple fisheries characterised by many species featuring in the catch. Fish catches are dominated by a few species groups, namely parrot fish, rabbit fish, sardines, and mackerels, which together account for over 50% of the total landed catch. Main commercial marine species are sardine and anchovy, which together forms 30 - 50 percent of the total fish landing. Other fish species being landed include; Emperors/Scavenger/Lethrinidae (changu), Snappers (fuatundu), Parrotfish (pono), Carangidae (kolekole), Rabbit fish (Tasi), Tuna (jodari), Kingfish (nguru) ,Mackerel (Vibua), Sharks (papa), Rays (taa), Lobster (kamba kochi), shrimp (kamba) Sardines (dagaa) and octopus (Pweza)

The fisheries employ multiple fishing gears that are both traditional as well as modern. The gear includes dema (basket fish-trap), uzio (stakes tidal fish-trap), mshipi (hand-line), nyavu or jarife (gillnet), and juya (seine net) (Bryceson 1985, sobo 2007). The vessels include ngalawa (outrigger dug-out boat), mtumbwi (dug-out canoe), dau and mashua (planked boats).

In term of production, the main share of marine catches more than 95% is landed by small-scale fishers using traditional fishing vessels including small purse-seine nets, gill nets of different sizes, hand lines, long lines and traps. The motorization level is still low with about 21% of fishers on the Mainland owning motorised crafts.

Fishing plays an important role as a source of protein-rich food and employment. In overall the artisanal marine fishery sub-sector in 2007 employed more than 36,247 full time fishers, using about 7,342 relatively small fishing dug out canoes. Beside many fishers operate on foot without crafts using hand traps and small nets. A large number of fisher more than 56% also did not own fishing gear or craft. The number of full-time fisher folk operating in Zanzibar is about 2,300 (Lyimo et al. 1997, Fisheries Frame Survey report 2007).

The per capita consumption of fish is 25-30kg/person. The contribution of fishery to the GDP varies between 2.1 - 3% in mainland Tanzania and 2.2-10% in Zanzibar, mostly from export of fishery products (Jiddawi and Ngoile 1999). Tanzania exports marine fishery products are valued at US$7,652,700 from the mainland and US$598,203 from Zanzibar (Jiddawi and Ngoile 1999). These products include prawn, Sea cucumber, shells, lobster, crabs, squids, octopus, sardines and aquarium fish. Although catching of Sea cucumber has been put on a hold until its stocks recovers.

The fishery industry also supports a significant number of individuals working in associated sectors such as boat building and repair, gear selling and repair, and marketing of fishery products.

There are also several industrial fishing companies in operation; all of these are foreign-owned (some in joint ventures with Tanzanians) and mostly operate in the Bagamoyo-Saadani area and the Rufiji Delta, fishing mainly for prawns (shrimp) (Mgaya et al. 1999). They also catch many non-target species and dump these as low value ‘by-catch’.

The trawlers claimed to severely damage sea grasses and other bottom biotopes, thus harming the habitats of the fish and crustaceans. This kind of damage has a negative impact on the artisanal and small-scale fisheries too. In addition there are direct physical damage caused by trawlers to traps and nets belonging to traditional fishers thus causing a serious conflict between the two fisheries.

Various segments of the inshore fishery sector have recently been showing signs of overexploitation. This can be seen especially in Zanzibar where the trend in annual catch is showing a decline. The total annual catch in Zanzibar was about 20,000 tonnes in the 1980s, but in the recent years it has dropped to less than 13,000 tonnes per annum. This reduction in fish catch can also be observed in some localised areas such as Chwaka Bay (Jiddawi 1999b). The small pelagic fisheries of Zanzibar have also witnessed a drastic decline from 600 tonnes caught in 1986 by the Zanzibar Fisheries Corporation vessels to about 91 tonnes caught in 1997 (Jiddawi 1999a). For the long line fisheries in most parts of the eastern African region including Tanzania, the catch rate, in numbers and weight, has declined (Ardill 1984). Tuna fleets from Europe fish intensively off the coasts of eastern Africa to the benefit of their commercial interests.

Table 1 – Fisheries in the economy (mainland)

Fisheries as percentage of gross domestic product (GDP)	2.7%	2000 (BoT, 2001)
Fisheries as percentage of exports	12%	2000/01, idem
Direct employment Artisanal Industrial Marine Freshwater	121 000 119 400 1 500 21 300 99 600	2002, Fisheries Department (Artisanal), estimate (Industrial)
Production (tonnes) Nile perch Shrimp	334 000 92 000 2 000	2002, Fisheries Department
Exports (million US$) Shrimp Nile perch (all forms)	91.1 6.6 77.1	2002 (URT, 2003)

Table 2 – Fisheries in the economy (Zanzibar)

Fisheries as % of GDP	2.5%	RGZ, 1999
Direct employment	23 800	1997, Fisheries Department, Zanzibar (FDZ)
Production (tonnes) Anchovies Emperors	22 000 3 500 2 100	2002, FDZ

Appendix 3.2

4.3b Fisheries Resources

The Tanzanian coastal fisheries combine the living marine and brackish-water resources, and have great species diversity characteristic of this tropical area (FAO, 1985). Fish catch levels have been between 40,000 – 50,000 MT, however it is estimated that Tanzania's marine territorial waters (inshore) fish potential is around 100,000 MT (MNRT Fisheries Division, 2001). Trends in fishing capacity and annual catches are given in Table 1.

Table 1: Trends in number of fishers, fishing vessels, gears, and total yearly catch 1984-2001

Year	Vessels	Fishers	Shark nets	Traps Fixed	traps	Beach seines	Hooks	Ring nets	Cast nets	Scoop nets	Gill nets	Catch (MT)
1984	3556	13783	2342	9418	2182	371	6757	0	408	462	6955	40890.1
1985	3045	11392	3093	9159	6418	1288	12351	0	622	1288	4943	42847.3
1986	3690	12619	3590	9159	3159	1003	13478	0	216	1013	8842	46984.7
1987	3595	12739	3193	7888	3052	1087	10708	0	516	1087	9549	39094.7
1988	4390	13855	3751	6351	176	832	7088	56	653	832	7810	49382
1989	4399	15491	3649	2056	233	588	5786	56	645	690	5022	50242
1990	4354	16178	2856	5873	167	1189	7083	96	374	1225	5887	56779.4
1991	4402	16361	2530	4736	234	665	6721	104	398	615	6018	54342.7
1992	3514	15027	3427	5183	34	537	5672	92	124	70	3388	43886.2
1993	3232	15027	3427	5593	34	537	5672	92	124	70	3388	36684.8
1994	3232	15027	3427	5593	34	537	5672	92	124	70	3388	40785.4
1995	3768	13822	3351	3390	25	350	7839	221	49	75	4120	51073.3
1996	3768	13822	3351	3390	25	350	7839	221	49	75	4120	58780.2
1997												50210
1998	5157	20625	3463	5299	254	319	9383	128	0	0	9125	48000
1999												50000
2000												49900
2001	4927	19293	2852	5557	72	485	13382	224	173	5138		52934.9

Source: Fisheries Division –Dar es Salaam

The marine waters have diversified fish types. Fish and shellfish combined form the most economically important group. The larger fish groups include the bony fishes, sharks, and Rays. Other groups include the lobsters, shrimps, cephalopods and gastropods. Holothurians, marine mammals and marine turtles are legally barred from fishing. Most species found in Tanzanian waters are generally widely distributed throughout the western Indian Ocean region. The common fish species caught and recorded by fisheries Division are presented in Table 2.

Most of the fish caught in inshore waters by artisanal fishermen are mostly demersal species (Lethrinidae, Serranidae, Mullidae, Lutjanidae) followed by large and small pelagic species (Carangidae, Scombridae, Cluepidae, Engraulidae). Others include sharks, and rays, crustacea, octopus and squids

Table 2: Weight of marine fish caught by species

English/Scientific Name	Local/Swahili Name	Amount Caught (MT) in the years 1993 – 1996			
		1993	1994	1995	1996
Sharks	Papa	962	1,187	1,399	1,594

Rays	Taa	2,511	2,474	3,327	4,006
Octopus	Pweza	393	314	215	604
Prawns	Kamba miti	1,044	390	193	267
Psattodes spp./ Flat fishes	Gayogayo	40	27	144	148
Sardines/Anchovy	Dagaa	5,472	8,562	8,514	14,324
Nemipterus spp./Threadfins	Koana	191	123	591	937
Cat fish	Hongwe	947	456	1,546	913
Hemiramphus spp./Half beaks	Chuchunge	1,219	1,066	1,285	1,483
Mackerels	Vibua	2,542	3,248	3,779	4,619
Parrot fish	Pono	2,040	2,583	3,146	3,725
Rabbit Fish	Tasi	2,319	2,537	3,246	3,816
Lethrinus/Scavenger	Changu	4,308	4,566	6,024	7,304
Scombridae/Kingfish	Nguru	594	544	697	734
Thunnidae/Tuna	Jodari	538	1,001	945	801
Carngidae/Jacks	Kolekole/Karambi si	1,015	8,175	1,026	1,406
Rockods/Groupers	Chewa	278	335	599	652
Pomadasyidae/ Silver biddy	Chaa	312	269	344	333
Mullets	Mkizi	436	234	503	619
Chanos chanos/Milk fish	Mwatiko	23	23	174	29
Rachycentron/Cobia	Songoro	198	144	120	51
Sword fish	Samsuli/Nduaro	530	905	358	240
Istiophorus spp./Queen fishes	Pandu	201	199	1,986	2,263
Others		6,408	6,112	8,599	8,639
Total		**34,227**	**37,286**	**48,760**	**59,508**

Source: Fisheries Division, Annual Fisheries Statistics (various years)

Generally, the catch composition is multi-species without evidence of a dominant species, although in some areas sardines (dagaa) comprise about 25% of the catch (Table 2)

The best fishing grounds are found in the Coast Region. The region has the continental shelf extending to the Islands of Zanzibar (Unguja) and Mafia, as well as estuaries of the largest rivers like Wami, Ruvu and the Rufiji Rivers which flow into the Indian Ocean. These conditions give good fishing grounds in the coastal areas, in particular the estuary areas. Areas with relatively high abundances of fish include the areas between (i) Dar es Salaam, Bagamoyo and Zanzibar (Zanzibar channel), (ii) Areas around Mafia and Rufiji delta (Mafia channel). Seasonal variations are noticeable in the months of March, April, May, and June possibly due to rougher conditions prevailing during the SE Monsoons. However overall monthly production data reports indicate only a slight drop in fish catches during these months. Most of the artisanal fishing is carried out close to shore and protected areas allowing fishing activities to continue throughout except on a few days when conditions are particularly bad.

The main commercial fishery is (prawns/shrimps) mainly for export market. Other fisheries include a deep water trawling and sardine fishery.

There is serious information gap on fisheries statistics nationwide. Compiled and published fisheries information is only available up to 1996. Figures for 1984 to 2001 used in this report are very broad based; compiled in the form of water bodies (marine & fresh water), total values (national) and/or regional totals. The accuracy of fisheries data

is hard to ascertain. The original base information is not traceable and after 1996 no data collection seems to have taken place, possibly due to shortage of data collectors. Informal discussions indicate most of the collectors were laid off at that period.

Artisanal fishery

The artisanal fishing is carried out in fishing villages scattered along the entire coast and including Dar es Salaam. Approximately 20,000 fishers are engaged in the artisanal fisheries at 234 fishing villages and landing sites located in the entire 1424-km coast (Table 1). Dar es Salaam, having the largest consumer market, is the most active landing site, used by the fishing fleets within the region and fish-buying boats from Mafia, Pemba, Unguja, Bagamoyo, etc. Table 3 gives a comparison of Regional performance in fishing.

Table 3: Regional comparison in total catch, number of fishers and boats in 1998.

Region	Catches (tons)	% of Total Catch	No. of fishers	No. of fishing boats	Boats with outboard or diesel engines	% of boats that are motorised
Tanga	6,599	11.1	4,480	969	97	10.0
Coast	13,564	22.8	6,199	1,714	132	7.7
DSM	30,403	51.1	5,250	966	248	25.7
Lindi	4,292	7.2	2,640	620	24	3.9
Mtwara	4,649	7.8	2,056	859	17	2.0
Total	59,507	100.0	20,625	5,157	518	10.0

Source: Tanzania Fisheries

The fishing is carried out mainly in the shallow areas of coral reefs that are easily accessible from fishing villages and landing sites (near shore waters). Reef fish alone account for almost one third of the overall fish catch indicating that shallow reef waters are the main fishing grounds. Fish catch is normally low per unit of effort and the shallow fishing areas tend to be over-fished.

Fishing gear and methods

The main fishing methods used in the artisanal fishery are hand lines, gillnets, surrounding nets, purse seine/ring nets, long lines, traps, and fixed traps. Other methods used, but only to limited extent, include shark nets, scoop nets, spears, hand lining (hooks), madema (fish cage/trap) and spears. Although beach seines are prohibited fishing gear under the Fisheries Act No, 23 of 2003; but they are still used illegally. Ring net fishing is for small pelagic fish and is the most productive fishing methods in terms of catch volume. This method is used to catch small pelagic fish such as sardines and small mackerel, using light to attract fish at night. Around 128 ring net fishing boats are based in Dar es Salaam, Tanga and Bagamoyo. These catch a large proportion of sardines and mackerel, which account for about one third of the total production of the marine artisanal fisheries (MNRT Fisheries Masterplan, 2002). This fishing method is thought to be the most efficient.

Hand line fishing method is the most preferred method in terms of number of fishers engaged especially those who use dug out canoes and outriggers. Table 1 gives the numbers of each gear type for the period 1984- 2001.

Fishing vessels

The fishing boats used for the marine artisanal fisheries are dugout canoes, outrigger canoes, and planked construction boats (consisting of mashua, dau and boat). These are built using traditional skills in all major fishing villages and landing sites along the coast. They may or may not be motorized. Most of the dugout canoes are found in Coast, Mtwara and Lindi regions operating in the shallow waters of the Rufiji delta and Mafia

channel. Motorised (outboard and inboard engines) are often used by a few fishers and on fish collection boats, which are relatively larger than a common canoe.

The motorized ones which tend to be more efficient and are used for fish collection or by middle level fishermen. Of the 5,157 vessels recorded in Table 3, only around 10% are motorized. In the southern regions (Mtwara and Lindi) only 2 to 3 percent are motorized (Table 3). In spite of the low motorization rate, there is few fishing boats that are fitted with inboard engines (35 – 75 HP diesel). These boats are common in Dar es Salaam where they sail to fishing grounds around Mafia and Zanzibar. Inboard engines are use for the large planked construction boats or Metal hull boats that are used in the dagaa or prawn fishery by middle level fishermen.

Commercial fishing industry

Commercial fishing is limited to prawn trawling adjacent to mangrove areas, and small scale exploitation of pelagic resources offshore (deep-sea waters), fishing for finfish, shellfish and molluscs. In terms of production the commercial fisheries account for only about 5% of the total marine production. The commercial fisheries landed about 1,300 tons. The commercial prawn trawl fishery is basically for the export market. The most abundant and marketable types of prawns/shrimps include *Penaeus monodon*, *Penaeus japonicus*, *Penaeus indicus, Metapenaeus monoceros* and *Penaeus semisulcatus*. The most important prawn fishing grounds are found around the inshore reefs, deltas and river mouth in the Rufiji and Bagamoyo waters.

Shark fin trade has declined and some species are rarely seen now in Tanzania waters (Barnett 1997, Jiddawi and Shehe 1999). The demand for fishery resources has been gradually increasing with the growth in population and tourism development. This has caused an increase in fish prices, which in turn has increased fishing pressure and the use of gear that are efficient but destructive. Some of the destructive gear commonly used includes dynamite, beach seine, sticks, spears, and juya la kigumi (dragged net used when smashing reefs). The latter fishery practice is one of the most difficult to control because the net used is not illegal; however, it is the action involved in the technique of using the net that is a problem as it involves smashing corals with sticks to chase out hiding fish. The use of poison in fishing has also been observed. Destruction of habitats by humans, particularly through indiscriminate mangrove cutting, also has a negative influence on commercial fisheries.

Fish handling facilities

Fish handling facilities include Fish receiving stations & Markets (Landing Sites); Land based fish storage facilities (cold rooms), Ice making facilities and Processing plants. These are facilities to support fishers in their day-to-day operations. They are meant to facilitate marketing of the catch and reduce post harvest losses. Fishers pay nominal cost for the service in terms of taxes, levies or rent and in other cases pay on service. Other services are payable at cost, e.g. supply of a ice block.

Appendix 3a

4.3.1 Demersal Fishery

Demersal fish contributes about 58 % of the total fish catch in Tanzania mainland (according to Fisheries data of 1993-1996; Table 1). Besides mixed demersal fish group which contributes about (15 %), the most important demersal fish groups in the catch were Lethrinids/ scavengers (or Changu group), rays and skates (Taa group), rabbit fish (Tasi group) and Parrot fish (Pono group). Other less important demersal fish includes Milk fish, flat fishes, silver biddies, mullets, groupers, cat fish, queen fish and half beaks. Table 1 shows the relative importance of each demersal fish group.

High catch rates are obtained in shallow waters in seagrass beds, coral reefs and mangroves. Fishing gears used include mainly dema traps, hook and lines, dragnets and bottom set gillnets. Most fishers in this zone operate with small non-motorised boats and some operate without boats, e.g., octopus fishery in subtidal zones.

Species composition of demersal fish catch varies with seasons and tidal conditions. Coral reef species with territorial behaviour, e.g. groupers have experienced higher overfishing rates from fishers using spears guns. The use of SCUBA in fishing is likely to cause further decline of sedentary/sessile marine invertebrate species (lobsters, sea cucumbers, shelled molluscs, etc). Any expansion of demersal fishery has to be done cautiously. Any factor that will change the sea bottom structure and its biota and flora, will eventually have an impact on demersal fisheries.

Table 1: **Demersal fish in artisanal fishery**

Fish group	**Aina ya samaki**	**% of Total (demersal and pelagic)**
Others – mixed demersal fish	Mchanganyiko	15.8
Lethrinus/Scavenger	Changu	11.8
Rays	Taa	6.5
Rabbit Fish	Tasi	6.3
Parrot fish	Pono	6.1
Hemiramphus spp./Half beaks	Chuchunge	2.7
Istiophorus spp./Queen fishes	Pandu	2.5
Cat fish	Hongwe	2.1
Prawns	Kamba miti	1.0
Rockods/Groupers	Chewa	1.0
Mullets	Mkizi	1.0
Octopus	Pweza	0.8
Pomadasyidae/ Silver biddy	Chaa	0.7
Rachycentron/Cobia	Songoro	0.3
Psattodes spp./ Flat fishes	Gayogayo	0.2
Chanos chanos/Milk fish	Mwatiko	0.1
Total		**58.8**

(Summarised from Fisheries Division data of 1993-1996)

There has been a general agreement that demersal fisheries are overexploited and probably already overfished. The relative contribution of demersal fishery may be much lower today (2008) than it was in 1996. Hence, statistics presented in this report should be viewed with great cautious as the real situation may be different. Recent and reliable fisheries statistics are not available hence were not obtained during this study.

Appendix 3b

4.3.2 FISHERY OF SMALL PELAGIC

Small pelagic fish are differentiated from large pelagic fish by their relative size and fishing methods deployed. Small pelagic fish include mainly sardines, anchovy, and mackerels, while large pelagic fish include tuna, sail fish, kingfish, sword fish, sharks, etc. Small pelagic fish are caught using mainly purse seine nets involving light attractions. Most of the catch is landed by commercial purse seine nets located mainly in Dar es Salaam, Zanzibar and Tanga and to a small extent in Pemba and Mtwara. Fishery of small pelagic contributed more than 25 % of total fish catch in 1993-1996 and is increasingly becoming more important. Prediction given so far suggests that increase in fish catches are likely to come from expanded fishery of small pelagic rather than demersal fishery or large pelagic fish.

Purse seining was introduced by Greek fishermen in the mid seventies. The purse seine (or ring net) fishery operates with light attraction on moonless nights using a bag of heavy thread 20 mm stretched mesh and a hand-hauled net up to 400 m long and 65 m deep. One or more lamp skiffs are used for concentrating the schools of fish, around which the net is set. The mainland coast of Tanga Region yields the greatest catches up to 600 to 820 ton a year (including landings of the small-scale surrounding net boats operating in the light phases of the moon), normally about 25% of the national total. (Nhwani, 1981).

There are currently 13 seiners in the country 7 in the mainland and 6 in Zanzibar. Nine of these are in the 8-10 m range; the remaining four have lengths of 13. 17, 18 and 20 m this purse seine fishery landed about 856 t of fish in 1981. The 3 Zanzibar Fisheries Corporation boats landed 316 t in 1981-1982 (Nhwani *op cit*.).

The main limiting factors of this fishery are preservation and market access. The highest landings are registered at the towns of Tanga, Tangoni, Zanzibar and Dar-es-Salaam because they offer the best opportunities for rapid sale of these highly perishable fishes. Nhwani (1981) reported the species composition of catches from the period October - March to be as follows*:* *Sardinella sirm* (spotted) 51.4%; *Sardinella gibbosa* (gold stripe) 19.3%; *Decapterus maruadsi* (round scad) 10.7%; *Rastrelliger kanagurta* (Indian mackerel) 5.3% and Leiognathidae (slipmouths) 2.6%

Gulland (1979) suggested that the annual yield of small pelagics in coastal Tanzania could be as much as 20 000 t. The majority of the fish catch (by weight) from the

shallow water trawling were sardines, scads and Indian mackerel. Trawling by using small trawlers to catch the small pelagic would catch 3/4 ton of these fish with a two-hour tow of a trawl net.

Table 1: Relative contribution of small and large pelagic fish in total catch (summarised from Fisheries statistics data of 1993-1996)

Pelagic fish	Fish group name	% of total catch	**pelagic**
Sardines/Anchovy	Dagaa	19.6	Small
Mackerels	Vibua	7.5	Small
Nemipterus spp./Threadfins	Koana	1.0	Small
Carangids/Jacks	Kolekole/Karambisi	6.2	Large/small
Sharks	Papa	2.7	Large
Thunnidae/Tuna	Jodari	1.7	Large
Scombridae/Kingfish	Nguru	1.4	Large
Sword fish	Samsuli/Nduaro	1.1	Large
		41.2	
	Small pelagic fish	**31.2**	
	Large pelagic	**10.0**	

4.3.3 LARGE PELAGICS

The most sought after fish in this category are yellowfin and bonito tunas and sailfish. Also are dolphin (Coryphaena), Pampano and rainbow runner (Carangidae), skipjack (Katsuwonus) and Kingfish (Scomberomorus). The large pelagics are fished in open waters beyond the reefs. Most of the fishing takes place away from the near-shore outer reefs on shoals is accomplished with large-mesh gill nets. For large pelagics (the same species as mentioned above, though there may also be some sharks, and probably few or no Carangids), the preferred method is drift netting at night; These nets are up to 800 m long and 8 m deep, with meshes of 140 to 200 mm (stretched), and anywhere from 18 to 60 ply. Some fishermen use pressure lamps at night to attract baitfish to their lift nets and dip nets. They prefer Indian mackerel fillets for hand lining and herrings/anchovies for trolling.

The Ngalawa are the principal boats used for fishing outside the fringing reefs, though they normally do not venture out more than 10 km from shore unless the weather is very good and the winds are favourable. The planked dau (dhow) and mashua use the same lateen type sailing rig, but are longer, beamier, have deeper draft, and have greater carrying capacity. However, these boats cost two or three times as much to build as a ngalawa and they wear out just as fast (average life - about 4 years). Some of the mashua have small outboard motors, which help to increase fishing efficiency, but greatly add to costs of operation and headaches over trying to get them repaired.

Some trolling is carried out by ngalawa boats, and occasionally by mashuas with small outboard motors, particularly along the edge of the continental shelf. The materials used for trolling are variable, depending on what kinds of rope, twine, wire, nylon, hooks and home-made lures are available.

The most heavily fished areas beyond the reef are those that lie in the lee of islands or where the current is minimal and as close to shore as possible. Hand lining is less common than in the past because the required mono-filament lines and hooks are scarce, the gear is often snatched by sharks and there are not enough seines and cast nets available for catching bait.

Demersal fishing with set nets and hand lines is mostly carried out just beyond the fringing reefs, around shoals, and on the shelf slopes in the 10-100 m depth range. Bottom gillnets are mainly for snappers, groupers, jacks, etc. (similar to those used inside the reef). Nets of larger mesh (as much as 330 mm) and deeper (up to 6 m) are used for sharks, skates, rays, turtles and large groupers. Bottom gill nets deployed outside the reef must be picked no more than 8 hours after setting; otherwise much of the fish will spoil in the water. Often the fishermen cannot get out there soon enough, due to unfavourable conditions of sea, wind, tide or other factors. Dau and mashua boats are used for fishing the voluminous gill nets outside the reefs. These longer (up to 9 m) and beamier (up to 1.5 m) boats are more capable of accommodating the nets, crew and catch than are the canoe-type boats.

Table 1: Relative contribution of small and large pelagic fish in total catch (summarised from Fisheries statistics data of 1993-1996)

Pelagic fish	Fish group name	% of total catch	**pelagic**
Sardines/Anchovy	Dagaa	19.6	Small
Mackerels	Vibua	7.5	Small
Nemipterus spp./Threadfins	Koana	1.0	Small
Carangids/Jacks	Kolekole/Karambisi	6.2	Large/small
Sharks	Papa	2.7	Large
Thunnidae/Tuna	Jodari	1.7	Large
Scombridae/Kingfish	Nguru	1.4	Large
Sword fish	Samsuli/Nduaro	1.1	Large
		41.2	

Small pelagic fish	**31.2**
Large pelagic	**10.0**

Tuna Fishery

Dominated by foreign purse seine and Long liner vessels tuna fishery targets three main species of tropical tunas; skipjack, yellow fin and big eye. These species are also classified as highly migratory. The level of fishing by these vessels inside the Tanzania Exclusives Economic Zone (EEZs) is unclear as the majority of the foreign fishing fleet fishing illegally with France, Spain and Asian countries like China, Taiwan Province of China and Japan being major players. Illegal fishing, mainly for tuna, is considered a big problem in the western Indian Ocean region, both within the EEZ and in the high seas. Some of fishing vessels operate legally through a license issued by the Fisheries department of both Mainland and Zanzibar. The total number of the licensed foreign vessel is not known but is put at more than 84 vessels in 1998. Tuna catch within Tanzanian EEZ can not easily be estimated. Some catch statistics exist from estimates from the Indian Ocean Tuna Commission (IOTC).

The EU-SADC Monitoring, Surveillance and Control project has enabled the training of fisheries officers who are now able to monitor what the foreign fishing fleet is doing. As a result the licensed foreign purse seine and long line fleet that fishes off the coast of Tanzania has been forced to report its catches to the Fisheries department as part of a Monitoring Control & Surveillance Programme.

Although these reports are inconsistent and erratic they have however shown for the first time, that during the peak fishing season up to 10,000 tones of tuna are being caught weekly in Tanzania's EEZ waters. The tuna fishery in the Tanzania's EEZ is estimated to be worth up to 200 million dollars. Given the realization by the government of the important value of Tuna fisheries, Tanzania has joined the Indian Ocean Tuna Commission in order to strengthen its negotiation in the management of tuna fisheries in the region.

Tuna, an important fisheries resource in the country, has probably under fished by national fleets. The development of national fleets for tuna fishing has a potential to increase the national benefit from this resources. However, as established by the Indian Ocean Tuna Commission (IOTC) recently, with the exception of skipjack tuna, most of the important stocks (yellow fin, big eye and swordfish) are fished above their maximum

sustainable yield (IOTC, 2003,2004, 2005 and 2006). Thus any developments in the sub-sector have to be gradually and correctly managed to prevent further overexploitation and economic marginalization of existing fishing operations while affording the country access to the resources.

The country also plans to increase joint ventures with foreign companies in order to better access the industrial fishery. Other countries where such joint ventures are important include Mauritius and Mozambique.

The development of national fishing fleets for transboundary and highly migratory species such as these requires consideration at the national level of the objective hierarchy and the appropriate exploitation methods (development of a national fleet versus fishing agreements, maximization of employment objectives versus foreign exchange) this also require a consolidation of regional cooperation, which remains underdeveloped in the region.

Another critical issue for the development of this fishery as noted above is the lack of primary data (e.g. landings, fishing effort and biological data) on which to base reliable stock assessments. Deficiencies in the registration and monitoring of landings, fishers, vessels and landing points is due of a lack of human and financial capacity, together with inadequate infrastructure, structures and procedures.

4.3.4 Lobsters

Lobster fishery in Tanzania is based on shallow water rock and spiny lobsters. Six species of lobsters, *Panulirus ornatus, P. longipes, P. versicolor, P. homarus and P. penicillatus* and *Homarus spp* occur in Tanzania. The first two are the most abundant, contributing more than 80 percent to the landings (Bwathondi, 1980). *Sand lobsters Thenus orientalis* and two other scyllarid (Scyllaridae) species, *Parribacus antarcticus* and *Scyllarides squamosus* were also found in Tanzania, though in very small numbers and of least or no commercial value in most areas (Kyomo, 1999). Deep water lobster *Nephros* spp are also found however they do not feature very much in the commercial catches. Two species of Deep-water Lobster *Linuparus somniosus* and *Metanephrops andamanicus* were reported regularly in trawl catches in depths of 250 to 320 m at the southern end of the Zanzibar Channel during exploratory surveys with the R/V Prof. Mesyatsev; (Birkett, 1978; VNIR, 1978; Burczynski, 1976; Nhwani 1991). The catch rates ranged up to 50 kg/hour. The data collected however; were insufficient to allow an assessment of the potential yields. These lobsters have not been subject to exploitation.

Spiny lobsters are caught for export or supply to tourist hotels in major cities and tourist areas. Lobsters are collected from artisanal fisher and sold to companies that process them for export purposes. A number of commercial companies operate in Tanga, Dar es Salaam, and Mafia and just recently in Kilwa. Traditional fishing for Lobster was sustainable; fishers operated on foot while Lobsters were caught for local market only. However as population and tourism expanded, lobster fishery increased to satisfy local and foreign markets resulting in local overexploitation.

The fishery which is highly lucrative is nowadays carried out by commercial enterprises that employ local fishermen by providing them with a boat and engines and scuba diving equipment. More than six commercial companies are involved in this fishery. Fishing takes place in the reefs and sometimes on seagrass beds. Lobsters are picked using a stick and a scoop net and are put in containers placed in the boat. The catch is then transported to the land based fish processing plant where the catch is landed. Lobsters are then processed and parked for export. Lobster are exported live or processed.

Annual landed catches for lobster are estimated at about 80 tonnes Bwathondi and Mwaya (1984). However; more recent catch data are not available as the catches of lobster are not identified separately within the official statistics. Furthermore, no assessments of the lobster biomass or potential yields have been undertaken so far. In 2002 the government collected more than 157 million Tanzanian shillings as royalty from the export of Lobster (Table 1)

Table 1: Lobster export royalty revenue (mainland) – Value in TShs

Year	1995	1996	1997	1998	1999	2000	2001	2002
Lobster	4,825,175	1,147	15,821,145	9,754,868	36,697,887	17,387,400	40,590,682	78,670,528
Live lobster	131,221	354,087	-	-	-	8,875,898		78,484,476
TOTAL	**4,956,396**	**355,234**	**15,821,145**	**9,754,868**	**36,697,887**	**26,263,301**	**40,590,682**	**157,155,004**

Source: Fisheries Division

Coral reef monitoring programs by local community and Scuba-based (scientific) monitoring have reported significant reduction or absence of lobsters in reefs located near urban centres. This has been attributed mainly by overfishing and habitat destruction. To enhance conservation of lobster and other marine invertebrates, resource

harvesting using SCUBA is now banned. Important lobster fishery occurs in relatively good and abundant coral reefs sites in Mafia, Songo songo, Pemba and Tanga.

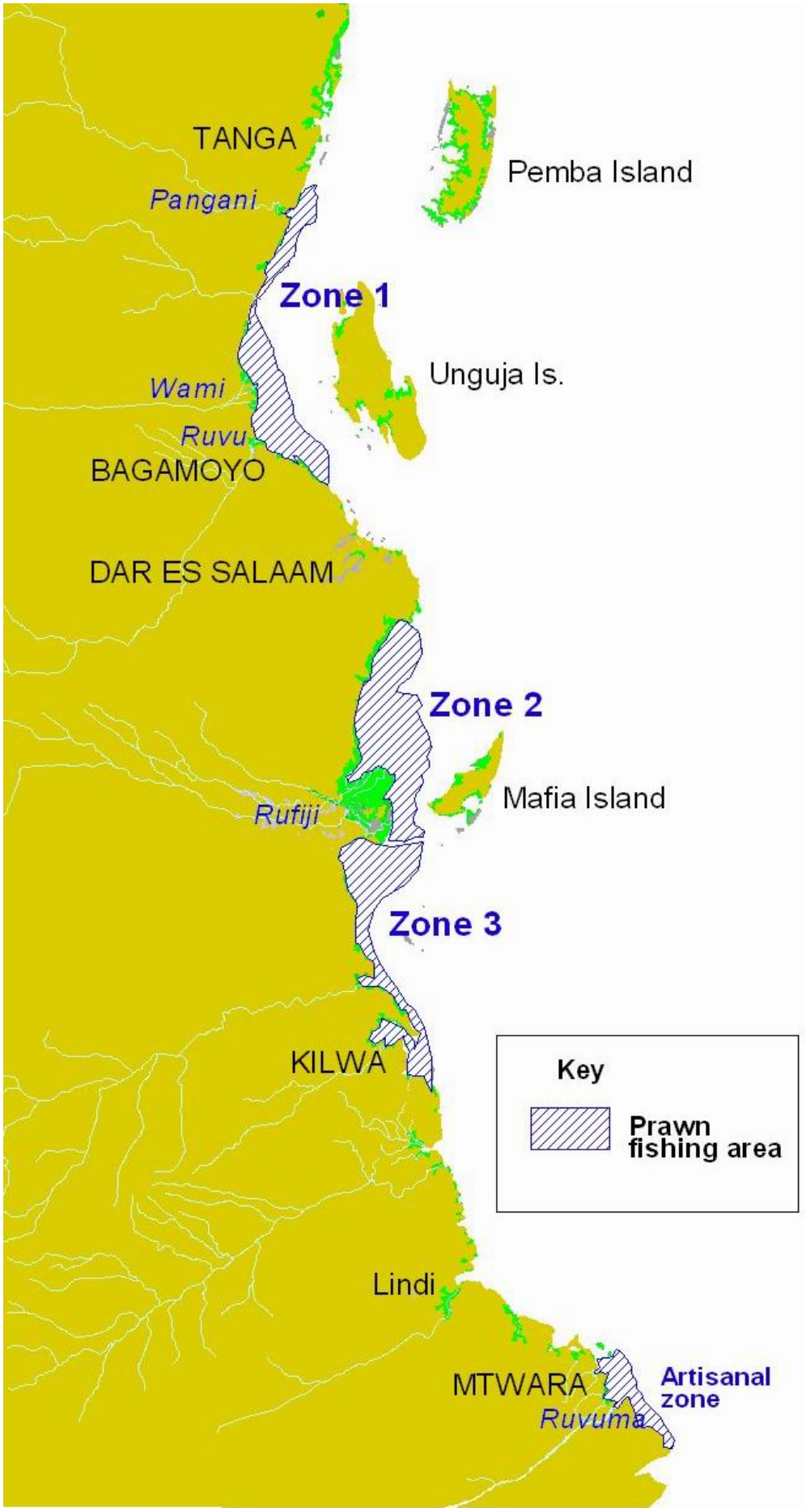
4.3.5 Prawn Fishery

Shrimp and prawn fishery in Tanzania is based on shallow water penaeid shrimp. These are crustaceans, have short life cycle and are found in brackish water environment associated with mangrove ecosystem and adjacent areas. The rich fishing ground is found around the Rufiji Delta and the Wami and Ruvu River entrances in Bagamoyo Pangani; Mkuranga and Mnazi Bay where conditions are good for the survival of the resource (prawns and shrimps). The most abundant and marketable types of prawns/shrimps include *Penaeus monodon* and *Penaeus semisulcatus (*tiger shrimp*), Penaeus indicus(*white shrimp*)* , *Penaeus japonicus (* flower shrimp*)* (Sawan Tanzania, 2002) and *Metapeneus monoceros* (brown shrimp) Rumisha and Sanders 1990. Those that makes the major contribution to the catches are the white shrimp (65.9%), brown shrimp (15.1%) and tiger shrimp (11.0%); with the contribution by the flower shrimp being 6.7 %.

Important prawn fishing grounds are found around the inshore reefs, deltas and mangrove forest areas mostly around Rufiji and Bagamoyo. Most catch is collected in less than 20 m depth. Both local artisan fisher and semi industrial trawler are involved in the fishery which is basically for the export market; a few are sold locally in Tourist hotels and restaurants. The major trawling grounds for prawn/shrimp have been zoned for management purpose into three zones. Zone 1 is located between Latitudes 5' 25' and 6' 30' S and includes the areas between Pangani, Saadani and Mbegani in Bagamoyo. Zone 2 is between Latitudes 7' and 8' S and includes the inshore areas around Kisiju, Bwejuu, Mafia Island and the northern part of Rufiji areas. This is the most productive of the three zones. Zone 3 lies between Latitudes 8' and 10' S and includes the southern part of Rufiji areas and Kilwa.

Total landings from the commercial prawn fishery increased from 1,081 tons in 1984 to 2,190 tons in 1988, with a corresponding increase the number of trawlers from 10 to 13. Landings dropped from 2,015 in 1990 to 1,119 tons in 1991 using same trawler effort indicating over-fishing in the trawling areas (TCMP, 2001). Currently about 23 prawn trawlers operate.

For management purposes, the Department of Fisheries has instituted other Management procedures and regulations to control the activities of prawn trawlers operating in these designated areas. These include the enforcement of the prohibition of dumping by-catch from the prawn fishery overboard. Previous dumping of finfish by catch was causing pollution of inshore waters. Following the strengthening of the Government's monitoring through improvement in the enforcement of the Fisheries Act, by-catch dumping has been greatly reduced. The by-catch is brought to landing sites on shore for the local market or processing. They are to observe the regulation of fishing during the day time and stay at the anchor at night. Also to observe a three month closed period for Commercial fishing for prawns from 1st December each year and reopens on 1st March of the proceeding year. With dwindling of catches however the closed season has now been extended to six Month effective from September 1st every year to end of February of the following year. Interviews with some trawler operators have revealed that they are even willing to increase the closed period to allow the shrimp prawn to breed and stocks to recover from over fishing and overcapitalization. Fishing under the artisanal fishing industry is allowed throughout the year. Conflict between artisanal fishers and trawlers occur


TANGA
Pangani
Pemba Island
Zone 1
Unguja Is.
Wami
Ruvu
BAGAMOYO
DAR ES SALAAM
Zone 2
Mafia Island
Rufiji
Zone 3
KILWA
Key
Prawn fishing area
Lindi
MTWARA
Artisanal zone
Ruvuma

Appendix 3f

4.3.6 Ornamental and Edible Shelled Molluscs

Edible Mollusks

Although edible mollusks are not commercially important fishery resources in Tanzania, they are however; an important component in the dishes of many coastal house hold. Gleaned at low tide on the intertidal mud and sandy or rocky flats they are hand picked mostly by women and children. They are collected in buckets and are processed at home or right on the beach where the flesh is removed from the shell, cooked and consumed or sold. They are harvested for food, for medicinal use and, as a source of lime in countries like Malaysian, Philippines, Indonesian and India (Salema 2004). In areas close to urban centers they are boiled or cocked and sold by vendors particularly women and earn a living from such an activity. The species that are involved include mapanga chaza *Ostrea amasa, Pinctada sp., Saccostrea cucullata.* On mud flats, estuaries and especially within mangrove areas the cockle's species of *Anadara antiquata* and the gastropod *Terebralia palustris* (Linnaeus) locally known as *suka* are harvested. The meat is removed for food and shells are collected and milled as chicken feed. In areas like Mtwara and in localized areas in Zanzibar *Tereblaria* are burnt to make lime. However, this activity is banned on the Mainland due to its negative environment consequences.

Ornamental molluscs

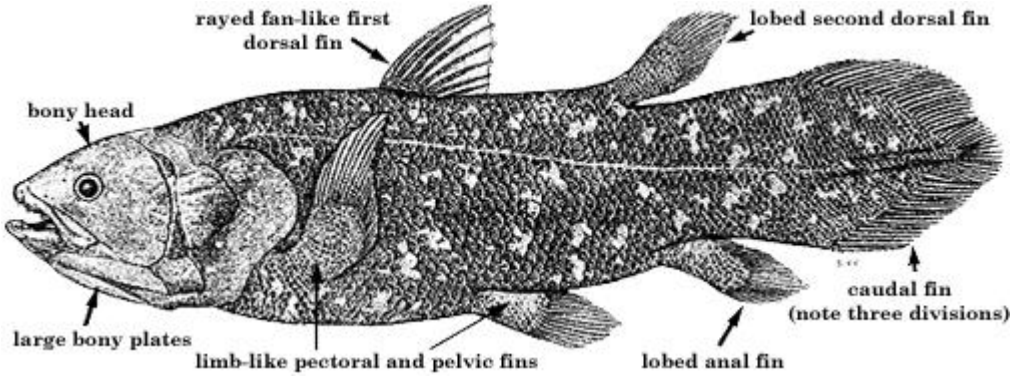
Harvesting of colourful shells is also an important contribution in both food and income of many coastal families. Historically, ornamental shells were exported in bulk from Zanzibar. However, a recent decline in exports (from 140 t in 1990 to 30 t in 1997) due to lower demands caused by environmental concerns has reduced this fishery. Despite this, shells are still sold locally or in tourist outlets. The favoured shells are the trumpet and helmet shells *Makombe* as well as tiger cowries *Cypraea tigris, Cyprae acassis rufa.* The opercula of certain shells (e.g. *Chicoreus ramosus* and *Pleuroploca trapezium*) are also exported to the Middle East. Many of the commercial species of molluscs are thought to be over-exploited, whether for food or for their shells, but distribution and abundance data are lacking.

Appendix 4a

4.4.1 COELACANTH (Latimeria chalumnae) CATCHES

1. Background information

The Coelacanth, a fish species thought to have become extinct some 65 million years ago along with Dinosaurs, came to world centre stage, when it was caught off the Indian Ocean waters, South Africa in 1938. It took the world some 14 years before it heard of the catch of the second fish in the Comoros. Since then many other specimen have been caught elsewhere especially in the Comoros (1952), Mozambique (1991), Madagascar (1994), again in South Africa (2000), (Kenya 2001) and most recently in Tanzania, (2003) where the recurrence of the catches have raised fears that, the stocks of the fish might be depleted.



The fish whose spine is hollow, hence the origin of the name coelacanth, has since been labelled the 'living fossil' for keeping its appearance and features unchanged since it acquired life between 350-370 million years ago.

The uniqueness and rarity of the coelacanth has made it a prized animal. Distinguished by the silver blue colour, six lobbed fins, and its unchanged nature and form for over 350 million years, the fish has raised interest and posed many unanswered questions to marine scholars of competing disciplines.

Although the fish's true evolutionary relationships are a matter of controversy, experts largely agree that coelacanths are primitive bony fishes occupying a side branch in the basal portion of the vertebrate lineage closely related but distinct from the ancestor of tetrapods (four legged vertebrates).

The coelacanth lives in deep ocean waters between150 metres and 700m where there are submarine caves, canyons, deep reefs with temperatures below 21 degrees Celsius. The fish which is a passive drift feeder, are opportunistic carnivores (meat - eater) preying mainly on fish. They are sluggish swimmers, but when threatened or in hunt for prey can swim very fast for a short periods. During the day time it is known to cluster in submarine caves from which they venture at night to feed.

The Coelacanth mode of production is ovoviviparity,(live bearing) that is eggs are fertilized internally, followed by a gestation period thought to be about one year to enable the embryo to grow culminating in the live birth of pups.

The fish breeds once every three years. Coelacanth reaches maturity after 20 years. Although there is no agreement over the fish's longevity, it is believed that it can live up to 40 or 50 years.

Because of the habits of the fish; the study of the fish however, is not easy as it demands specialized and expensive submersible equipment hence are expensive to carry out, and therefore uncontrolled exploitation of the species could be very damaging to the populations especially when the size of the populations are not known.

1.2 Occurrence

The first coelacanth was caught in Tanzania at Songo Mnara in Kilwa in 2003. The Second specimen was caught in Kilwa the same year. A third specimen was caught off Lindi in 2004. In August of the same five coelacanths were landed at Kigombe Village in Tanga. Since then more than 20 specimens have been caught off Kigombe alone. In 2007 three coelacanths were caught at Msimbati in Mnazi bay Marine Park. In the same year one specimen was landed at Sinda Island Marine reserve in Dar Es Salaam and another Coelacanth was landed at Nungwi in Zanzibar. So far more than a total of 35 Coelacanths have been caught, in Tanzania, mostly in the deep-set shark gill nets 'jarife'

A recent multi-national bathymetric survey, led by South African scientists, has found that deep water canyons (typical habitat of the coelacanth) fringe much of the continental shelf of mainland Tanzania, particularly in the south.

1.3. The status of coelacanth in Tanzania.

Tanzania entered the league of coelacanth countries when the first specimen of the fish was caught at Kilwa followed by another catch in the same area in Kilwa and Lindi towards the end of 2003 and early 2004.

These landings came at a time when Tanzania had joined the Africa Coelacanth Ecosystem Programme (ACEP). This is the regional research and conservation program led by South Africa involving the countries of the Western Indian Ocean region of Mozambique, Tanzania, the Comoros, Madagascar and Kenya. The program which started in 2002 its goal is the conservation of the coelacanth by using it as an icon to bring the expertise of the region together to work on the issues of importance to marine biodiversity and conservation. Among other thing ACEP require participating countries to establish National Management Committees which Tanzania had already established in 2003.

The first two specimens were preserved in the National Museum of Tanzania in Dar Es Salaam while replicas were distributed to various conservation and research Institutions in the country. The subsequent catches in Tanga, 20 out of 28 specimens were preserved in private refrigerators; the rest either went bad or were consumed by local fishermen. But being oily and unpalatable the fish is not a popular delicacy.

The National Coelacanth committee (which drew its membership from relevant sector both Mainland and Zanzibar) initiated preliminary studies which involved site verification and genetics of the fish. One specimen was donated by Tanzania Fisheries Research Institute to the Tokyo Institute of Technology for genetic research; and other samples were sent to South Africa for genetic studies.

Preliminary result from these studies showed that the Tanzanian coelacanth had two distinct populations. The Kilwa-Lindi population resembles the Comoro-South African line, while the Tanga coelacanths have peculiar traits resembling that caught in Kenya.

Also the committee engaged fishermen to change fishing gears, notably ‘jarife’ and deep set-gill nets to surface-set gill nets to minimize incidental capture. The Fisheries Department was requested to impose a moratorium on bottom trawling around the coast of Tanga.

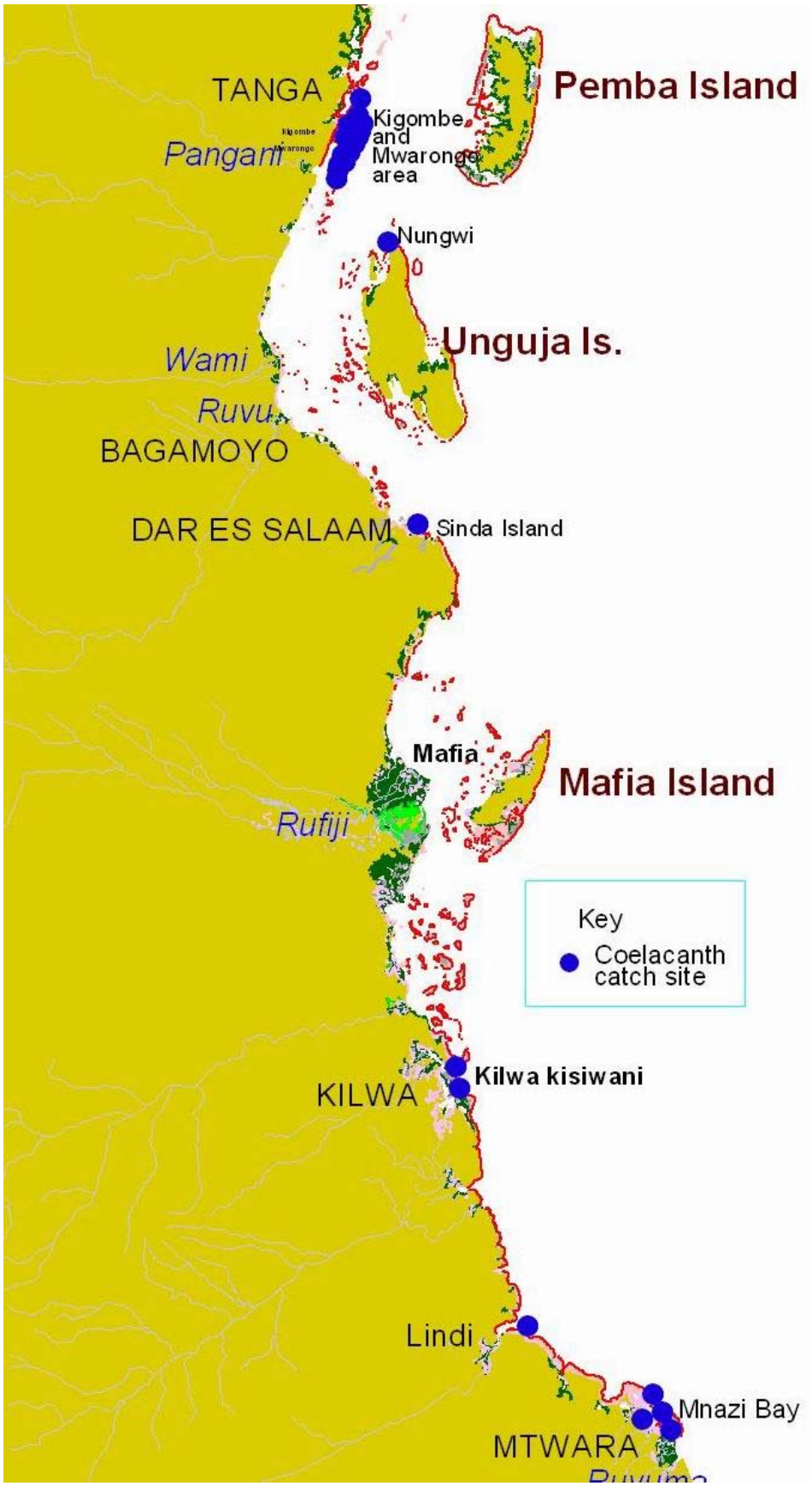
1.4 **Types and Severity of threats:**

Virtually all coelacanths caught in Tanzania were trapped in deep set shark gill net. In Tanga however; Coelacanth landings coincided with the re-introduction of trawling activities in deep waters along the Tanga coast. Trawling was temporarily banned in Tanga waters by the Director of Fisheries for one year 2005 January to December; however when it was lifted in January 2006, catching of coelacanth recurred.

Recorded experience from other parts of the world reveals that trawling fishing has been responsible for many catches of coelacanths than any other method.

In Tanzania, the stock of the coelacanths has not been determined. The increased incidence of catching the coelacanth fish whose stocks are unknown not only poses the danger of sending the coelacanth into extinction; but also it has reflected negatively on the image of our country.

Map 1: Coelacanth catch sites in Tanzania



4.4.2 Dugongs (*Dugong dugon*)

The dugong *Dugong dugon* commonly known as Sea cow are marine mammal that used to be relatively abundant and widely distributed prior to the mid-1970s, with incidental gillnet capture of 3-5 animals per day. They are found in shallow waters and graze on sea grasses. At one time considered locally extinct in Tanzania (Francis and Bryceson 2000) now they are very rare, with only a few sightings particularly in the Rufiji Mafia kilwa area, at around Muheza, Zanzibar and probably in Mnazi Bay (Muir et al., 2003, Wells et al 2005, Muir 2006). It is considered vulnerable in Tanzania and one of the most endangered species on the African continent. It is internationally protected in Appendix 1 of CITES and is listed on the IUCN Red List as Vulnerable). Information on its distribution and abundance in Tanzania is scarce and is mainly in the form of anecdotal reports, incidental sightings and capture.

The nation-wide assessment conducted in 2003 by the on going research on Mafia Island and the capture of an individual in fishing net in January 2004 in Rufiji and subsequent captures around Rufiji, Mafia and Kilwa areas indicate the existence of small but threatened population in the Mafia-Rufiji-Kilwa area. This is probably the largest remaining concentration in the country (between Jaja in Rufiji and Somanga in Kilwa) (Muir and Abdallah, 2003). Other relatively recent sightings include near Moa in Nkinga District and in the northern part of Pemba Island. Recent reports of confirmed dead dugong caught in gillnets are from Pombwe in Kilwa District in 2005, off the Coast of Zanzibar in 2005 and at Vikacha in Rufiji delta in 2005.

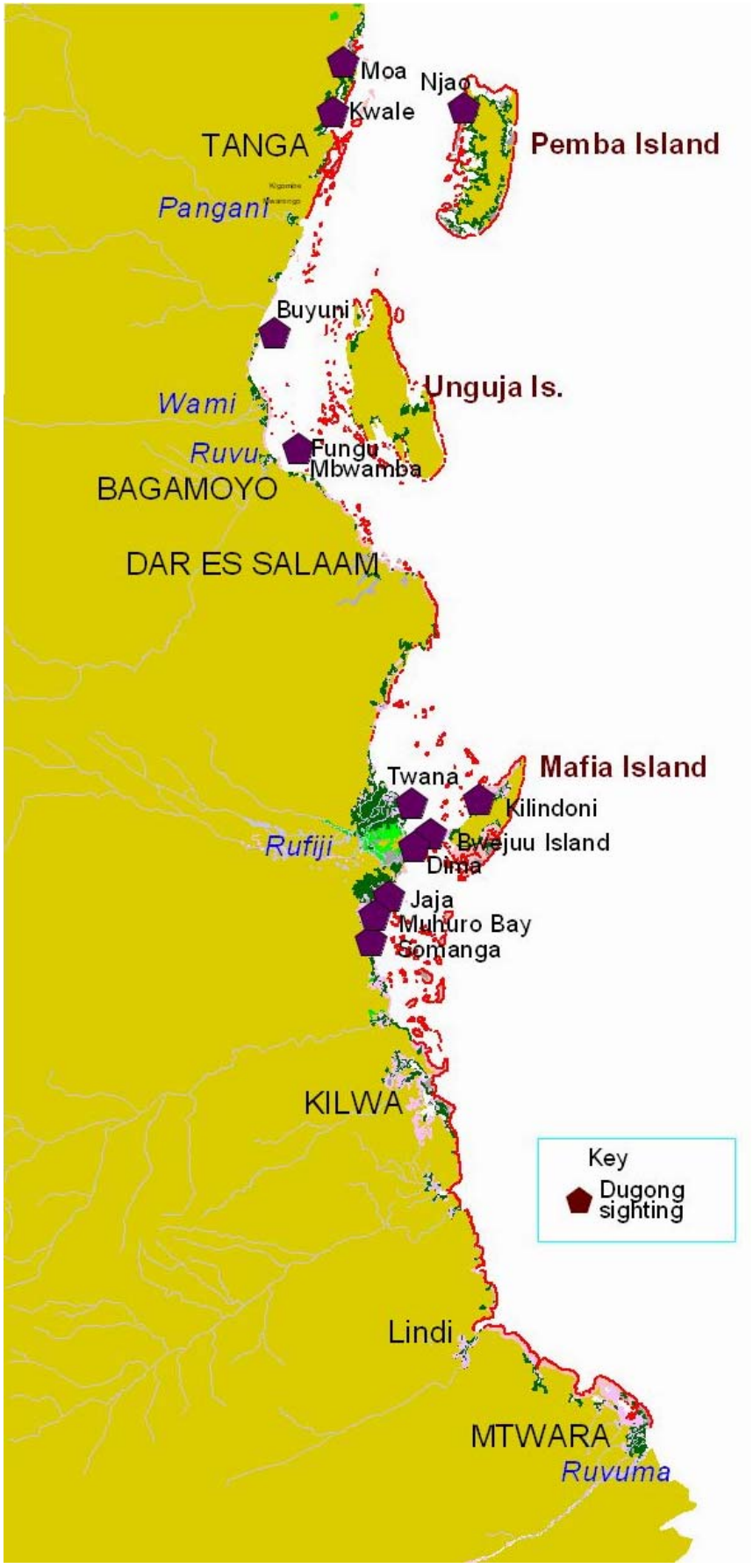
Records since 2000 suggest that 8-10 dugongs are killed annually for their meat and oil, but accidental entanglement and drowning in gillnets occurs often (Muir 2007).

In the Rufiji –Kilwa area dugong are said to move close to the shore during the cooler months, i.e. May – August (southeast monsoon) when sea temperatures are low, and to deeper waters during the warmer months of November – February (northeast monsoon) (Muir et al., 2003).

Threats

The Dugong (*Dugong dugon*) is threatened throughout its range in the Western Indian Ocean and world wide. In Tanzania the main threat to the dugong is heavy exploitation by local people for meat, oil and leather. It is also sought after for medicinal/aphrodisiac products. Accidental drowning at times kills dugongs when caught in gillnets. Other threats include degradation of sea grass beds; its main food supply. (Muir 2002) Although protected by national and international legislation, enforcement is inadequate.

Map 1: **DUGONG SIGHTING AREAS**



4.4.3 Sharks

As apex predators, the life history characteristics of sharks are typified by slow growth, late maturity and low rates of reproduction. These traits, which are shared by other elasmobranchs, make these animals particularly vulnerable to human exploitation. The most common group of sharks belong to the family Charcharinidae. Information on the biology and distribution in Tanzania is very scanty. However, they are known to be found in few numbers through out the Tanzania coastal waters in relatively deeper waters and are caught in shark nets and trawlers. Areas known to have relatively higher concentrations of sharks include Tanga, Dar es Salaam, Unguja Island, Nyuni Island and Kilwa area (Map 1)

Sharks are hunted for meat and shark fins are exported to far eat. Shark fin trade however has recently declined substantially. Some shark species are rarely seen now in Tanzania waters.

Whale Sharks

Whale shark is the largest living fish. They can be a brown, blue-grey or dark grey colour with creamy white spots covering its back and a white underside. It has a flat and very wide mouth (1.5m / 5ft) which is used for drawing in up to 1500 gallons of water per hour when feeding. The Whale Shark filters plankton through its Gill rakers and any fish drawn in are eaten.

The biology and behaviour of whale shark is poorly understood, but they are thought to undertake long distance migrations. The female gives birth to approximately 300 pups max and they are approximately 60 cm in length and grow up to 18m. Whale Sharks roam in Open Ocean and in coastal waters and bays of Warm temperate to tropical waters. They have been tracked down to depths of 250m. Whale Sharks can be seen in the Philippines, Seychelles, Australia, USA, Belize, Honduras, Ecuador, Cuba, Mozambique, Tanzania, South Africa, Thailand and the Maldives. The Whale Shark is harmless and is very curious and often swims up to divers or snorkelers that are diving in their waters.

Globally, catches have declined and populations have been depleted by artisanal and commercial fisheries. They are fished for their liver oil for waterproofing and their Fins and meat for food as a delicacy and are still actively fished in the waters off Taiwan. In Tanzania, they aggregate in groups of 5 – 20 off the west coast of Mafia Island, and are occasionally sighted in Zanzibar (Map 1).

Although whale sharks have been present off Mafia for some years, it was only in late 2005 that they attracted the interest of local hoteliers as a magnet for tourism. Since then, whale shark watching has become a daily occurrence. The rapid growth in whale shark tourism on Mafia coupled with poor regulations prompted the formation of an Association to protect whale sharks in Mafia for the benefit of the species and local stakeholders including fishers, the District Council and the tourist sector. This has helped

to somehow protect the animal through the use of a voluntary Code of Conduct for whale shark viewing.

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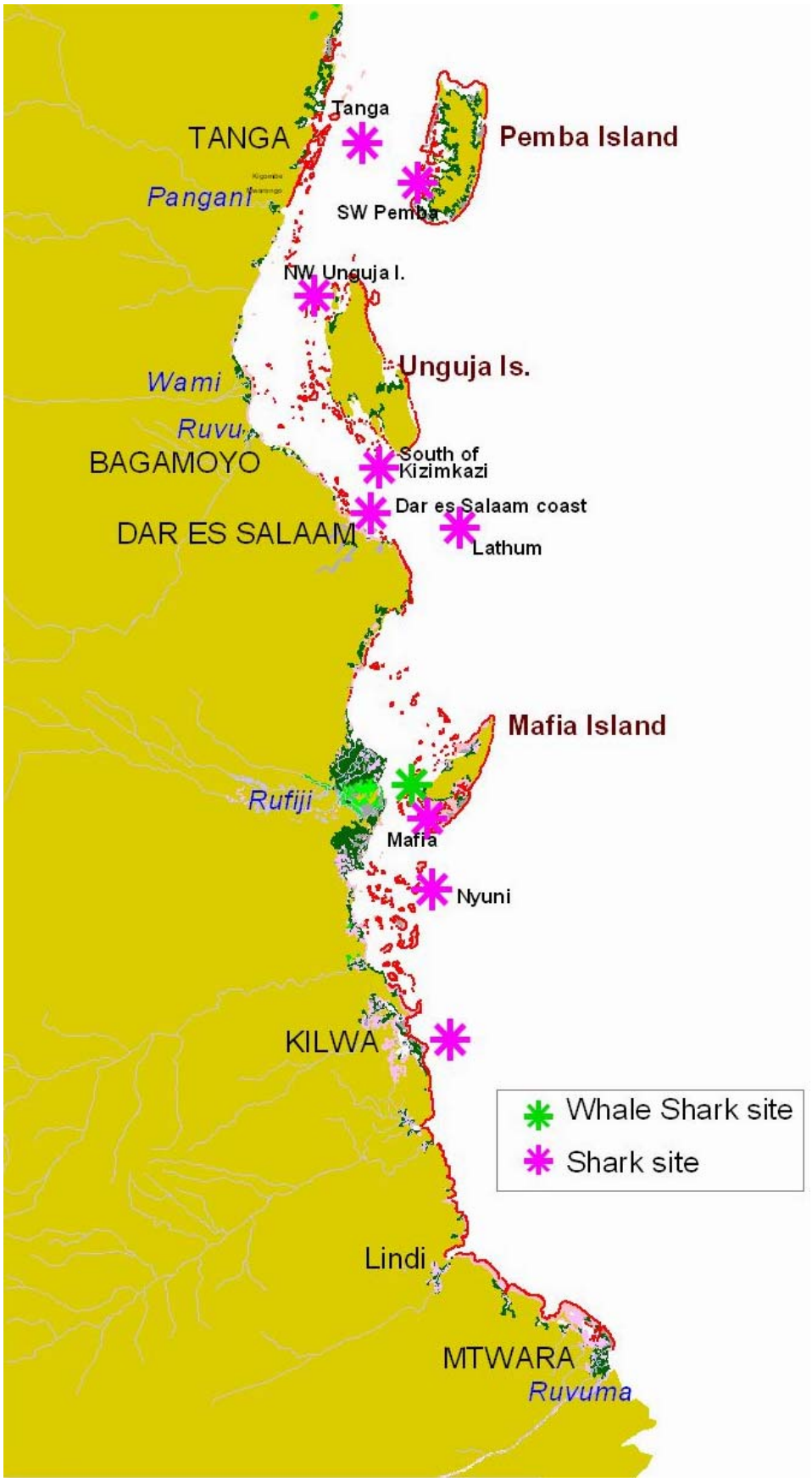
MAP 1: IMPORTANT SHARK SITES



Appendix 4d

4.4.4 Dolphins and Purposes

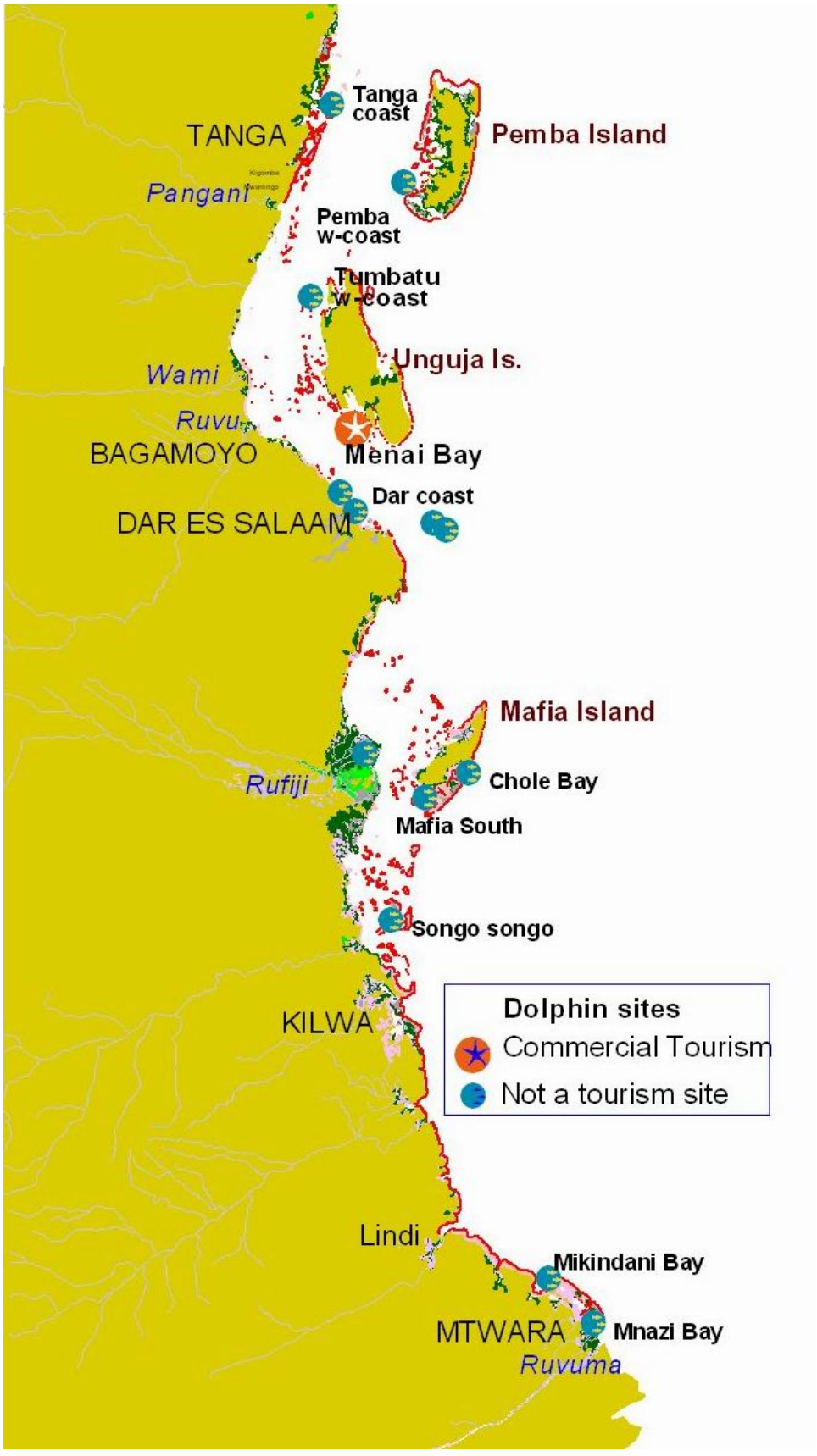
Eight species of dolphin have been recorded (Stensland *et al*., 1998) and are often caught accidentally in tuna/billfish/marlin nets, particularly off Nungwi (Unguja) (Amir *et al*., 2002). The commonest species are probably the Indo-Pacific bottlenose dolphin *Tursiops aduncus*, the Indo-Pacific humpback dolphin *Sousa chinensis* and the spinner *Stenella longirostris*. Menai Bay has a significant population of about 150 resident bottlenose and 75 humpback dolphins. Other areas with significant population of dolphins include Latham Island. Mafia Island Marine Park, Moa bay in Nkinga, Rufiji delta and Mnazi bay. Few sightings are reported around Dar es Salaam Marine Reserves, Mzinga Creek at the Harbour entrance and Saadani.

Threats:

Dolphin are threatened by incidental capture in gillnets (Francis and Bryceson, 2000). Also beaching as the case was with a recent mass death of Dolphins in Zanzibar the cause of which is yet to be accertained. There are speculations that the precence military submarine in the East african coast could have affected their sonar navigation system hence beaching. Other potential threats are wreckless speeding of Boats during dolphin tourism as well as swimming with dolphin by tourist.

Francis J and I.Bryceson 2000 Tanzanian Coastal and Marine Resources: Some Examples Illustrating Questions of Sustainable Use pg 76 – 102 in Lessons Learned: Case Studies in Sustainable Use

MAP 1: IMPORTANT DOLPHIN SITES IN TANZANIA

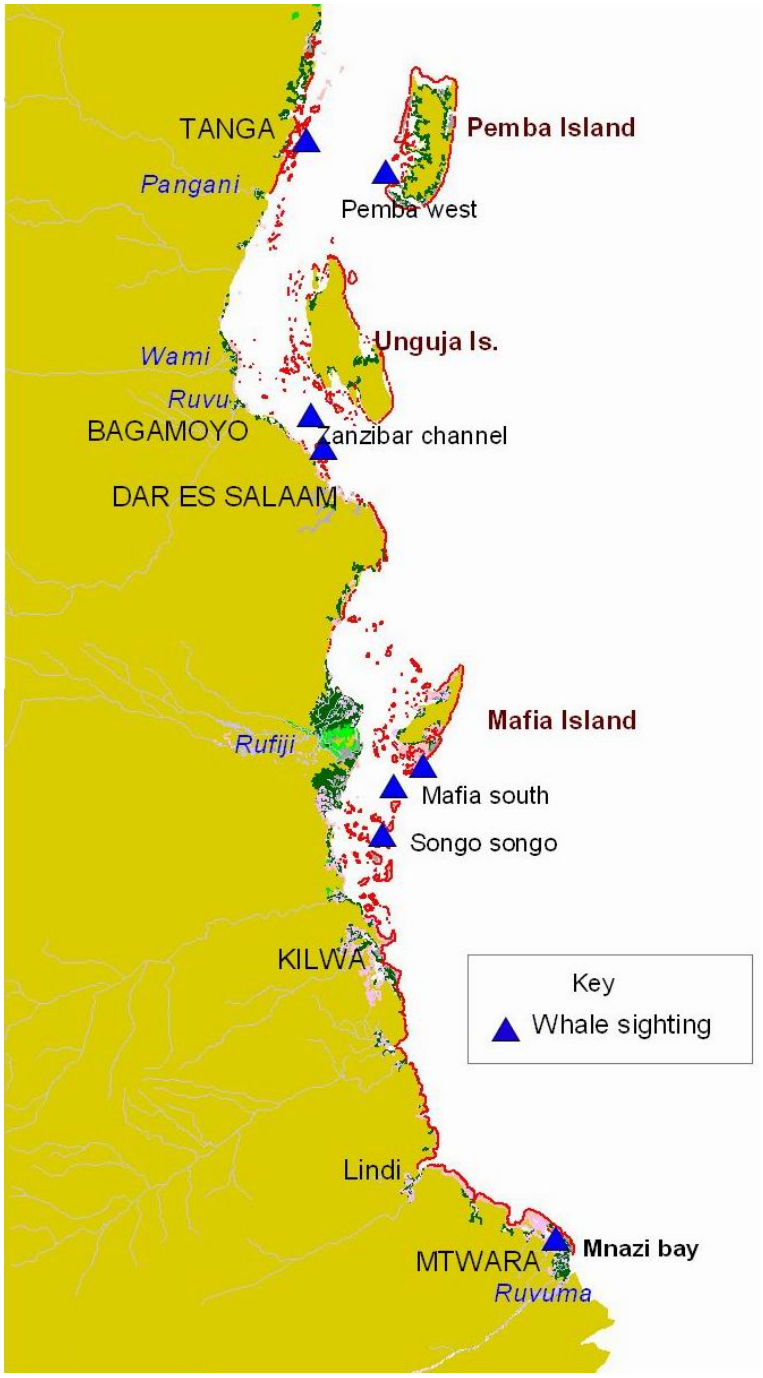


4.4.5 Whales

Humpback and other whale species pass through Tanzanian waters on migration (and may calve in Mnazi Bay).

Threats
Whales are protected through out their range and the Indian Ocean is a Sanctuary for Whale. They are threatened by being stranded in shallow water due to high tidal range

MAP 1: IMPORTANT WHALE SITES



Appendix 5a

4.5.1 Fish landing beaches/Markets and Facilities

Fish landing sites are an important part of the fishing industry as they play a major role in the fish marketing chain. Fish landing sites are specific areas, which are selected to suit the intended purpose. The criteria used for selecting a fish landing site are not clear but may include one or a combination of the following criteria as:-
That the area is sheltered against strong winds;

- The area has a reasonably deep water to allow for anchoring of different sizes of fishing vessels;
- The area is easily accessible by road; and or;
- The area is reasonably large enough to allow for expansion, construction of land-based fish processing and/or storage facilities.

According to Fisheries Frame survey of 2007, there are over 200 permanent fish landing sites along the coast in the Mainland Tanzania (Table 1). Attempts to map the landing sites on the Tanzania mainland coast were unsuccessful because most of the names of the landing sites lacked geo-references (Sobo, 2007). A map of the landing sites of Unguja and Pemba Islands exist (Map 1 and Map 2). Important fisheries statistics for the mainland are however available (Tables 1, 2, 3, 4 and 5).

Table 1: The number of fish landing sites observed in Tanzania mainland coastal Districts

Region	**District**	**Permanent Landing site**		**Temporary Landing site**		**Total Landing site**	
		2001	2007	2001	2007	2001	2007
Coast	Bagamoyo	13	11	0	4	13	15
	Mafia	32	34	2	5	34	39
	Mkuranga	10	14	0	0	10	14
	Rufiji	12	20	3	6	15	26
Dar es Salaam	Ilala	1	1	0	0	1	1
	Kinondoni	5	5	0	1	5	6
	Temeke	8	7	0	0	8	7
Lindi	Kilwa	17	15	1	3	18	18
	Lindi	18	19	0	4	18	23
Mtwara	Mtwara	29	27	0	0	29	27
Tanga	Muheza	18	19	0	0	18	19
	Tanga	12	27	0	0	12	27
	Pangani	25	12	0	1	25	13
Grand total		**200**	**211**	**6**	**23**	**206**	**234**

Source: Fisheries Frame Survey Results, May 2001 and 2007

Generally the majority of the fish landing sites are natural sandy harbours with the exception of the Dar es Salaam harbour and the TAFICO jetty located in the Kigamboni area. There are no fish landing sites that are dedicated exclusively for fishing boats. The tidal differences are large (about 4 meters), hence fishing boats are sometimes forced to moor several hundred meters away from the beach and access to the beach may be difficult during spring low tides. Additionally, due to lack of mooring facilities, fish

catches are often unloaded onto a small canoe and landed in the harbour. Sometimes auctioning of fish takes place in the intertidal shore.

Table 2: Landing site facilities reported during the 2007 Frame survey

Region	District	Landing site Bandas		Cold Rooms	Freezers	Fish kiln	Boat rep. facility	Net rep. facility	Water supply	Electricity	FD Staff
		Tempo	Permanent								
Coast	Bagamoyo	4	4	0	2	2	6	8	3	2	3
	Mafia	13	0	0	0	0	22	28	2	3	2
	Mkuranga	0	0	0	0	2	12	10	8	0	1
	Rufiji	5	7	0	0	0	6	4	1	0	3
Sub total		22	11	0	2	4	46	50	14	5	9
DSM	Ilala	0	1	1	1	0	1	1	1	1	10
	Kinondoni	0	2	0	1	1	4	1	4	5	1
	Temeke	2	3	0	0	0	5	7	14	6	6
Sub total		2	6	1	2	1	10	9	19	12	17
Lindi	Kilwa	4	3	0	0	0	8	8	10	3	3
	Lindi	9	4	0	1	0	9	11	17	3	4
Sub total		13	7	0	1	0	17	19	27	6	7
Mtwara	Mtwara	0	2	0	1	0	15	20	15	5	2
Tanga	Muheza	5	4	0	0	0	11	13	2	3	3
	Pangani	2	1	0	0	0	8	12	4	2	5
	Tanga	1	2	0	1	0	12	12	21	6	6
Sub total		8	7	0	1	0	31	37	27	11	14
Grand Total		45	33	1	7	5	119	135	102	39	49

Source: Fisheries Division – 2007 Frame Survey Results

Table 3: Fishing crafts and engines observed during the 2007 Frame survey

Region	District	Type of fishing vessels							
		BT	DC	DH	MS	NG	Total	Engines	
		Planked Boat	Dugout canoe	Dinghy	Mashua	Ngalawa		Outboard	Inboard
COAST	Bagamoyo	35	95	72	29	175	406	28	4
	Mkuranga	11	238	10	66	93	418	0	0
	Mafia	149	665	34	57	214	1,119	125	19
	Rufiji	12	757	6	2	6	783	8	2
	Sub total	207	1,755	122	154	488	2,726	161	25
DSM	Ilala	96	95	8	0	33	232	75	32
	Temeke	131	165	34	1	103	434	84	4

	Kinondoni	63	141	59	14	96	373	87	0
	Sub total	290	401	101	15	232	1,039	246	36
LINDI	Lindi	9	314	42	16	171	552	11	0
	Kilwa	58	272	121	25	89	565	59	1
	Sub total	67	586	163	41	260	1,117	70	1
MTWARA	Mtwara	28	825	195	21	0	1,069	24	3
	Sub total	28	825	195	21	0	1,069	24	3
TANGA	Muheza	0	81	116	39	220	456	31	0
	Pangani	1	39	25	22	184	271	16	0
	Tanga	14	222	103	108	217	664	124	6
	Sub total	15	342	244	169	621	1,391	171	6
GRAND TOTAL		607	3,909	825	400	1,601	7,342	672	71

Source: Fisheries Division – 2007 Frame Survey Results

Table 4: The type and number of Fishers counted during the 2007 Frame survey

Region	District	Resident fishers		Non Resident fishers		Sub Total	Foot fishers		Total F/men
		Owners	Workers	Owners	Workers		Other than seaweed	Seaweed farmers	
Coast	Bagamoyo	204	1,100	18	211	1,533	484	58	2,017
	Mkuranga	459	965	8	26	1,458	980	0	2,438
	Mafia	1,001	1,896	228	1,131	4,256	1,478	465	5,734
	Rufiji	406	364	385	375	1,530	1,265	0	2,795
	Sub total	**2,070**	**4,325**	**639**	**1,743**	**8,777**	**4,207**	**523**	**12,984**
DSM	Ilala	94	1,136	3	279	1,512	32	0	1,544
	Kinondoni	251	730	31	285	1,297	96	0	1,393
	Temeke	373	1,097	24	218	1,712	238	12	1,950
	Sub total	**718**	**2,963**	**58**	**782**	**4,521**	**366**	**12**	**4,887**
Lindi	Lindi	636	1,562	10	24	2,232	515	516	2,747
	Kilwa	440	1,409	35	226	2,110	157	3,660	2,267
	Sub total	**1,076**	**2,971**	**45**	**250**	**4,342**	**672**	**4,176**	**5,014**
Mtwara	**Mtwara**	1,504	1,512	107	158	3,281	2,325	320	5,606
	Sub total	**1,504**	**1,512**	**107**	**158**	**3,281**	**2,325**	**320**	**5,606**
Tanga	Muheza	404	1,373	50	196	2,023	171	208	2,194
	Pangani	293	521	18	146	978	343	184	1,321
	Tanga	627	3,177	43	241	4,088	153	0	4,241
	Sub total	**1,324**	**5,071**	**111**	**583**	**7,089**	**667**	**392**	**7,756**
Grand Total		**6,692**	**16,842**	**960**	**3,516**	**28,010**	**8,237**	**5,423**	**36,247**

Table 5: Types and number of gears counted during the 2007 Fisheries Frame survey

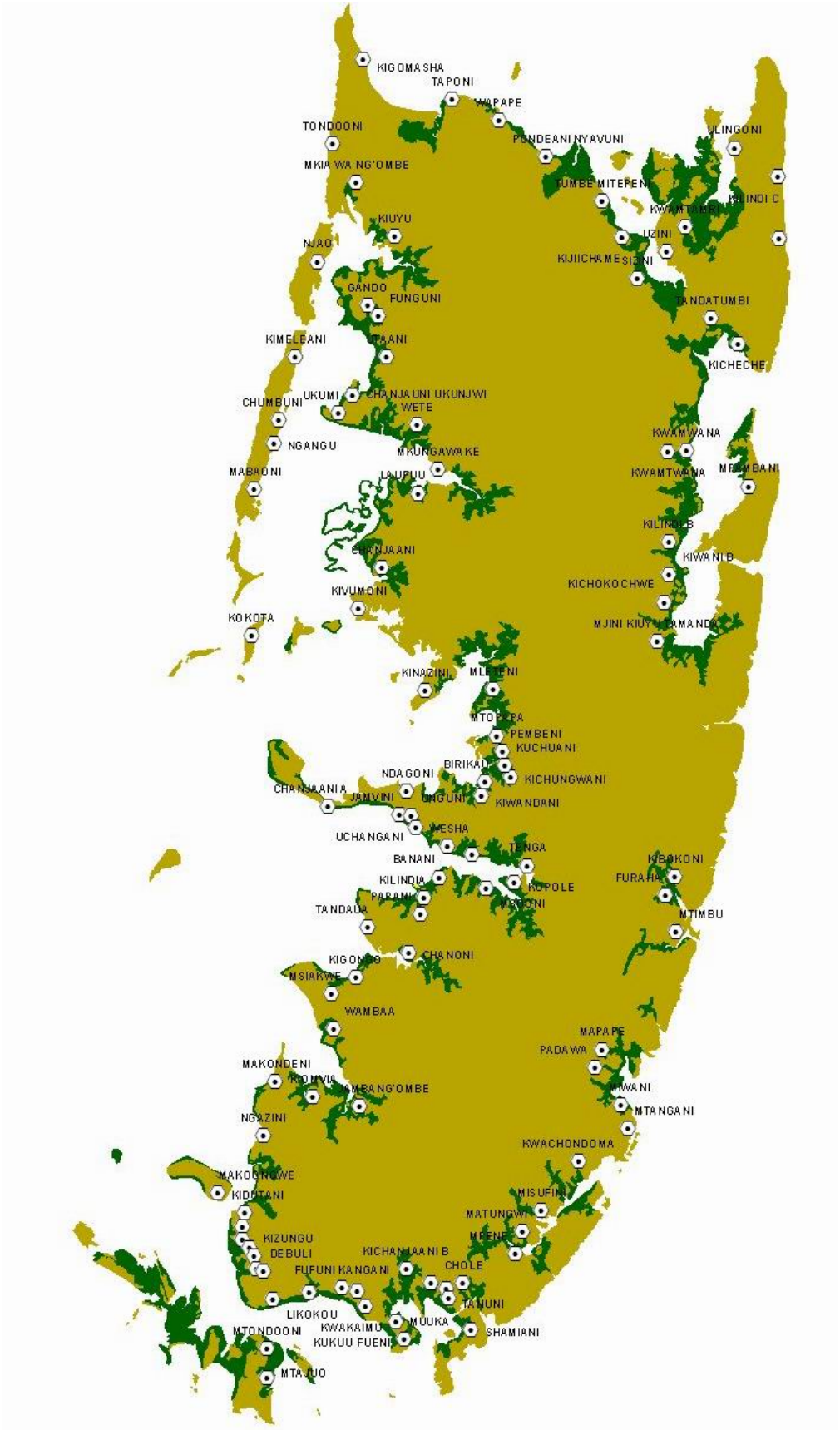
Regions	District	Gear types													
Regions	**District**	**TRP**	**SN**	**GN**	**HL**	**LL**	**BS**	**PS**	**CN**	**RN**	**SC**	**WR**	**SP**	**AN**	**T.net**
Coast	Bagamoyo	136	161	367	1,519	12	53	11	0	5	7	0	4		3
	Mkuranga	0	483	8,057	16	915	0	13	0	41	1	15	0		
	Mafia	608	609	1,197	1,750	36	3	59	0	399	150	43	566		
	Rufiji	0	401	15,947	210	1,043	7	154	54	0	16	361	51		
	Sub Total	744	1,654	25,568	3,495	2,006	63	237	54	445	174	419	621	0	3
DSM	Ilala	49	7	397	1,163	0	0	0	0	65	13	0	45		
	Kinondoni	396	81	545	764	192	33	0	18	157	6	4	8		
	Temeke	0	157	143	873	3	103	15	5	42	44	0	15		
	Sub Total	445	245	1,085	2,800	195	136	15	23	264	63	4	68	0	0
Lindi	Kilwa	161	350	1,222	1,315	15	15	95	0	30	20	66	163	20	
	Lindi	375	173	591	1,835	0	233	5	45	201	4	51	37		
	Sub total	536	523	1,813	3,150	15	248	100	45	231	24	117	200	20	0
Mtwara	Mtwara	657	369	1,438	1,646	9	122	10	18	15	23	0	364		
	Sub total	657	369	1,438	1,646	9	122	10	18	15	23	0	364	0	0
Tanga	Muheza	385	440	243	1,135	13	10	0	0	25	4	0	280		
	Pangani	656	644	213	371	27	5	0	26	2	0	0	23		
	Tanga	762	424	850	1,393	4	31	1	3	94	18	4	208		6
	Sub Total	1,803	1,508	1,306	2,899	44	46	1	29	121	22	4	511	0	**6**
	Grand Totals	**4,185**	**4,299**	**31,210**	**13,990**	**2,269**	**615**	**363**	**169**	**1,076**	**306**	**544**	**1,764**	**20**	**9**

Source: Fisheries Division – 2007 Frame Survey Results

Map 1: Fish landing sites in Unguja Island, Zanzibar

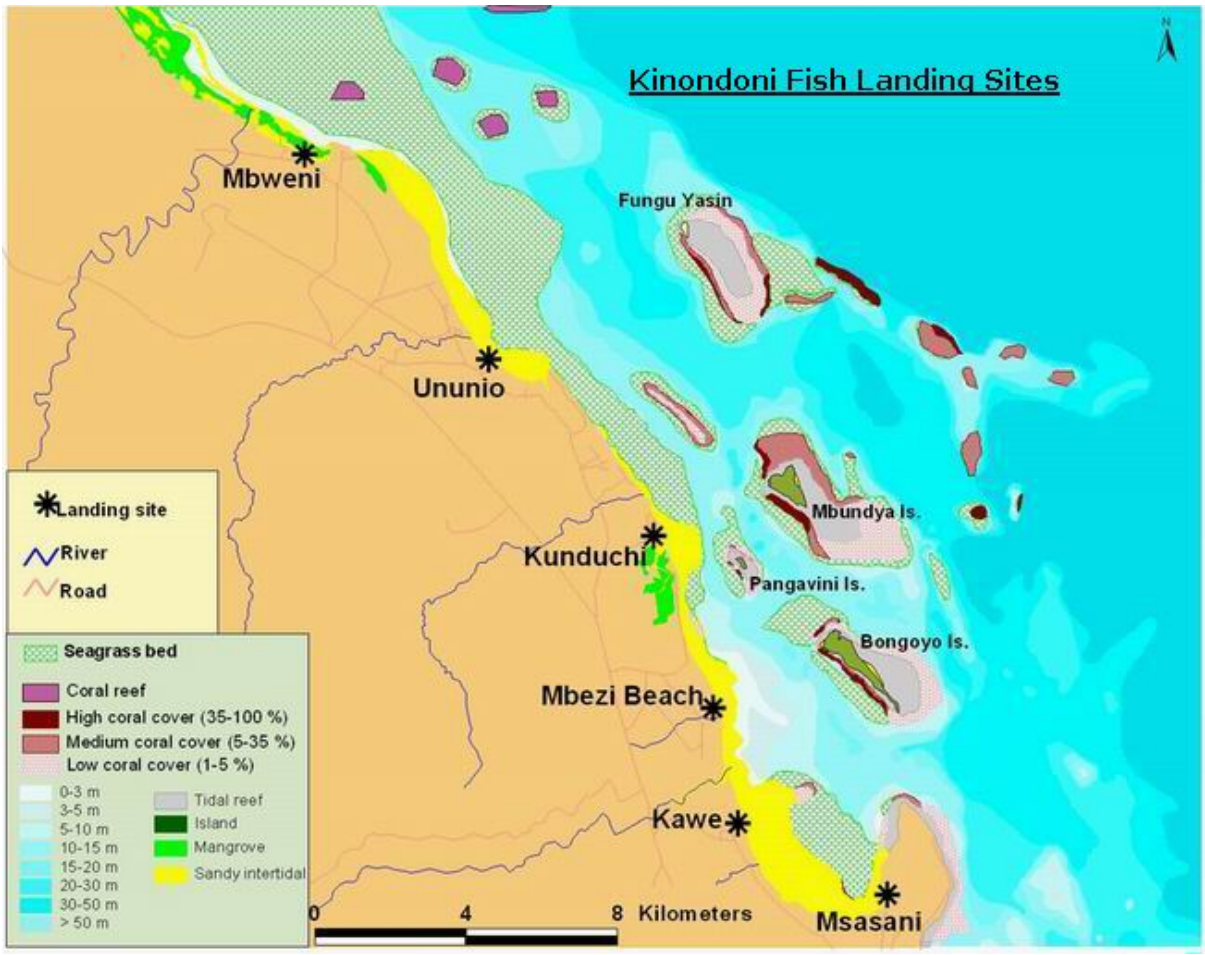
Source: IMS Database

Map 2: Fish landing sites in Pemba Island, Zanzibar



Source: IMS Database

Map 3: Fish landing sites in KICAMP area



Appendix 5b

4.5.2 Coastal Hotels and Resorts

Tourism is one of the fast growing sectors of the country economy. It ranks number one foreign exchange earner and has overtaken agriculture in GDP terms. Coastal tourism is also picking up and shows a promising future as evidenced in the number, variety and diversity of accommodation facilities that have been constructed or are planned along the Coast. They range from ecologically friendly lodges, stylish to classic type of hotels. The diverse type of accommodation target different market segment of tourist and holiday makers who visit the Coast. There are accommodation facilities targeting upper class market as represented by The Kempiski Kilimanajro hotel to those catering for nature lovers as represented by Chole mjini Tree houses and Mnemba Island Resort.

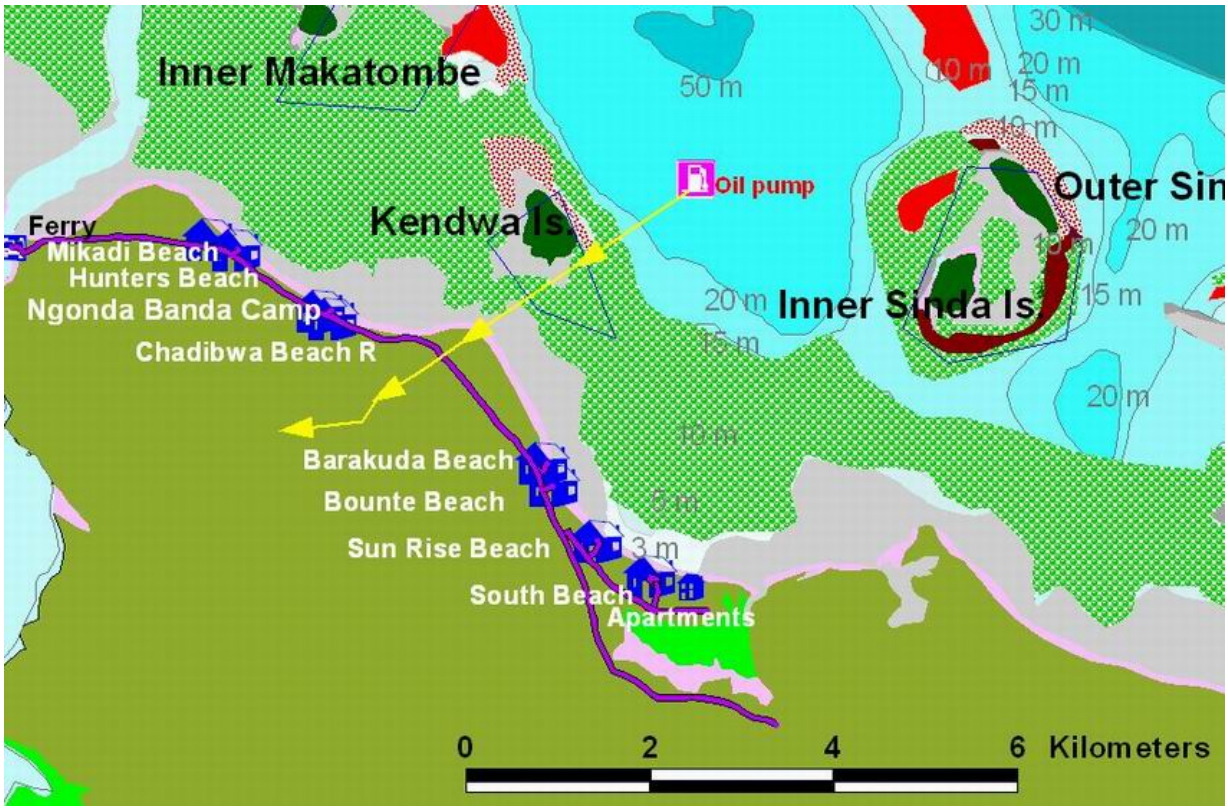
A list of important coastal hotels and resorts in the different coastal Districts is given in the table below. Due to difficulties in hotel databases, this list is far from complete.

Region	District	Name of Hotel/ Resort
Tanga	Tanga	Ocean Sea breeze,
		Tanga Yatch Club
		Mkonge Hotel
	Pangani	Koma bay Beach Resort
		Tinga tinga Baech Resort
		Pangani Beach Resort
		Protea Hotel Pangani
		Emayani Beach Resort
		Tides Beach Resort
Coast	Bagamoyo	Saadani Beach Resort
		Malaika Hotel
		Palm Tree Hotel
		Paradise Holiday Beach Reort
		Oceanic Bay Resort
		Bagamoyo Beach Reort
		Traveller's Lodge
		Livingstone Beach Resort
		BADECO Beach Resort
		Millennium Sea Breeze Hotel
		Mary nice place lodge
		Mlingotini Hotel
		Kasiki Hotel
	Mafia	Mafia Island (Marine Park) Lodge
		Pole pole Bungalow Beach Resort
		Kinasi Lodge
		Chle Mjini Lodge
Dar Es Salaam	Temeke	Protea Hotel Amani Beach
		Ras Kutani Beach Resort
		South Beach Resort
		Sunrise Beach Resort
		Bounte Beach resort
		Barakuda Beach resort
		Kipepeo Beach Resort

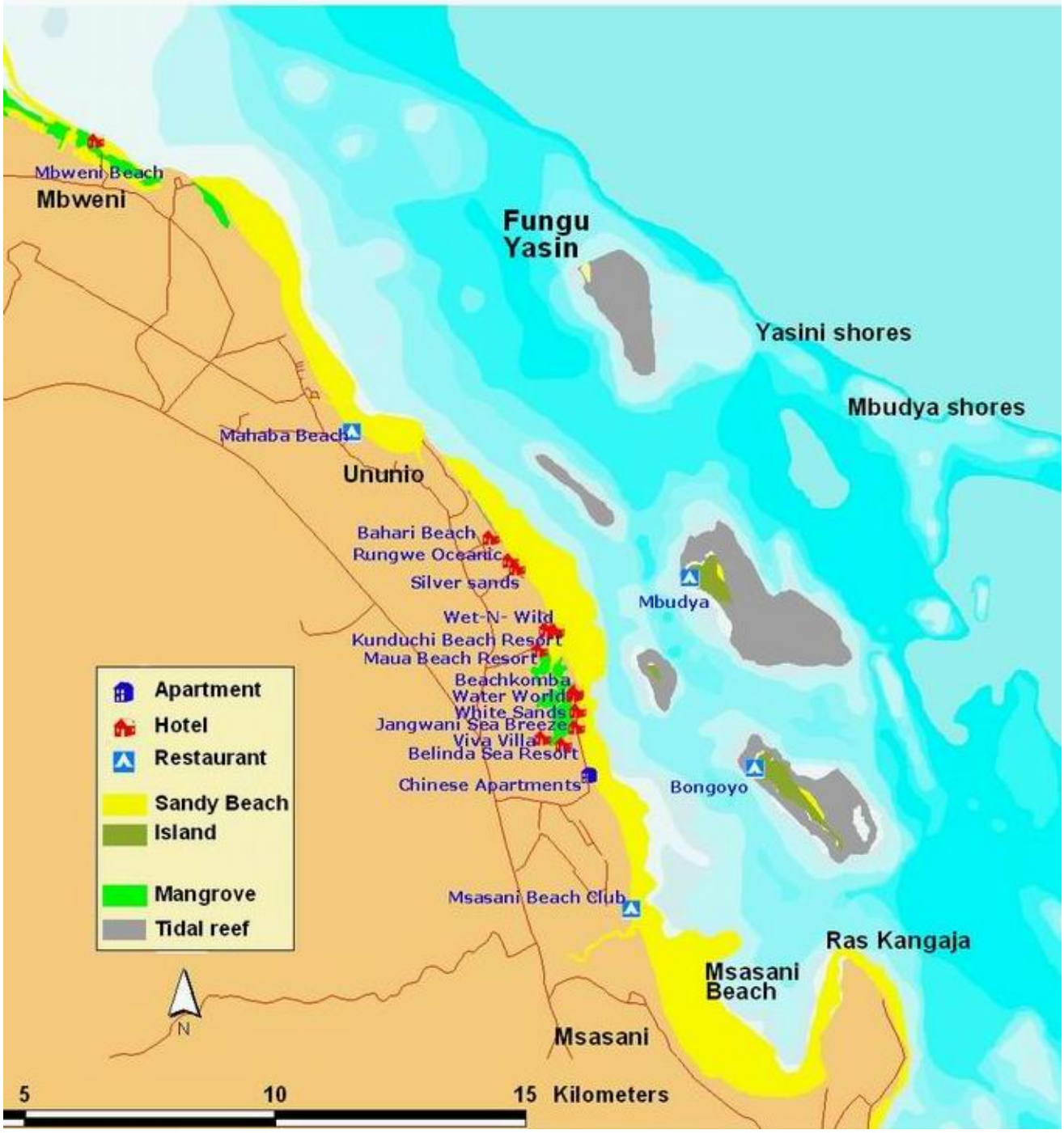
		Chadibwa Beach Resort
		Ngonda Beach Camp
		Hunters Beach resort
		Mikandi Beach Reort
	Ilala	Holiday Inn Hotel
		Kilimanjaro Kempisnki Hotels
		New Africa Hotel
		Protea Hotel Sea View
		Moven Peac Hotel
	Kinondoni	Protea Hotel Oyster Bay
		Golden Tulip
		Hotel Sea Cliff
		Dar Es Salaam Yatch Club
		Msasani Beach Apartments
		Mediterenaneo Beach Resort
		Chinese Apartment
		Jangwani Sea Breeze
		Belinda Beach Resort
		Villa Villa Resort
		White Sands Hotel
		Beach Comber Beach Resort/
		Water World
		Maua Beach Resort
		Kunduchi Beach Hotel
		Wet N Wild
		Silversands Hotel
		Bahari Beach Hotel
		Rungwe oceanic beach hotel
Lindi	Kilwa	Kilwa Ruins Beach Resort
Mtwara	Mtwara	Mikindani Boma hotel
		Ruvula Sea Safari

Mapping the location of Hotels and Resorts for the whole coastline was not possible due to lack of spatial references of most hotels. Geographical coordinates of some hotels and resorts located in Kinondoni and Temeke Districts were taken using GPS and used to prepare a hotel and resort distribution maps for the respective areas (Map 1 and Map 2). District level mapping is likely to produce better and more useful presentations in A4 or A3 paper sizes.

Map 1: Beach Hotels and Resorts along Mjimwema, part of Temeke District coastline



Hotels, Restaurant and Apartments along KICAMP coastal area



Appendix 5c

4.5.3 Historical and cultural sites

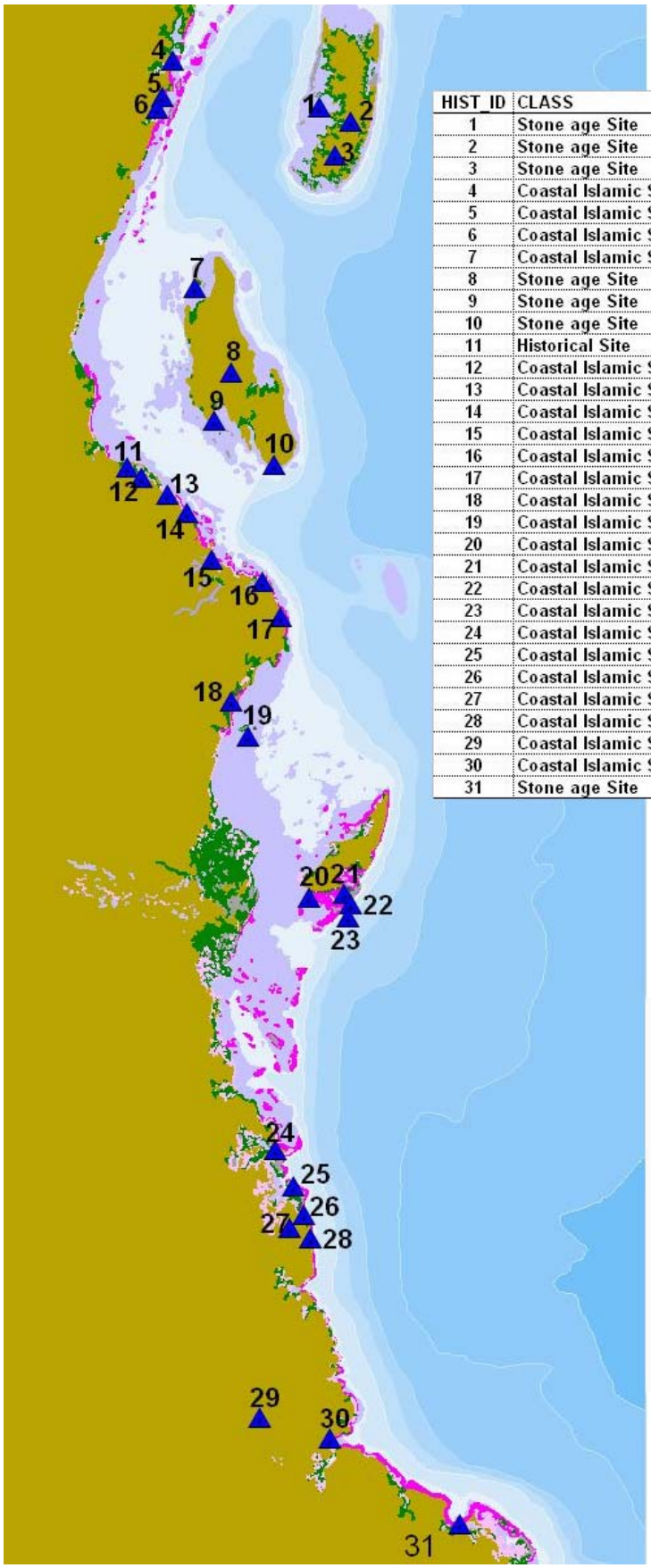
Cultural tourism is growing and for many countries it is a significant source of income. There are many links between cultural tourism and nature-based tourism or Ecotourism. In Ecotourism, both cultural (including historical) and natural resources are valuable assets.

The Tanzanian coast and islands is particularly rich in cultural heritage resources. There is several surviving physical evidence of a long history of settlement, including periods of notable wealth, which stretches back to at least 800AD. At the same time it has coastal and marine resources that are regionally outstanding and some that are of global significance. This combination makes Tanzania one of the important ecotourism sites in the world.

The Antiquities Department, which currently falls under the Ministry of Natural Resources and Tourism (MNRT), is the governmental body assigned as custodian of the cultural heritage on the mainland. The principal legislation relating to monuments and sites on Zanzibar and Pemba is the Ancient Monuments Preservation Decree of 1927, amended in 1971 and 2002. This legislation protects and conserves historical sites and monuments as well as other related sites. There are 44 historical sites and monuments listed which date from the 9th to the 20th centuries; 21 are on Unguja (Map 2), and 23 in Pemba.

There are several efforts to restore historical sites and monuments with the purpose of conserving history and tourist related income.

Map 1: Important Historical Sites of Tanzania



HIST_ID	CLASS	NAME	REGION
1	Stone age Site	Pemba Is	PEMBA
2	Stone age Site	Pemba Is	PEMBA
3	Stone age Site	Pemba Is	PEMBA
4	Coastal Islamic Site	Toten Is	TANGA
5	Coastal Islamic Site	Ndumi	TANGA
6	Coastal Islamic Site	Tongani	TANGA
7	Coastal Islamic Site	Tumbatu	ZANZIBAR
8	Stone age Site	Zanzibar	ZANZIBAR
9	Stone age Site	Zanzibar	ZANZIBAR
10	Stone age Site	Zanzibar	ZANZIBAR
11	Historical Site	Bagamoyo	PWANI
12	Coastal Islamic Site	Kaole	PWANI
13	Coastal Islamic Site	Mbweni	DAR ES SALAAM
14	Coastal Islamic Site	Kunduchi	DAR ES SALAAM
15	Coastal Islamic Site	Mzizima	DAR ES SALAAM
16	Coastal Islamic Site	Mbwamaji	DAR ES SALAAM
17	Coastal Islamic Site	Kimbiji	PWANI
18	Coastal Islamic Site	Kisiju	PWANI
19	Coastal Islamic Site	Koma Is.	PWANI
20	Coastal Islamic Site	Kisimani Mafia	PWANI
21	Coastal Islamic Site	Chole	PWANI
22	Coastal Islamic Site	Kua	PWANI
23	Coastal Islamic Site	Jibondo	PWANI
24	Coastal Islamic Site	Mtitmira	LINDI
25	Coastal Islamic Site	Kilwa Is.	LINDI
26	Coastal Islamic Site	Songo Mnara	LINDI
27	Coastal Islamic Site	Sanje ya Kati	LINDI
28	Coastal Islamic Site	Sanje Majoma	LINDI
29	Coastal Islamic Site	Tena Rungu	LINDI
30	Coastal Islamic Site	Lindi	LINDI
31	Stone age Site	Mikindani	MTWARA

Map 2: Some of the cultural and historical sites in Unguja, Zanzibar.
Source: Moon, 2004

References

Karen Moon, 2004: CULTURAL TOURISM ON THE TANZANIAN COAST AND ISLANDS. A Background Study document of a Book – “A Blueprint 2050 - Sustaining the Marine Environment in Mainland Tanzania and Zanzibar”, Edited by J. Ruitenbeek, Hewawasam I and Ngoile, M., 2005.

Appendix 5d

4.5.4 Diving Sites

DIVING SITES IN THE MAINLAND TANZANIA

1. MAFIA

At the centre of East Africa's largest marine park, is wonderful Mafia Island. A real sleepy backwater and remnant of the old Swahili coast retaining a traditional, unspoilt friendly culture reminiscent of the Zanzibar of thirty years ago. With over 400 marine species identified, this is the meeting place for large oceanic fish, as well as those common to coral reefs in the Indian Ocean. Almost all of Mafia's best diving is at less than 30 metres, with an unparalleled variety of hard and soft corals and fabulous shallow reefs, bommies, channels, walls and caves, drift and night dives. Among the grasses of the Mafia Channel, the Dugong is found. The Giant Sea Turtles lay eggs on the beaches of small islands to the east of Mafia, while the fascinating giant Madagascan Fruit Bat remains an alluring and unusual visitor's attraction.

Diving of Mafia Island is undertaken mostly in the Mafia Island Marine Park, specifically in Chole Bay, Juani and Kitutia reefs:

Dives inside the Chole bay takes place in the following sites:

KINASI WALL This is a sheltered bank reef, moderately deep and steeply sloping from 8 to 21 metres. It runs south-east:north-west for approximately 800 m and is an excellent dive on a slack tide or with a slight incoming current. It is in superb condition and composed of many species of hard and soft corals and supports a great variety of shoaling and solitary fish and giant clams, sea fans, large groupers, and Napolean wrasse; there are abundant reef and pelagic fish, and turtles (especially the hawksbill) are often seen.

CHOLE WALL .A steep bank of coral descending to 15 m is another bank reef that joins the Kinasi Wall but lying north-east: south-west, also about 800m long., usually with excellent visibility, and ending in coral rubble and sand. A panorama for the diver as there is a startlingly rich tapestry of corals enveloped in clouds of tiny fish, dominated by colourful damselfish and fusiliers; numerous butterfly-fish and angelfish. The site is especially interesting for the many species of colourful nudibranchs and flatworms. This is an excellent night or introductory dive.

CORAL GARDENS A very large area of beautiful coral outcrops or "bommies", lying in a wedge behind the Kinasi and Chole walls. The coral is very densely packed and continuous behind Kinasi wall; elsewhere the coral is separated by sea grass and sand patches. This is an excellent site for photography with a very high diversity of fish, colourful corals and anemones and the shallow water makes visibility excellent. This is a shallow water dive, often undertaken as the last phase of one of the wall dives. Behind Kinasi Wall at low tide is excellent for snorkellers.

THE CORAL PATCHES This site comprises three extensive and spectacular coral patches at 9 to 17 m that are separated by sand channels. The many species of coral are packed around the ancient Porites formations. There are a large number of dense shoals of fish, equalled only by Kinasi Pass. A peculiarity is the occurrence of large numbers of spotted garden eels, so named for their habit of living together in "gardens" in the sand around the coral.

THE PINNACLE The Pinnacle is a 12 m spire of ancient coral rock (7o57'005S/39o47'850E) lying in the inner Kinasi Pass, close to the last rock island. Maximum depth is 24m at the base of the spire. This is a spectacular dive for the

unusual structure and the mixture of reef and pelagic fish in the channel. The site is a home to a very large potato cod and a very large resident moray in a hole on the "whale-back" of rock that slopes off the western side of the stack and many giant batfish.

KINASI PASS After completing a tour of the Pinnacle the diver heads south-west to the side of the channel, the Kinasi Pass dive, rightfully famous as a stunning drift dive. The Pass has two walls, commencing with a deep 20-26 m shelving reef, then a shallower one at 6-15 m. The diver floats along a wall with small caverns and overhangs, with great shoals of juvenile and adult reef fish, barracuda and carangidae that sometimes block out the light, a vast array of corals, parrotfish, large groupers and pelagic coming and going with the tide. This site is a fantastic dive.

MILIMANI Extremely picturesque with unusual coral formations through which the diver navigates. Spectacular layered coral peaks. This is followed by vast Porites formations that are dome-like, with many lionfish, glass fish and moray eels. From here it slopes away to 21 m with a wide variety of soft and hard corals. This site is good in all conditions as it is only slightly affected by currents; an excellent second dive.

MSUMBIJI This site consists of a small primary reef with a variety of soft and hard corals on slopes and sheer walls down to 15 m. Away from the central formation are spires of coral that provide archways and overhangs for the diver to explore. Beautiful anemones of fluorescent red colour and rays (especially blue spotted) are common. This site is a good introductory dive but has unpredictable visibility conditions.

Dive site outside Chole Bay takes place in the following sites:

DINDINI WALL NORTH This is a rock wall from 8 m down to 28 m, with caves, caverns, overhangs and an archway; this is the only true rock wall so far discovered and it makes a spectacular and exciting dive. Large groupers, sharks, guitarfish, turtles and basket sponges are features. We have also seen many large pelagics here, including sailfish, very large tuna and dolphins, as the wall lies close to great drop offs. There is lush growth of sedentary filter feeders and algae on the upper part of the wall; sea fans and whip corals lower down.

DINDINI SOUTH WALL An extension of the same wall, from 9-22 m, this dive is interesting for the many small walls interspersed with shelving reef, offering a great variety of soft and hard corals and more reef fish. There are very many Napoleon wrasse and potato bass. This is also an excellent dive.

JINA PASS This site is also an extension of the Dindini Wall lying at the northern tip of Jina Island, ranging in depth from 8 m to 20 m at the base of a small, vertical wall that has shallow caverns and overhangs and bottoms out in a gravel field. The site is one of our favourites for a rough-mannered, persistent, overfriendly and very large potato bass who dominates every dive.

JINA REEF A gently sloping fringing reef down to 26 m with many brightly coloured soft corals. Home to many mid-size groupers (Flowery Cod) and inquisitive blue-spotted trevally, which are common on all Mafia dives. This site is close to and a continuation of the fringing reef complex near Kinasi Pass.

KINASI PASS ENTRANCE The north and south shoulders of the Pass are fringing reefs with dramatic landscapes; here there are excellent stands of pristine staghorn and large table corals. Shoals of juvenile reef and pelagic fish; the red lunar-tailed groupers are common; many parrotfish. Turtles, rays and small reef sharks are often seen, as well as many of the larger ocean-going fish - kingfish, caranx, barracuda, and rainbow runner.

Both dive sites - on either side of the Pass - slope to 20 m, where the coral peters out to rubble and sand, about 500 m offshore.

KITUTIA REEF This comprises two large bare sand bars or "cays" and an ancient coral rock outcrop, surrounded by patch reef, approximately 9 km south east of Jibondo Island and 18 km from Kinasi. There is a high diversity of corals and reef fish, large oceanic pelagics on the outer slopes, and excellent stands of staghorn corals. Closer to the cays there is excellent snorkelling with "bommies". There are moray and honeycomb eels, and turtles and dolphins frequent Kitutia. There are several dive sites here; the site due east of the coral cay slopes to 21 m with a pristine coral slope and a great variety of fish; a pair of giant potato cod and a Chinaman cod provide friendly company. There is also a superb drift dive down the western side from the sand cays.

THE DHOW WRECK ON MWAMBA UKUTA. **FRONTIER – Tanzania Expedition** lost a 12 m dhow close to Ras Kisimani, during high winds that forced the vessel onto the reef. Heavy seas then overturned her and she has since become home to a variety of interesting fish, including giant batfish and groupers. This excursion is wonderful when coupled with a picnic on Ras Kisimani beach.

MANGE REEF AND SANDBAR This is a sand bar with patch reef 3 km long located 18 km south-west of Kinasi. The best dive site is off the eastern corner of the reef where the reef drops off to a maximum depth of 20 m. At 10-14 m the coral is dominated by massive, encrusting forms with an impressive variety of soft corals flourishing at all depths. There are many juvenile fish, extensive stands of staghorn coral, octopus, crayfish, moray eels, and large pelagics.

KIFINGE (FORBES) BAY This is part of the fringing reef that is typical of the whole south-eastern side of Mafia, and has pristine coral and an unusual diversity of fish, small groupers, large rays and batfish are a feature. The site is 10 km north of Kinasi Pass and is a great excursion along the wild, jagged cliffs of the coast; fishing on the way is also good with every chance of giant trevally and sailfish. The reef stretches across the mouth of the bay (which is exposed at low tide) and slopes gently to meet sand and coral rubble at 18-20 m. There is a spectacular coral wall at the northern extremity of the bay. In particular, the diver will see uncommon butterfly-fish (Meyers, Black Pyramid and the Longnose) and there is an unusually high population of mid-size groupers and shoals of red-toothed triggerfish.

RAS MKUMBI (THE LIGHTHOUSE) Some of the most exciting diving anywhere, but a long way from KINASI and therefore usually undertaken as a camping excursion (we camp on the beach at Bweni Village). The dive sites are variations of shelf and small walls, coral gardens and overhangs. The exciting feature is the high probability of sighting sharks, large turtles and many of the pelagics. All the features of Kifinge and Jina Wall are also found here.

OKUZA ISLAND This is an overnight (or longer) excursion during which we camp out on Okuza beach; blissfully there are no flies or mosquitoes on this isolated islet. The island is extremely beautiful and surrounded by sand bars and protected channels; the colours are wonderful and there is an excellent protected anchorage. The outer wall is a fringing reef that falls away to a maximum of 32 m on the first shelf and then much further beyond the sport diving limits at the northern end. The southern extremity ends in coral gardens at 6-9 m. There are vast gardens of lettuce corals, huge fan corals, clams, lobsters, a vast variety of reef and pelagic fish and small black and white tip sharks. The snorkelling on the north-western side is surpassed only by that on Nyuni Island, a little further south.

Night diving

Many reef creatures are nocturnal, avoiding daytime predators. As the light fades and the rich "soup" of plankton rises from deeper water, the daytime, rock-like appearance of corals is transformed into a brilliance of colour as the polyps emerge from their stony cups to feed on the plankton. Many sheltering, daytime fish will be seen resting amongst the corals and in crevices, while octopus, sea-cucumbers and crayfish forage on the reef. Night diving focusses the attention on the many small, delicate reef species usually missed during the day. A spectacular occurrence is the spawning behaviour of corals. Chole Wall and the Coral Gardens are an excellent night dive.

(Source: Frontier Tanzania expedition report; Kinasi Lodge library).

2. **MTWARA**
Dive sites in Mtwara include the following:

- Mnazi Bay-Ruvuma Estuary Marine Park
Some of the best diving in Tanzania is found within the marine park and includes spectacular outer reef drop offs, extensive spur and groove formations, channel and patch reefs. Over 400 species of fish have so far been identified and more species of coral (>258) than anywhere else on the East African Coast. Intertidal reef flats teaming with life and the pristine white sands of Ruvula beach complete this tropical paradise.

- Mikindani Bay
Outer Reef and Big Blue - Steep drop offs with large schools of pelagics. Whale sharks and manta's regularly seen. Extensive spur and groove system literally covered in reef fish and abundant marine life
- Channels Reefs - Forests of giant seafans in deeper water, spectacular cliffs of 'photogenic' foliose and plate coral with large coral promontories in the shallows
- Pinnacles - Extending to the depths (150m), architecturally impressive columns and walls that make the descent feel like skydiving.
- Coral gardens - Amazing variety of patch reefs of different character including staghorn dominated and mixed coral gardens teeming with fish life.

3. DAR ES SALAAM AND BAGAMOYO DIVE SITES
Diving in Dar es Salaam takes place in Fungu Yasini, Mbudya shores (so called T-reef), Mbudya, Bongoyo in the northern Dar es Salaam es Salaam Marine Reserve system. Strong currents and wave have limited the number of dive sites in the Southern Dar es Salaam Marine Reserve System to one site, Sinda reefs. In Bagamoyo diving takes place in Mwamba Mshingwi, Mwamba Kuni, Mwamba Kitame and Mwamba Manyata.

4. ZANZIBAR
Zanzibar is a flat, palm-clad coral atoll surrounded by a coral reef structure that ensures abundant marine life. Good visibility (20 - 60 metres) and year-round average water temperatures of 27'C Zanzibar archipelago is the perfect 'all year round diving destination. Shallow coral reefs, sloping banks and vertical drop-offs with hard and soft corals and over 350 species of Indo-Pacific marine fauna offer an ideal opportunity to learn to dive or to upgrade ones diving qualification.

Best Dives in Zanzibar
The he dive sites are mentioned in chronological order starting with the nearest to Nungwi onwards within the Zanzibar/ Archipelago area.

CHAKATUNI
Located on the northern tip Zanzibar, Barracuda, Surgeon Fish & Unicorn Fish and shoals of colourful Triggerfish, Anemone Fish, along with Moray Eels and Sting Ray habitat this interesting reef covered in dense coral.

MBWANGAWA

This unique East Coast site has spectacular petal corals sheltering large Lobster, Lionfish, Turtles (Green & Hawksbill), and both Yellow Back Fusilliers and Blue Striped Snappers abound surprisingly the Giant Grouper remains very friendly!

HAJI
Large Lionfish and Stingrays populate this unspoilt coral bank and in the deeper water game fish such as King Mackerel, YellowFin Tuna & Reef Sharks are common sight.

KICHAFI
A superb coral bank descending to a sandy seabed, large Moray Eels and Sponges are often sighted as are a variety of Grouper & Turtle.

LEON WALL
A coral wall covered in large numbers of reef fish attracting large Pelagic fish to these hunting grounds, unpredictable currents makes the dive suitable for advanced divers only.

NANKIVELL
This busy reef is home to Lobster, Scorpionfish Octopus, and resident Red & Yellow Snapper. Large Grouper and Napoleon Wrasse swim through the corals, hunting gamefish such as Jack, Trevally & hundreds of schooling Barracuda patrol the waters. Eagle Ray are regularly sighted.

HUNGA
This West Coast reef with massive corals is home to shark like Cobia resident Groupers. Surgeonfish are silhouetted in the waters along with Giant Barracuda, Blue Fin Tuna, Kingfish & Travelly.

LITTLE HUNGAS
These small reefs are joined with sand gullies and are home to Giant Reef Rays, Eels and Large Emperor & Regal Angel Fish.

MNEMBA ATOLL
These crystal clear waters owe their excellent visibility (25M+) to the protected waters of this East Coast paradise. The island has several dive sites including wall dives with stunning landscape vistas & reefs populated with Whale Sharks, Dolphins, Turtles & Reef Shark. Pelagic fish cruise the deep water of the atoll to feed on the many reef fish, offering the best opportunities for underwater photography. A great site for experienced & novice divers alike.

LEVEN BANK
This is the ultimate dive for the adventurous! With big drop offs with excellent visibility (25M +) common place to encounter Hammerhead, White & Black Tip Sharks, Strawberry Grouper, Giant Saddleback Grouper and huge Moray Eels

Uzi Island
On the remote island of Uzi 6000 people are living, despite the fact that its only accesable during low tide, on a path through mangroves or on boats. On Uzi you will find a different Zanzibar. Untouched nature and an unchanged African way of life mingled with primary forest, monkeys, curious locals, deserted beaches and the tropical Indian ocean setting make Uzi Island a really off the beaten track adventure!

Latham Island
Latham is a tiny island situated some 45 nautical miles east of Dar Es Salaam, featuring spectacular reefs and drop off`s covering an area of approximately 10 miles. The crystal clear waters that surround Latham host almost every species of pelagic game fish and reef fish in the Indian Ocean in abundant quantities.

5 PEMBA DIVE SITES

Surrounded by numerous small islands Pemba offers some of the best diving in the world. The coastline of mainland Pemba drops steeply into the Indian Ocean whilst the outlying islands tend to have the endless beaches dotted with palms trees, providing the perfect getaway for 'the recluse.' Local dive sites provide some of the most adventurous blue water diving, the majority of dives sites scattered around the small islands which fringe main Pemba. Most of the dives are wall, drift dives, and some are spectacular and challenging sites requiring an ADVANCED diving qualification. The area's pristine coral is home to one of the widest varieties of marine life, including Giant & Pickhandle Baraccuda, Wahoo, Karambizi, Dorado, Trevelly, Humphead Wrasse, Whale Shark, Manta Rays, Bottlenose & Stripped Dolphin and numerous varieties of shark (including Hammerheads) to mention but a few. It is also widely recognised as some of the most spectacular, unspoilt diving regions in East Africa. Home to resident Hawksbill Turtles, Manta Rays & Batfish these impressive coral gardens also attract Sharks that glide through the reef and its a delight to watch the Manta Rays that love to play near the waters surface.

Pemba Island is severed from the African continental shelf by sheer coral walls that drop down to over 300 metres. Spectacular wall diving, the variety of sites, big marine-life, clarity and excellent visibility (40-50 metres) makes Pemba the best diving location in East Africa. Characterised by a mix of drift and pinnacles diving, majestic clear blue water drop-offs and pristine, shallow reefs of lush hard and soft coral gardens, the sea is alive with schools of pelagic marine life, Bottlenose, and Spinner Dolphins, mantas, turtles and coral fish, and creatures from Napoleon Wrasse to brightly coloured reef fish. Misali Island, Pemba's only Marine Sanctuary, is especially important as a Sea Turtle nesting area. Big pelagic fish such as Tuna, Wahoo, Barracuda, Manta and Eagle Rays, as well as Giant Grouper are common.
Whilst new dive sites are still being discovered and the island still untouched by any large commercial tourism, the following is a list of known best dive sites so far explored.

MANTA POINT

Home to Pemba's Manta Rays who dance around a steep sided, underwater Coral Mountain amassed with Gargoneon Fan & Leaf corals. The cliff face falls away to a far greater depth than sport divers are allowed to venture.

'NJAO SOUTH WALL

This magnificent, deep wall dive leads to teeming shoals of colourful reef fish, Big Jacks, Dorrado & Pompano whilst Red Snapper hide amongst stunning tabletop corals, stacked on shelves precariously hanging off the wall into the blue.

FUNDO GAP SOUTH

This fast moving dive is for the more adventurous amongst us! Drift into the Fundo Channel through large shoals of (amongst others) Unicornfish and squadrons of Manta Rays. Once through the gap the reef extends into large coral bommies resembling large sky scrapers, topped with lettuce coral.

FUNDO OUTER WALL

A sheer wall of breathtaking overhanging pinnacles and swim throughs covered with soft coral bushes, small Damselfish, Royal Anglefish & Blue Banded Surgeonfish hide amongst the branches. Meanwhile Giant Trumpetfish wait in the shadows eyeing dinner whilst ever cautious of not becoming the victim to bigger fish who frequent the area as a hunting ground!

KOKOTO CAVES
This dive is for the advanced diver only, due to the extreme depth and penetration. The numerous caves are a favorite spot for Electric Reef & StingRays, and snoozing Guitar Sharks making them incredibly approachable. The cave floors are littered with amphorae coral, the rarest, most delicate, and most expensive coral in the world (fingers off!).

UVINJE WALL
The dive begins on a sandy bottom at 20M where you drop into one of numerous gullies to drift amongst impressive coral pinnacles where small Frogfish can be seen hiding in, and between Blue Pipe Sponge tubes along with colourful, tiny Nudibranchs. It's a macro photographer's haven!

THE BALCONY
Named after an impressive rock formation at 35M you look over the precipice that gives you the feeling of what it's really like being an astronaut! The wall is not vertical but actually undercut by 5M hence the name.

MISALI ISLAND THE CHANNEL
The dive starts with a heart stopping 30M free decent into the blue, dropping through massive schools of Scissortailed Fussiliers before looking up as they form a ceiling of orange and yellow above you. Meanwhile squadrons of Eagle & Manta Rays nonchalantly pass by at an impressive current of 4knots as you quickly leave behind the turquoise blue. At the North West tip of MISALI there is an impressive sea mound covered in Rose Plate & Basket Coral.

MISALI ISLAND CORAL GARDENS
The colour of the water at Misali ranges from a vivid turquoise in the shallows to a deep indigo blue where the bottom falls away. The sheer coral wall drops vertically to great depths its edges a solid bank of Stag horn & Leaf Coral, crowned by huge Mushroom & Brain coral heads. Underneath fish of every variety play hide n seek, and the entire length of this huge wall presents a fairy tale dive to match the best the sea world has to offer.

THE GREAT SOUTHERN
This fabulous, sloping wall encrusted in Green coral radiates an intense hue to the entire reef. A forest of Soft coral backed by huge coral heads are home to extensive numbers of the rare & elusive Mantis Shrimp, Lobster and Crabs. Spanish Dancers spiral into the depths whilst ghostly silhouettes of Tiger Sharks can often be seen cruising silently the waters. This dive is a must for Shark enthusiasts (but not for the weak hearted due to its exposed position & large Sharks).

THE WRECK
Surrounded by mystery because this wreck (that hit the reef) has never been officially identified, looks like a 1950s iron freight steamer. A great length of the thick anchor chain is draped on the reef off PANZA POINT and it is possible that the anchor came adrift and the swift north flowing current probably did the rest. Unlike many other wrecks it is photogenic. The deformed shape of the wreck covered with colourful marine growth, soft corals & sponges together with good lighting conditions and crystal clear water contribute to dramatic shots. The funnels provide perfect hideouts for abundant marine life and create amazing tunnels to swim through. You can also see the large steam condenser with the freight masts pointing forlornly towards the surface.

Appendix 5e

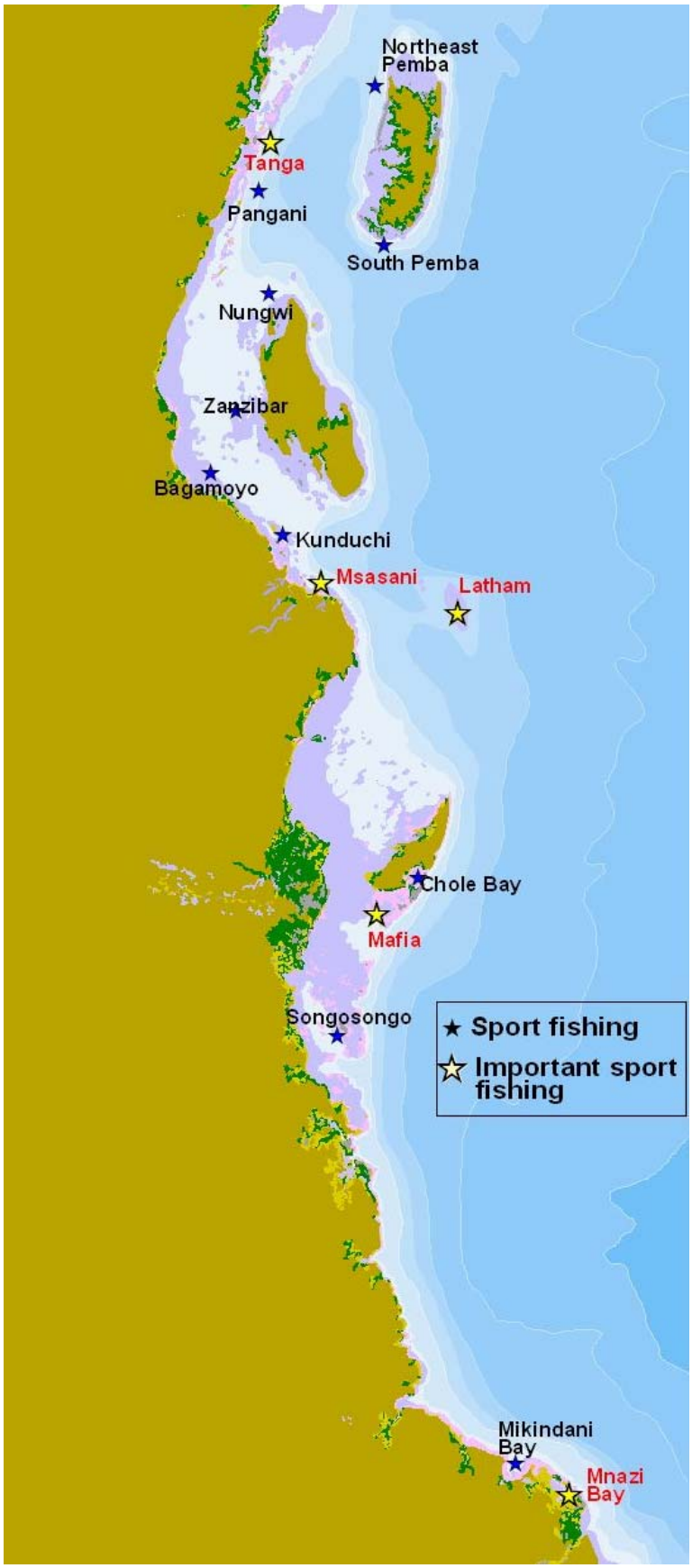
4.5.5 Sport fishing

Sport fishing or game fishing is based on large fish especially the Marlins, Barracudas, Sharks and jacks. It is conducted using angler line normally from Yatch boats. The best sport fishing areas are Mafia, Latham Island, Pemba channel and off Mnazi bay (Map 1). Sport fishing in Mafia dates back in the 1950's when the Mafia Fishing Club was organizing sport fishing events that attracted anglers from all over the world. Mafia fame went down in the Seventies when the club was nationalised and handled over to the then Tanzania Tourist Corporation (TTC). TTC was the sole government Body responsible for running tourism business in Tanzania. With the opening up doors for foreign private investors to participate in tourism business four tourist lodges have been established on Mafia Island. All the four lodges offer sport fishing facilities. With these developments Mafia Island has been on the spotlight again for sport fishing. Sport fishing in Mafia takes place in Chole bay within the Marine Park. Game fishes found are the Jacks, Barracudas and tuna. Latham Island is famous for its extraordinary game fish particularly sharks, marlins, sword fish and tuna. Depending on the weather conditions members of the Dar Es Salaam Yatch Club using luxury sport fishing Boats frequent Latham Island almost every other week end. The Tanga yatch club conduct game fishing in Pemba channel. This is also true for hotels in Zanzibar and Pemba Islands. Sport fishing trips to Pemba Channel are also illegally organised from Shimoni in Kenya.

Licences for sport fishing are issued for a seven day period. They are obtained from the Fisheries Department and Tourism Departments. For sport fishing conducted in the marine protected areas, licences are obtained from the Marine Parks and Reserves Unit.

The evolution of the barrier fishing net in the Zanzibar Channel targeting highly prized Marlin fish is a threat to the fish species under reference and the sport fishing industry in general.

Map 1: Important sport fishing sites



Appendix 6a

4.6 Marine Parks, Reserves and Conservation areas

Tanzania has two Marine Parks, Mafia Island Marine Park and Mnazi Bay Marine Estuary Marine Park both located on the mainland coast. Saadani National Park is the only terrestrial mainland Park extending to marine waters. In Zanzibar, Jozani – Chwaka Bay Park includes extensive mangrove forest as well. Eleven marine reserves have been declared in Tanzania mainland: Maziwe located off Pangani; Fungu Yasin, Mbudya, Pangavini and Bongoyo just north of Dar es Salaam; Inner and Outer Makatombe, Kendwa and Inner and outer Sinda, just south of Dar es Salaam; and Nyororo, Shungi Mbili and Mbarakuni, northeast of Mafia Island. There are three marine reserves (Misali, Chumbe and Mnemba) in Zanzibar. There are numerous community managed areas and more are being planned in both mainland and Zanzibar. There are six such conservation areas in Tanga with six closed reefs (Chundo Kiroba, Kipwani, Shenguwa, Makome, Dambwe and Maziwe). In Bagamoyo there are four no-take areas (Mwamba Mjini, Poyogo, Mwamba Mshingwi and Maduga). Work towards establishment of such areas in ongoing in Rufiji-Mafia-Kilwa (RUMAKI) area. Conservation areas with strong community involvement in Zanzibar include Pemba Conservation Area (PECA), Menai Bay Conseration Area (MBCA) and Mnemba Conservation Area (MCA). Several others, e.g., chwaka-Paje conservation area, Stone Town conservation area, Tumbatu Conservation area and Kiwengwa area are in different preparation stages. Short information about the marine managed areas is given in Table 1 and location is shown in Map 1.

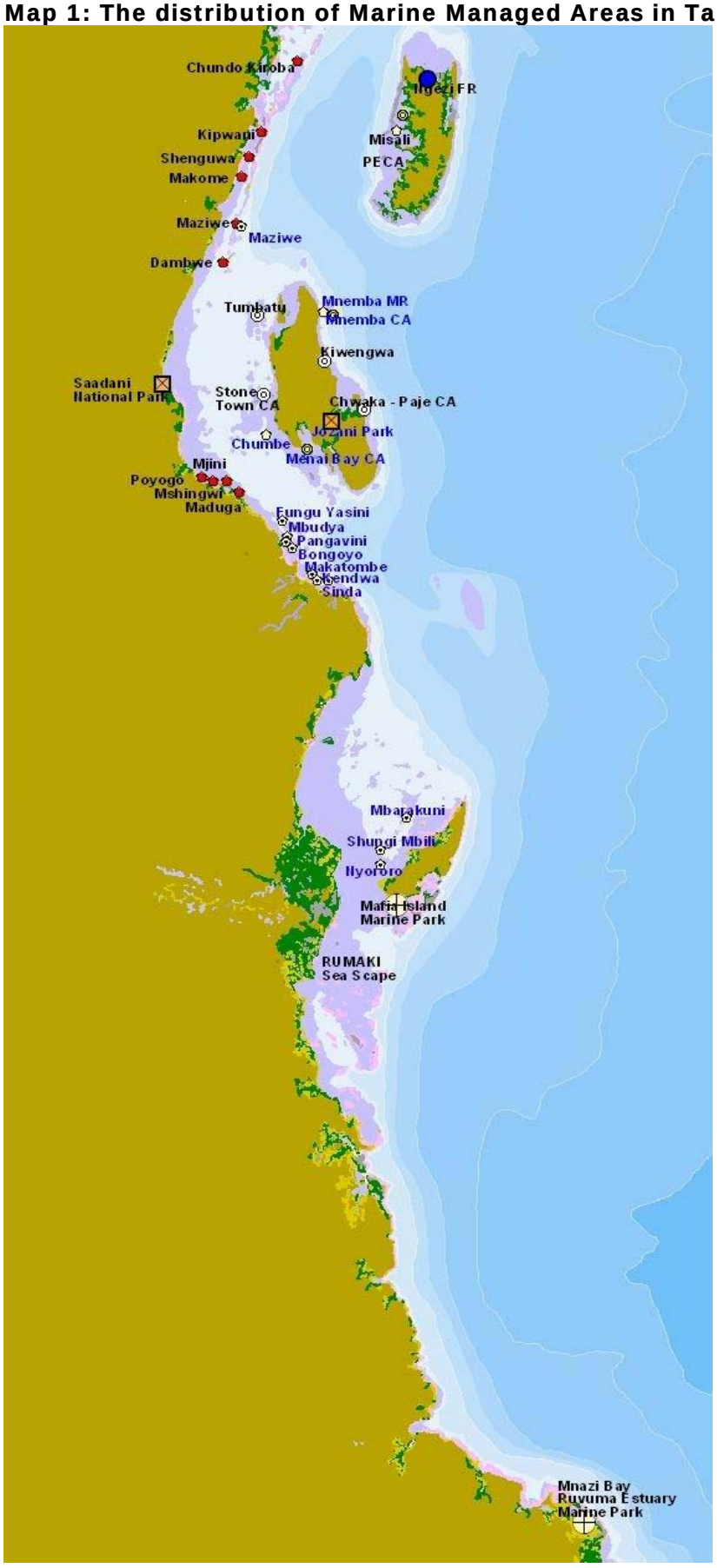
Table 1: **Marine Management Areas in Tanzania**

Marine Management Area	IUCN cat	Date Estab	Sq km
MAINLAND TANZANIA			
Maziwe Marine Reserve designated as Marine Reserves in 1975, and in 1999 placed under the mandate of MPRU	II	1975	c. 2.6
Tanga collaborative fishery management areas. Total area is about 1603 sq km, of which 28 sq km is no-take covering coastal areas of Mkinga, Muheza, Tanga and Pangani Districts. They were set up as joint initiatives between local communities and Districts; include closed reefs (Chundo Kiroba, Kipwani, Shenguwa, Makome, Dambwe), and Maziwe Island Marine Reserve.	----	1996-2000	26.4
Saadani National Park: a new protected area, created by up-grading the previous Game Reserve, and extending protection into the sea	I		66.0
Bagamoyo Collaborative Fisheries Management program has set up no-take zones around coral reef areas at Mwamba Mjini, Poyogo, Mwamba Mshingwi and Maduga reef. The purpose of the no-take zones is to create safe heaven for fish and other resources thereby protecting the fishery from total collapse.	?		
North Dar es Salaam Marine Reserves System - comprises 4 Marine Reserves: Fungu Yasin, Mbudya, Bongoyo and Pangavini designated as Marine Reserves in 1975, and in 1999 placed under the mandate of Marine Parks and Reserves Unit	II	1975	26.0

South Dar es Salaam Marine Reserves System - comprises: Inner and Outer Makatombe Islands, Kendwa Island and Inner and Outer Sinda Islands. Is a new marine reserve system declared in 2007	II	2007	
Kinondoni Integrated Coastal Area Management Programme (KICAMP) North of Dar es Salaam – from Msasani to Mbweni			
Mafia Island Marine Park. Has a total area of about 822 sq km of which 75% is marine waters. It is a multiple use marine park with zoning	VI	1995	615.0
Nyororo, Shungi Mbili and Mbarakuni Islands Marine Reserves. It is a new marine reserve system declared in 2007	II	2007	
Rufiji, Mafia, Kilwa Seascape Programme (RUMAKI) – a large programme covering the entire delta, and Mafia Channel to include the Mafia Island Marine Park. Efforts are underway to introduce community managed areas – as in Bagamoyo and Tanga.			
Rufiji, Kilwa Mafia Ramsar Site – The only Ramsar site that protect the marine component covering the entire delta, and Mafia Channel overlapping RUMAKI Seascape			
Mnazi Bay-Ruvuma Estuary Marine Park (total area = 650 sq km)	VI	2000	200.0
ZANZIBAR			
Misali Island Conservation Area (total area 23 sq km located in Pemba include Misali Island forest, marine no-take zone (about 1.4 km^2). Is managed jointly by Government, an NGO with participation of local community	VI	1998	21.6
Pemba Conservation Area (PECA)			
Ngezi Forest Reserve (1959) (14.4 sq km) – proposed for redesignation as a Nature Reserve; includes mangroves			
Menai Bay Conservation Area - a community-managed MPA	VI	1997	470.0
Mnemba I. Conservation Area (no take) – privately managed MPA, supported through Conservation Corporation Africa	VI	2002	0.15
Chumbe I. Coral Sanctuary (all no take) - management delegated to a private company	II	1994	0.3
Kiwengwa Controlled Area - established in 2000 but never managed		2000	17.5
Jozani Forest Reserve estab; Jozani-Chwaka National Park (to be estab) – a pilot ICM site and protected forest area, shortly to become Zanzibar's first national park			
Stone Town Marine Conservation Area – earmarked and consultations are ongoing			

Modified from Wells et al. 2005

Map 1: The distribution of Marine Managed Areas in Tanzania mainland



4.7 Ocean Currents

Ocean currents during Northeast and Southeast monsoon

Current

Three currents, the South Equatorial Current (SEC), the East Africa Coastal Current (EACC), and the Equatorial Counter Current (ECC) influence the coastal waters of Tanzania. Flowing across the Indian Ocean, the South Equatorial Current meets the coastline of Africa approximately at the border of Mozambique and Tanzania. When the current meets the shores of southern Tanzania and northern Mozambique the current divides with a large portion swerving northwards to become the East Africa Coastal Current. The smaller southern flow forms the Mozambique Current (MC). The north-flowing EACC is a steady current, strongest during the southern monsoon when surface currents can exceed 3 metres per second, especially when southerly winds are strongest. Depending on the strength of the North East Monsoon the northward flowing EACC in any particular time of the year this current change direction to eastward and flow offshore as ECC.

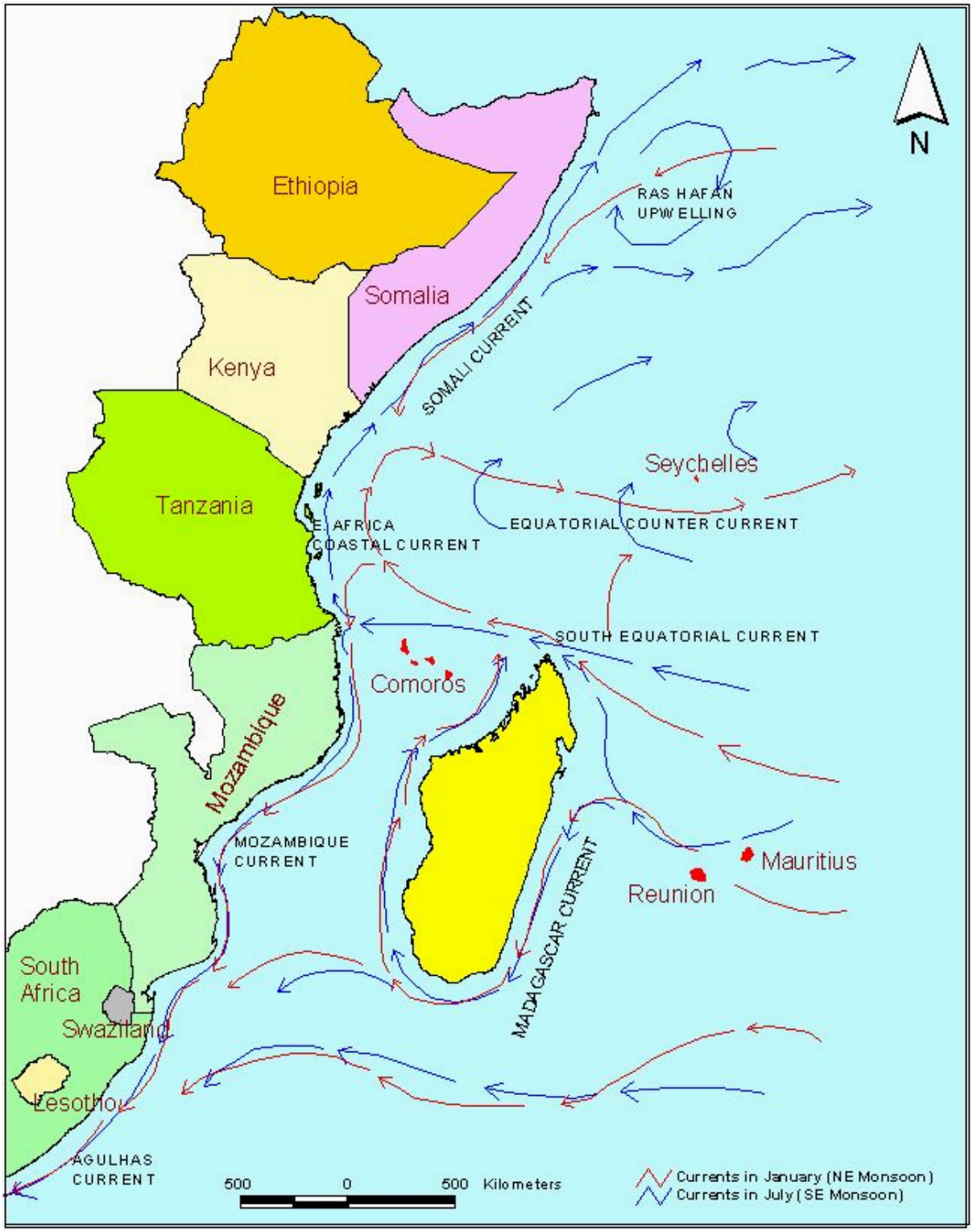
This is significant for the coast of Tanzania because the waters that are brought across have come a long way. Within the waters of the SEC are the eggs and juvenile stages of thousands of marine animals and plants that were produced among the mangroves, sea grass beds, rocky shores and coral reefs of Indonesia and Australia. Southern Tanzania and northern Mozambique are the first arrival points in Africa for these drifting species; for that reason therefore places like the Mnazi Bay Marine Park are therefore strategically located and are very important for the settlement and subsequent dispersal of marine organisms both north and south along the coast of East Africa.

Tides

In most of Tanzania, the maximum tidal range is about 4.5 metres, occurring during spring tides (around new and full moon) in end of March and October. During the low water of spring tides, big changes are seen over the area of most intertidal areas. Several square kilometres of sand and sea grass bed around shallow reef flats and bays are exposed and seawater visibility becomes clear most of the times. During spring high tides the sea enters estuaries, deltas, creeks and bays and floods all the intertidal areas.

Weather

The southern coast of Tanzania has a tropical climate influenced by the seasonally changing monsoon winds of the Indian Ocean. Two distinct monsoon periods occur, the Northeast Monsoon (Kasikazi) which prevails November and March, and the Southeast Monsoon that blows from April to August (Kusi). In between the changing monsoons there is an intermediate easterly wind (Matlai). The Northeast Monsoon usually brings calm weather while the Southeast Monsoon is usually windy with cool temperatures and rough seas.



Temperature and cyclones

The Northeast Monsoon is normally associated with high air temperatures (28-32 degrees Celsius), high surface water temperature up (as high as 31^{0}C) and a few showers. Winds are moderate to strong. Beyond June, into the Southern Monsoon, the climate is cooler and drier, but the consistently strongest winds are normally experienced during this season, slowing down to November. Cyclones in this part of the Indian Ocean occur between January and March, mainly in Madagascar and the Comoro Islands. Fortunately for Tanzania Region, during the cyclone season, rarely is there any impact

other than occasional days of strong winds especially in the southern part of the Coast areas.

Rainfall and Sediments

Rainfall is generally low, usually between 500-1,000 millimetres per year and most of it falling over a short period. The wet season lasts from March to May.

El Nino

In late 1997 and early 1998, the seawater along the east coast of Africa became warmer than average by 2- 3 degrees Celsius. This caused the hard corals on the reefs to loose their symbiotic algae, which leads to dis-colouration and whitening or bleaching. The bleached corals can survive for several months but if the high water temperatures continue, many coral colonies die. The rise in water temperature is a global phenomenon that has been called the El Nino event, usually starting at around the end of the year. During the El Nino of 1997-98 many coral reefs in the Indian Ocean suffered with the death of many coral colonies. In certain parts of Tanzania, Kenya and Seychelles over 70% of corals died.

General remarks

Knowledge on hydrography is extremely important in managing oil spills and other pollution disasters along the Tanzania coast. While the general water circulation pattern is fairly known, there is a gap in knowledge concerning shallow water circulation patterns, especially the Tidal currents. Tidal currents are known to be reversing but the actual direction is determined by different physical factors which differ between places, making it difficult to predict. Local fishers are more knowledgeable than scientist because of long term experiences. Unfortunately local knowledge have not been investigated enough to offer solutions to scientists. Further studies are required especially in areas with high value investments and biological resources.

Appendix 8

4.8 Hydrocarbon Occurrences and Source Rocks in Tanzania

The occurrence of hydrocarbons in Tanzania is represented by gas fields, oil and gas shows in wells, oil seeps and bitumen outcrops. Table 1 illustrates drilling activity and Map 1 shows the location of all exploratory wells and most boreholes.

Gas Fields

1) Songo Songo: Gas reserves estimated to be 1 TCF were discovered in the Lower Cretaceous sands and were encountered in seven appraisal wells in SongoSongo area, offshore Coastal Basin. The gas tested up to 23 million cubic feet per day and minor volumes of oil with 33°-47°API

2) Mnazi Bay: Estimated gas reserves of about 1 TCF have been discovered in Mnazi Bay area, Ruvuma Basin. Mnazi Bay-1 well tested gas at rates of up to 14 million cubic feet per day from the Oligocene sands.

Gas and Oil Shows

Gas shows have been encountered in most of the deep wells in offshore and onshore Coastal Basin. Biogenic gas has also been reported in some shallow bore holes in the Msimbati area, Ruvuma Basin.

Methane and heavier hydrocarbon gases and geothermal fluids have been reported in lake water at the northern part of Lake Tanganyika. Such hydrothermal hydrocarbons are attributed to early maturation products of oil prone lacustrine organic matter in the lake sediments.

Oil shows have been reported in several wells. Significant oil shows were observed in a couple of formations encountered in Mita G-1and Mbate-1 wells, in the Mandawa Basin. SongoSongo wells, Mafia-1, Makarawe-1, Mnazi Bay-1, Mandawa-7 and Pemba-5. Bitumen staining are reported in the Lower Cretaceous Kipatimu Beds from Wingayongo-1 borehole, Bathonian limestone cores in Kisangire-1, and Miocene sands in the Mtwara-1 borehole in the Ruvuma Basin are thought to be related to residue oil.

Oil/Gas seeps and Bitumen

Proven live oil seeps occur at Ruhoi River in Wingayongo area on the flanks of the Rufiji Trough; at Tundau on the west coast of Pemba Island and in Kilwa Masoko at the vicinity of the Kilwa Masoko jetty (Fig.3). Oil seeps and a sublacustrine flow of asphalt have been reported elswhere in Lake Tanganyika. In Nyuni Island, an oil seep is apparently present at the sink hole in the middle of exposed reefal carbonates in the centre of island. The existence of genuine oil seep in this locality is indicated by the presence of hopanes and steranes biomarkers from the GCMS analyses. There are also tar balls along the southeastern side of the beach. Similar occurrance appear at Okuza Island north of Nyuni Island.

Thermogenic gas seeps occur in Msimbati Peninsula at various localities such as Nyuruko, Liangalikulu, and Makukwa. Methane is a dominant component with high C1/(C2+C3) ratio and in association with strong sulphur odour. Bitumen occurs in fissures and as impregination in Cretaceous sandstone outcrops at Wingayongo. In Msimbati Island, bitumen occurs as a cementing matrix of surface sands at the northern side of the Ruvuma River estuary. In both cases it is associated with strong sulphur odour.

Typing and Correlation of oil Seeps

The Tundaua seep on Pemba Island seep is a live oil seep with biomarker correlation to extracts from Campanian Marine Shales in Kimbiji East-1 well. However, the typing of the seep does not correlate with oil shows from nearby Pemba-5 well. The Wingayongo oil seep shows isotope and biomarker signatures that indicate a non-marine, restricted lagoonal or lacustrine depositional environment; likely candidate sources being Middle or Lower Jurassic Shales. gas samples from Nyuruko and Lipwata in Msimbati area are dentified as Petrogenic from their Carbon isotope values. Oil seeps at Makukwa and Msimbati, like Wingayongo, show a restricted saturate biomarker distribution indicative of biogenic origin. The Mikindani seep indicates a source from terrigenous component. Two families of oil are interpreted one from Carbonate source deposited in a strongly reducing environment; the other from terrestrial organic matter with biomarkers of Late Cretaceous or Younger age. (Text copied from TPDC http://www.tpdc-tz.com/Petroleum%20Opportunitie2.pdf)

Table 1: Exploration and Development of Oil and Gas Wells

WELL NAME	Latitude	Longitude	STATUS
MAFIA –1	07°52'40"	39°45'21"	P&A with oil-gas shows
ZANZIBAR-1	06°03'26"	39°13'02"	P&A with gas shows
MANDAWA-7	09°24'58"	39°25'04"	P&A with oil shows
PEMBA-5	05°16'11"	39°41'53"	P&A with oil-gas shows
RAS MACHUIS-1	06°00'56"	38°51'19"	P&A with gas shows
SONGO SONGO-1	08°28'38"	39°28'33"	Gas Discovery
KISANGIRE-1	07°29'09"	38°32'42"	P&A
KISARAWE-1	07°00'19"	39°03'32"	P&A
SONGO SONGO-2	08°31'00"	39°31'00"	P&A gas blowout
SONGO SONGO-3	08°31'19"	39°29'46"	Gas well
SONGO SONGO-4	08°31'01"	39°29'30"	Gas well
KIZIMBANI-1	09°02'25"	39°22'30"	P&A
SONGO SONGO-6	08°31'26"	39°30'04"	P&A with gas shows
SONGO SONGO-5	08°31'18"	39°28'53"	Gas well
SONGO SONGO-7	08°31'56"	39°29'15"	Gas well
KIMBIJI EAST-1	06°59'16"	39°32'40"	P&A with gas shows
SONGO SONGO-8	08°33'08"	39°30'56"	P&A
MNAZI BAY-1	10°19'45"	40°23'28"	Gas Discovery
SONGO SONGO 9	08°30'54"	39°28'45"	Gas well
TAN CAN-1	06°56'58"	39°36'40"	P&A with gas shows
KIMBIJI MAIN-1	06°58'19"	39°28'31"	P&A with gas shows
MAKARAWE-1	05°33'10"	38°52'11"	P&A with oil-gas shows
RUARUKE NORTH-1	07°43'10"	39°10'16"	P&A
LIWALE-1	09°25'53"	37°31'16"	P&A
KIWANGWA-1	06°21'43"	38°32'56"	P&A with gas shows
LUKULIRO-1	08°21'32"	38°25'42"	P&A with gas shows
GALULA-1	08°33'34"	32°54'24"	P&A
IVUNA-1	08°15'25"	32°18'27"	P&A
MBUO-1	09°26'41"	39°16'51"	P&A
LUKULEDI-1	10°09'56"	39°39'58"	P&A
DIRA-1	07°32'32"	39°33'58"	P&A
MITA GAMMA-1	08°54'56"	39°09'53"	P&A with oil shows
EAST LIKA-1	09°16'26"	39°04'04"	P&A
MBATE-1			P&A

Source: TPDC (http://www.tpdc-tz.com/Petroleum%20Opportunitie2.pdf)

Well	Status
East Lika-1	Oil stain and cut fluorescence in Middle and LowerJurassic
Kimbiji East-1	Good gas show in Eocene and Paleocene
Kimbiji Main-1	Poor gas show
Kisangire-1	Middle Jurassic bitumen stain
Kiwangwa-1	Trace oil show, high mud gas
Lukuliro-1	Gas shows in Lower Jurassic Madaba series
Mafia-1	Oil and gas shows in Lower Tertiary
Makarawe-1	Trace oil, high mud gas in Middle Jurassic
Mandawa-7	Free oil in Nondwa Shale and Mbuo claystone
Mbuo-1	Oil fluorescence
Mita Gamma-1	Oil stain, streaming fluorescence
Mnazi Bay-1	Gas Discovery in Miocene/Oligocene sands, oil shows in Upper Cretaceous/Upper Tertiary
Pemba-5	Minor oil and gas shows in Eocene/Oligocene
Ras Machuisi-1	Mud gas at base of Tertiary
SongoSongo-1	Gas Discovery well in Lower Cretaceous
SongoSongo-2 to 9	Development Wells in Lower Cretaceous
Tan Can-1	Minor gas in Paleocene
Zanzibar-1	Minor gas in Eocene limestone
Boreholes	
Lindi-1	Minor oil show and gas kick
Mtwara-1	Bitumen staining and gas in Miocene sandstone
Pindiro-1	Wet gas in Lower Jurassic
Wingayongo-1	Bitumen staining

Source: TPDC (http://www.tpdc-tz.com/Petroleum%20Opportunitie2.pdf)

Map 1: Exploration and extraction of Oil and Gas sites

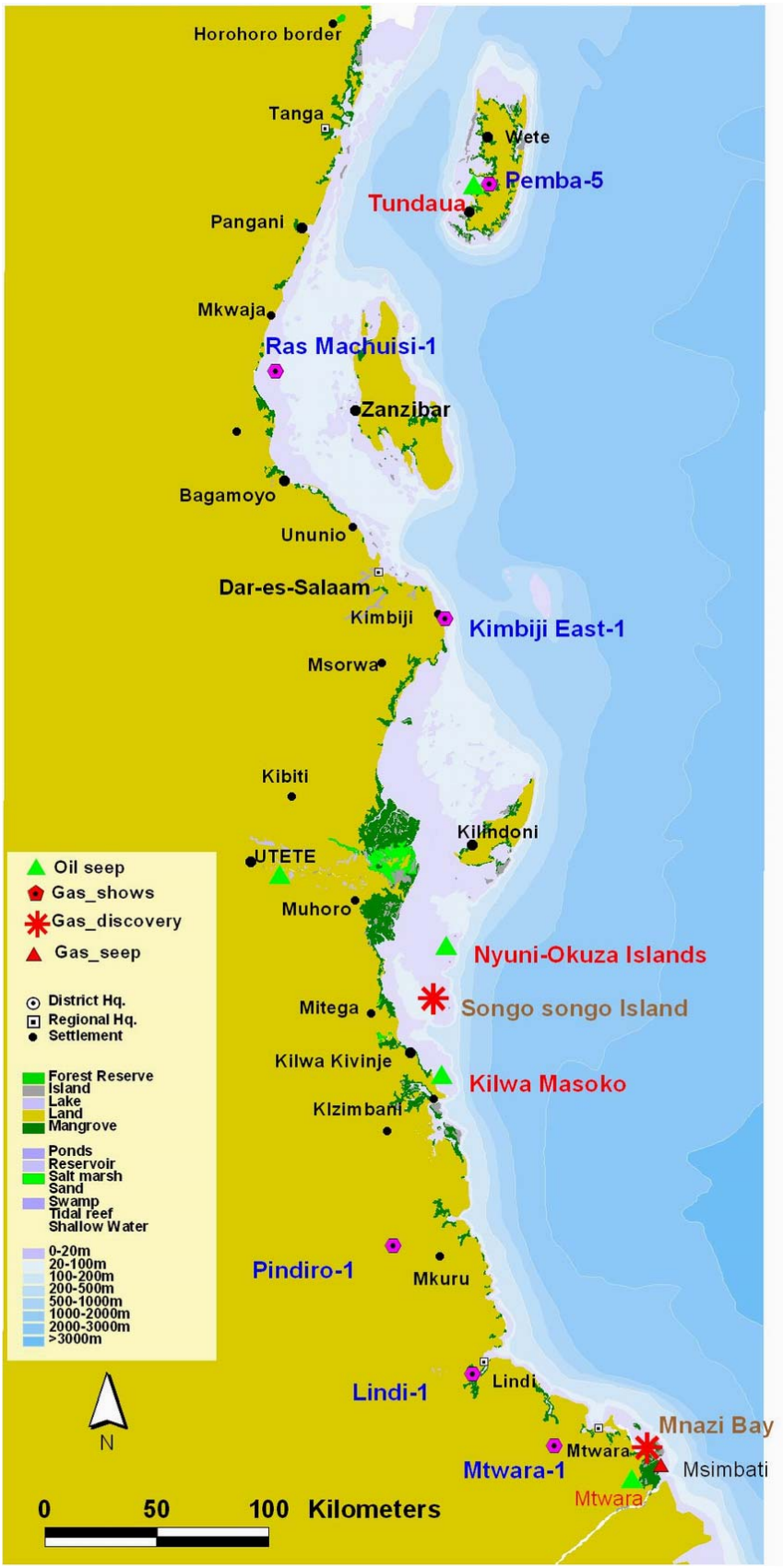


Figure 3: Well and Borehole Locations on the Eastern Basins.